



Hu, H., Prokop, J., Shi, Y. and Trautwein, H.-M. (2020) The rating spillover from banks to sovereigns: an empirical investigation across the European Union. *Journal of International Financial Markets, Institutions and Money*, 64, 101161.  
(doi: [10.1016/j.intfin.2019.101161](https://doi.org/10.1016/j.intfin.2019.101161))

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Deposited on 21 January 2020

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# **The Rating Spillover from Banks to Sovereigns: An Empirical Investigation across the European Union**

Haoshen Hu<sup>1</sup>, Jörg Prokop<sup>2</sup>, Yukun Shi<sup>3</sup>, Hans-Michael Trautwein<sup>2</sup>

## Abstract

This paper investigates how changes in European banks' credit risk affect their host countries' sovereign risk by exploring bank-to-sovereign rating spillover effects. Using credit rating data from Standard & Poor's, Moody's, and Fitch for the period ranging from 2002 to 2016, we identify both positive and negative bank-to-sovereign spillover effects, and find the negative rating spillover effect to be more pronounced than the positive one. Further, we provide evidence on differences among the three rating agencies in terms of the occurrence of positive spillovers, and the degree of negative spillovers. Our results are robust to the changes in model specifications with respect to the currency type of ratings, the structure of regression models, and the approach used to link bank and sovereign ratings. Overall, our analysis sheds new light on how information related to systemic risks emanating from the banking sector affects domestic sovereign credit ratings, and thereby complements previous research focusing on the opposite sovereign-to-bank rating transmission channel.

*JEL classification:* F36, G15, G24

*Keywords:* bank rating, European sovereign debt crisis, sovereign rating, spillover effect

<sup>1</sup> KPMG AG WPG, D-20459 Hamburg; Germany

<sup>2</sup> Department of Business Administration, Economics and Law, Carl von Ossietzky University of Oldenburg, D-26111 Oldenburg; Germany

<sup>3</sup> Corresponding author; Adam Smith Business School, University of Glasgow, G12 8QQ, UK;  
[yukun.shi@glasgow.ac.uk](mailto:yukun.shi@glasgow.ac.uk)

## 1. Introduction

The 2007-2009 global financial crisis (GFC) vividly demonstrated how financial market shocks combined with high levels of interconnectedness among banks and interdependence between banks and countries can trigger macroeconomic downturns (De Bruyckere et al., 2013). As several European governments made considerable efforts to rescue troubled banks, they transferred private banking sector risks to sovereign treasuries and public budget deficits increased. Likewise, increasing sovereign credit risk burdened financial institutions mainly through four different transmission channels: first, banks' holdings of sovereign debt and derivative securities; second, collateral used for obtaining external wholesale funding and central bank refinancing; third, implicit and explicit government guarantees; fourth, sovereign rating downgrades which contribute to a deterioration in domestic or foreign banks' creditworthiness (BIS, 2011). Consequently, in the aftermath of the GFC understanding and managing the manifold sources of systemic credit risk became a focal point of subsequent public policy actions, as well as academic research (Giglio et al., 2016).

In this paper, we concern with the relationship between sovereign credit ratings and domestic bank credit ratings in terms of credit risk spillover. Numerous studies show that there is a sovereign-to-banking rating spillover effect through the sovereign ceiling channel (see Williams et al., 2013; Alsakka et al., 2014; Poon et al., 2017; Klusak et al., 2017; Almeida et al. 2017; among others). However, few papers, if not none, examine the opposite direction, i.e. the rating spillover from banks to sovereigns.

We argue the opposite direction also holds for the following reasons. Firstly, previous literature suggests there are strong linkages between a country's financial sector and its macroeconomic status. Allen et al. (2012) note that high levels of systemic risk in the banking sector leads to aggregate lending activity, which further impacts the financial health of the

overall economy. Giglio et al., 2016 how the developments in banking sector can affect macroeconomic and fiscal outcomes. Gilchrist et al. (2009) and Gilchrist and Zakrajšek (2012) argue that credit market shocks have contributed significantly to US economic fluctuations. Furthermore, Schularick and Taylor (2012) show that leverage ratio can forecast future GDP growth in crisis. Therefore, the creditworthiness of a country's banking sector could possibly be a good indicator of its sovereign credit risk.

Secondly, prior contributions also confirm a two-way credit risk interdependence between banking industry and sovereign sector measured by credit default swap (CDS) spreads. Alter and Schöler (2012) and Merler and Pisani-Ferry (2012) show that changes in sovereign CDS spreads have a significant impact on bank default risks and vice versa during and after government interventions. Both CDS and credit rating measure the creditworthiness of an entity so that we believe similar relationship can also be found in credit ratings.

Finally, in particular for European debt crisis, Acharya et al. (2014) show that greater financial sector distress leads to a larger scale of bank bailouts, which in turn results in higher sovereign credit risk. Angelini et al. (2014) introduce the self-reinforcing negative spiral among sovereign difficulties, bank fragility and economic recession. While risks arising from a European sovereign borrower can be transmitted to the country's banking sector, there is also some evidence on the bank-to-sovereign causality direction during the European sovereign debt crisis: The Irish and Spanish government debt sectors suffered from the financial obstacles of the domestic banking industry.

Motivated by the reasons above, we argue there is a bank-to-sovereign rating spillover effect and investigate three main questions against the background of the European sovereign debt crisis. Since European sovereigns have incurred substantial costs from bank bailout decisions, these countries' credit ratings should be negatively affected by a large scope of

deterioration in their domestic bank industry's creditworthiness. Firstly, we examine whether, and to which extent, changes in a European country's bank credit ratings influence sovereign ratings. Secondly, we test whether the outbreak of European sovereign debt crisis leads to a structural change in the intensity of rating spillover effect. Thirdly, as recent literature indicates that distinct opinions among the leading credit rating agencies (CRA) on sovereign ratings have become prevalent in Europe in the post-crisis era (Vu et al., 2015; Alsakka et al., 2017; Abad et al., 2018), we also study the differences in the level of bank-to-sovereign spillover effects among S&P, Moody's, and Fitch.

Our paper contributes to several strands of the literature. Our primary contribution is to document bank-to-sovereign credit rating spillover. Previous literature (i.e. Alsaka et al. 2014; Almeida et al., 2017) only shows a sovereign to bank credit rating channel while we find the opposite direction also holds. This suggests a bilateral relationship between bank and sovereign credit ratings. Our paper also contributes to the linkages between a country's financial sector and its macroeconomic risks. Although the bank-to-sovereign risk transmission mechanism in the EU has been confirmed by previous contributions using CDS data (Acharya et al., 2014), we extend the empirical examination to credit ratings for the following reasons. Firstly, the European bank rating data has a much larger coverage than the bank CDS data. Secondly, Oehmke and Zawadowski (2017) suggest that speculative trading concentrates in CDS markets and CDS spreads are noisy while trading in bond markets is mainly hedging motivated. Therefore, credit ratings could provide better information about the domestic banking sector's overall creditworthiness.

To this end, we employ a comprehensive rating sample of 439 banks from 28 countries rated by S&P, 343 banks from 28 countries rated by Moody's, and 690 banks from 26 countries rated by Fitch. In brief, our empirical outcomes confirm that both positive and

negative bank-to-sovereign spillover effects exist, and the negative rating spillover is more pronounced than the positive one. Against the background of European debt crisis, the results also show that the severity of positive and negative rating transmission effects is different and depends upon pre-crisis/crisis-and-post-crisis periods and the origin countries. Moreover, there is evidence on agency-related differences with respect to the existence of positive spillover effects and the degree of negative spillover effects.

The remainder of this paper is structured as follows. Section 2 describes the data, while section 3 introduces the methodology. In section 4 we present the empirical findings, and in section 5 we show the results of further robustness checks. Our conclusions are presented in section 6.

## **2. Data**

Sovereign and bank credit rating data used in this study are from S&P, Moody's, and Fitch over the period from January 2002 to December 2016. Our sample starts from 2002 because Euro notes and coins were introduced to replace all national currencies in Eurozone on 1st January 2002 and European Monetary Union (EMU) officially established. The three years before 2002 is the transition periods and we want to avoid the impact of establishing EMU in this study. These three CRAs together have over 90% market share of the European credit rating industry (ESMA, 2015). We focus on long-term foreign-currency issuer ratings including watch status for sovereigns and banks, and additionally incorporating the outlook placements for sovereigns. According to Standard and Poor's (2017), a foreign-currency credit rating indicates an issuer's capacity to fulfil its obligations denominated in a foreign currency. Moody's (2015) emphasizes that a bank's foreign-currency deposit ratings are subject to sovereign ceilings and typically lower than its domestic currency ratings. Although foreign-currency ratings have taken the currency risk associated with sovereign actions into

account and constitute a more precise risk measure (Prati et al., 2012), we also employ the long-term domestic-currency rating data for robustness check.

The sovereign rating signals (including watch and outlook placements) issued by Moody's and Fitch are manually collected from their publications, while the sovereign rating data of Standard & Poor's are extracted from the S&P Global Credit Portal database. The primary sovereign rating sample covers all 28 member countries of the EU. The data source of bank ratings is Bloomberg. Bank ratings are included in our sample if they meet both the following two criteria: first, the issuer is classified as a bank located in one of the member countries of the EU; second, the issuer has been rated by at least one of the 'Big Three' CRAs during the sample period 2002-2016. To ensure sufficient quality and completeness of bank rating data, we further match the Bloomberg rating data with bank rating history obtained from Datastream Eikon and delete ambiguous entries. This selection procedure leads to a comprehensive sample of 1088 European banks from 28 countries.

**(Insert Table 1)**

Table 1 shows that the final pooled data sample consists of 1584 bank rating upgrades and 2640 downgrades issued by the three CRAs. During the whole sample period, the European countries received 167 sovereign rating upgrades and 200 downgrades. Panel B of Table 1 presents macroeconomic explanatory variables that are used in later sensitivity tests. Typing in with (Cantor and Packer, 1997) and Hill et al. (2010), we collect GDP per capita, GDP growth, inflation rate, current account balance, fiscal balance, and external debt from the World Bank's World Development Indicators database. Apart from GDP per capita, which is measured in thousands of US dollars, all other macroeconomic variables are presented as percentages in our dataset.

In line with Alsakka and ap Gwilym (2013), sovereign and bank ratings are transformed into cardinal values according to a 20-point numerical scale ranging from 20 (Aaa/AAA) to 1 (C/SD-D). Furthermore, the end-of-month sovereign and bank rating datasets are extended to a balanced and an unbalanced monthly panel, respectively. Within the sample period, we are able to capture a full rating history for all sovereigns by recognizing the period between two successive sovereign rating actions as the months with no rating signal, and hence set up a balanced monthly panel for sovereign ratings. By contrast to the sovereigns, a number of European banks do not have a complete rating record over the whole sample period 2002-2016. For example, if a bank received its first rating signal in May 2008 in our dataset, it is only possible to generate a monthly time series starting from May 2008.

**(Insert Table 2)**

Table 2 illustrates a breakdown of our pooled sovereign and bank rating sample by rating agency. Panel A shows the distribution of end-of-month long-term foreign currency ratings (for both sovereigns and banks) as well as watch list and outlook signals (only for sovereigns) for the pre-crisis period (Jan 2002 - Dec 2008). Panel B illustrates the same sample statistics as in Panel A but for the crisis and post-crisis period (Jan 2009 - Dec 2016). Comparing Panel A and Panel B for each CRA subsample, we can find that i) both sovereigns and banks received more downgrades in the crisis and post-crisis period than in the pre-crisis period; ii) the proportion of banks and sovereigns that received no rating signals is higher in the pre-crisis period, which indicates that the CRAs issue rating signals more frequently since the outbreak of the European crisis; and iii) there are more downgrades than upgrades on both banks and sovereigns during the crisis and post-crisis period. For instance, focusing on the S&P subsample, there are 13 (157) sovereign (bank) downgrades before the crisis, but 67 (811) sovereign (bank) downgrades during the crisis and post-crisis period. After the outbreak



of the sovereign debt crisis in 2009, the percentage of sovereigns (banks) that received no rating signals decreased from 96.9% (95.9%) to 94.4% (91.1%). In the same period, 67 (35) downgrades (upgrades) were issued on European sovereigns, whilst 811 (135) downgrades (upgrades) were released on European banks.

Previous research employs different dates as starting points of the European sovereign debt crisis (see e.g. Beirne and Fratzscher, 2013; Bhanot et al., 2014; Caselli et al., 2016). We take January 2009 as the starting month of the European sovereign debt crisis and include the time period afterwards as a part of the ongoing crisis for two reasons: first, the GIIPS countries (Greece, Italy, Ireland, Portugal and Spain) reported substantial increases in fiscal deficit levels in 2009 (Lane, 2012), while European banks start to increase sovereign debt holdings of their origin country in the first quarter of 2009 (Singh et al., 2016); second, the bank-to-sovereign contagion effect and feedback loop is relevant for the European countries throughout the crisis period until at least 2015 (Vergote, 2016).

The main hypothesis underlying our study is that the systemic risk of a European country's domestic banking sector is transmitted to the sovereign sector through the credit rating channel. In order to investigate the bank-to-sovereign rating spillover effect, we have to define a maximal time span between a sovereign rating signal and the most recent bank rating action. In line with previous contributions which study the impact of sovereign rating changes on bank ratings such like Williams et al. (2013) and Alsakka et al. (2014), we similarly apply a 3-month linkage rule to the sovereign rating dataset by generating a linkage between sovereign and bank ratings issued by the same CRA. As a result, any sovereign rating observation which is more than three months later than the most recent bank rating signals (upgrade, downgrade or watch list placement) is omitted.

**(Insert Table 3)**

Throughout our analyses we distinguish between GIIPS and non-GIIPS countries to account for respective differences. This is because the government bond yield spreads between GIIPS countries and other countries (e.g., Germany and France) became considerable wider since 2009. This indicates strong economic divergence between the two groups of countries (Acharya and Steffen, 2015). Therefore, most of previous studies on European debt crisis split the sample into GIIPS and non-GIIPS countries (e.g. Acharya and Steffen, 2015; De Bruyeckere et al. 2013; Alsakka et al., 2014). Panels A and B of Table 3 summarize both subsamples characteristics. Sovereign rating upgrades (downgrades) are classified as single- or multiple-notch upgrades (downgrades). Bank rating upgrades (downgrades), which are issued within a 3-month period before the sovereign rating signal, are categorized as single and multiple upgrades (downgrades), respectively. No bank rating change means that at least one bank linked with sovereign rating is either put on the watch list or taken off watch status. Applying the 3-month linkage rule, there are more sovereign downgrades linked with bank rating actions than sovereign upgrades among both the GIIPS and the non-GIIPS countries. The CRAs took more rating actions in the GIIPS countries: the percentage of no rating change on the non-GIIPS sovereigns (banks) was 97% (17.1%), whereas the percentage of that on the GIIPS sovereigns (banks) was 93.0% (13.1%). In sum, sovereign downgrades of the GIIPS countries were substantially more frequent and more severe than downgrades of the other European countries.

### **3. Methodology**

We investigate the bank-to-sovereign rating transmission channel among European countries based on an ordered probit model, which is widely accepted in credit ratings literature (see e.g. Alsakka and ap Gwilym, 2010; Caporale et al., 2012; Williams et al., 2013). The discrete and ordinal nature of credit ratings makes ordered probit regression an appropriate tool to estimate

the probability of sovereign upgrades, or downgrades, or rating stability following bank rating changes.

In most of the cases, a sovereign rating signal included in our sample is associated with more than one bank rating action (upgrade or downgrade) issued during the previous three months. We record the number of bank upgrades and the number of bank downgrades issued within a 3-month period, respectively, to account for the potential systemic effect of multiple bank rating changes in the same direction. The underlying assumption is that the more rating upgrades (downgrades) are issued to the banking sector of a European country within a 3-month period, the more likely the sovereign will receive an upgrade (downgrade) due to the bank-to-sovereign spillover effect.

We distinguish sovereign rating changes according to the number of rating steps (0, 1, and 2 or more notches) based on the 20-point rating scale. Following Alsakka et al. (2014), we take two dummy variables to represent single and multiple bank rating changes which are linked with the following sovereign rating, respectively. The reason is that the impact of a single bank rating upgrade (downgrade) on domestic sovereign rating may be different from that of multiple bank upgrades (downgrades), since the latter may indicate changes in the national banking sector's systemic credit risk.<sup>1</sup> In line with the recent literature in credit rating which suggests that positive and negative rating actions are driven by distinct factors (see e.g. Afonso et al., 2012; Poon et al., 2017; Williams et al., 2013), we investigate bank-to-sovereign rating contagion effects separately for sovereign upgrades and downgrades:

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<sup>1</sup> Multiple bank rating upgrades (downgrades) refer to two or more domestic bank upgrades (downgrades) within a 3-month period prior to the sovereign rating signal. Due to the limited amount of cases in which more than three domestic banks are upgraded (downgraded) prior to the sovereign rating signal, we do not employ a third dummy to control three or more bank rating changes separately.

$$\begin{aligned}
SUP_{i,c,t}^* &= \alpha_1 * BANKUPNO\_1_{i,c} + \alpha_2 * BANKUPNO\_2_{i,c} + \alpha_3 * BANKDNNO\_1_{i,c} \\
&+ \alpha_4 * BANKDNNO\_2_{i,c} + \alpha_5 * SovRat_{i,c,t-1} + x * Macro_{i,r,yt} + \delta * Co_i \\
&+ \phi * Y_t + e_{i,c,t}; \quad e_{i,c,t} \sim N(0,1)
\end{aligned} \tag{1}$$

$$\begin{aligned}
SDN_{i,c,t}^* &= \beta_1 * BANKUPNO\_1_{i,c} + \beta_2 * BANKUPNO\_2_{i,c} + \beta_3 * BANKDNNO\_1_{i,c} \\
&+ \beta_4 * BANKDNNO\_2_{i,c} + \beta_5 * SovRat_{i,c,t-1} + \gamma * Macro_{i,r,yt} + \eta * Co_i \\
&+ \lambda * Y_t + e_{i,c,t}; \quad e_{i,c,t} \sim N(0,1)
\end{aligned} \tag{2}$$

where  $SUP_{i,c,t}^*$  and  $SDN_{i,c,t}^*$  are unobserved latent variables linked to the observed ordinal response categories  $SUP_{i,c,t}$  and  $SDN_{i,c,t}$  in the measurement model:

$$SUP_{i,c,t} = \begin{cases} 0 \text{ (i.e. no sovereign rating change)} & \text{if } SUP_{i,c,t}^* \leq \mu_1 \\ 1 \text{ (i.e. sovereign upgrade of 1 notch)} & \text{if } \mu_1 \leq SUP_{i,c,t}^* \leq \mu_2 \\ 2 \text{ (i.e. sovereign upgrade of 2 or more notches)} & \text{if } \mu_2 \leq SUP_{i,c,t}^* \end{cases}$$

$$SDN_{i,c,t} = \begin{cases} 0 \text{ (i.e. no sovereign rating change)} & \text{if } SDN_{i,c,t}^* \leq \mu_1 \\ 1 \text{ (i.e. sovereign downgrade of 1 notch)} & \text{if } \mu_1 \leq SDN_{i,c,t}^* \leq \mu_2 \\ 2 \text{ (i.e. sovereign downgrade of 2 or more notches)} & \text{if } \mu_2 \leq SDN_{i,c,t}^* \end{cases}$$

where  $\mu_m$  are the thresholds to be estimated using the maximum likelihood estimation (MLE), along with parameters  $\alpha_n$  and  $\beta_n$  subject to the constraint  $\mu_1 < \mu_2$ .

$SUP_{i,c,t}$  ( $SDN_{i,c,t}$ ) is an ordinal variable that takes the value of 1 if a sovereign  $i$  is upgraded (downgraded) by one notch by CRA  $c$  (S&P, Moody's or Fitch) in month  $t$ ; 2 if a sovereign  $i$  is upgraded (downgraded) by two or more notches by CRA  $c$  in month  $t$ ; 0 otherwise.

$BANKUPNO\_1_{i,c}$  ( $BANKDNNO\_1_{i,c}$ ) is a dummy variable that takes the value of 1 if there is one bank rating upgrade (downgrade) by CRA  $c$  in country  $i$  up to three months prior to month  $t$ ; 0 otherwise.

$BANKUPNO\_2_{i,c}$  ( $BANKDNNO\_2_{i,c}$ ) is a dummy variable that takes the value of 1 if there are two or more bank rating upgrades (downgrades) by CRA  $c$  in country  $i$  up to three months prior to month  $t$ ; 0 otherwise.

$SovRat_{i,c,t-1} = 1, 2, \dots, 19, 20$ . It is the numerical rating notch of country  $i$  by CRA  $c$  in month  $t-1$ . The initial sovereign rating level is used to control for non-linearity and asymmetry in the bank-to-sovereign rating transmission. Moreover, it also accounts for the country's economic and financial situation that is not controlled by the selected macroeconomic variables at the time of sovereign rating action.

$Macro_{i,r,yt}$  are a set of macroeconomic control variables of country  $i$  at time  $yt$  (the year of sovereign rating change), as described in Panel C of Table 1.

$Co_i$  consists of a full set of country dummies.

$Y_t$  consists of a full set of year dummies.

Eq. (1) and Eq. (2) are used for different test purposes as follows. First, based on the whole sample period (2002-2016) and all European countries, the upgrade model (Eq. (1)) and the downgrade model (Eq. (2)) are estimated by using pooled rating data from all three CRAs with two rating agency dummies to control the differences across the CRAs.<sup>2</sup> Second, the sample is divided into the GIIPS subsample versus the non-GIIPS subsample in order to capture potential differences in spillover effects rooted in the GIIPS countries' exposure to sovereign debt market turbulences during the observation period. Third, to account for potential structural changes in the bank-to-sovereign commission channel associated with the crisis, the models are separately estimated for the pre-crisis period versus the crisis and post-

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<sup>2</sup> *D-Fitch* takes the value of 1 if Fitch assigns the given rating, while *D-Moody* takes the value of 1 if Moody's assigns the given rating. Hereby S&P is used as the reference CRA.

crisis period. Fourth, our rating sample is further divided into three subsamples by rating agency to address the possible differentials among the three CRAs. Based on the regression analysis, we further calculate and present marginal effects (MEs) to test the economic significance of each independent variable.

Our aim is to examine whether the bank-to-sovereign rating transmission channel exists in European countries. We expect multiple downgrades of a country's local banks within a short period (no longer than three months) to have significantly negative effects on the respective sovereign ratings. Similarly, bank upgrades in countries may constitute good news for respective sovereign debt and therefore have a positive impact on sovereign ratings. Both the negative and positive spillover effects are expected to be more significant among European countries with moderate to low rating levels, since these sovereigns are justified by the respective CRA to own subordinate financial strengths. Because sovereign sectors of the GIIPS countries are increasingly volatile during the European sovereign debt crisis, we also forecast that negative bank-to-sovereign rating spillover effects in the GIIPS countries are more severe than in other European countries. Finally, the negative spillover effects are expected to be stronger during the crisis and post-crisis period than before the crisis.

For the purpose of robustness check in terms of bank characteristics, we treat the bank rating signals issued to Systemically Important Financial Institutions (SIFIs) in a separate way compared to the rating signals issued to Normal Banks (NBs, i.e. non-SIFIs) in the regression analysis. SIFIs are banks which are included in the EBA 2011 or 2014 Stress Test, all of which stand out in terms of their size and/or interconnectedness, and their considerable holdings of sovereign bonds (Acharya and Steffen, 2015). Other banks that are not considered SIFIs are labelled 'normal banks'. Although SIFI-to-sovereign and NB-to-sovereign rating transmission effects exist simultaneously, we try to separate them from each other in the

regression models. Hence, we construct four independent variables for SIFIs and NBs, respectively. The new variables apply to the upgrade and downgrade regression models in the following way:

$$\begin{aligned}
SUP_{i,c,t}^* &= \alpha_1 * SIFIUPNO\_1_{i,c} + \alpha_2 * SIFIUPNO\_2_{i,c} + \alpha_3 * NBUPNO\_1_{i,c} \\
&+ \alpha_4 * NBUPNO\_2_{i,c} + \alpha_5 * SIFIDNNO\_1_{i,c} + \alpha_6 * SIFIDNNO\_2_{i,c} \\
&+ \alpha_7 * NBDNNO\_1_{i,c} + \alpha_8 * NBDNNO\_2_{i,c} + \alpha_9 * SovRat_{i,c,t-1} \\
&+ x * Macro_{i,r,yt} + \delta * Co_i + \phi * Y_t + e_{i,c,t}; \quad e_{i,c,t} \sim N(0,1)
\end{aligned} \tag{3}$$

$$\begin{aligned}
SUP_{i,c,t}^* &= \beta_1 * SIFIUPNO\_1_{i,c} + \beta_2 * SIFIUPNO\_2_{i,c} + \beta_3 * NBUPNO\_1_{i,c} \\
&+ \beta_4 * NBUPNO\_2_{i,c} + \beta_5 * SIFIDNNO\_1_{i,c} + \beta_6 * SIFIDNNO\_2_{i,c} \\
&+ \beta_7 * NBDNNO\_1_{i,c} + \beta_8 * NBDNNO\_2_{i,c} + \beta_9 * SovRat_{i,c,t-1} \\
&+ \gamma * Macro_{i,r,yt} + \eta * Co_i + \lambda * Y_t + e_{i,c,t}; \quad e_{i,c,t} \sim N(0,1)
\end{aligned} \tag{4}$$

The eight new independent variables in the Eq. (3) and Eq. (4) are defined as follows:

$SIFIUPNO\_1_{i,c}$  ( $SIFIDNNO\_1_{i,c}$ ) is a dummy variable that takes the value of 1 if there is one SIFI rating upgrade (downgrade) by CRA  $c$  in country  $i$  up to three months prior to month  $t$ ; 0 otherwise.

$SIFIUPNO\_2_{i,c}$  ( $SIFIDNNO\_2_{i,c}$ ) is a dummy variable that takes the value of 1 if there are two or more SIFI rating upgrades (downgrades) by CRA  $c$  in country  $i$  up to three months prior to month  $t$ ; 0 otherwise.

$NBUPNO\_1_{i,c}$  ( $NBDNNO\_1_{i,c}$ ) is a dummy variable that takes the value of 1 if there is one NB rating upgrade (downgrade) by CRA  $c$  in country  $i$  up to three months prior to month  $t$ ; 0 otherwise.

$NBUPNO\_2_{i,c}$  ( $NBDNNO\_2_{i,c}$ ) is a dummy variable that takes the value of 1 if there are two or more NB rating upgrades (downgrades) by CRA  $c$  in country  $i$  up to three months prior to month  $t$ ; 0 otherwise.

Among the 1088 European banks rated by at least one of the three CRAs (see Table 2, Panel A), there are only 94 banks identified as SIFIs. Despite of the small sample size of SIFIs, we expect that the SIFI-to-sovereign rating contagion is more evident than the NB-to-sovereign transmission within the subsample of negative rating signals. Since SIFIs represent a majority of European banking industry with respect to total assets and are therefore systemically important (Alsakka et al., 2014), multiple downgrades issued to a country's SIFIs within a short period could induce stronger contagion to the sovereign sector if these rating events were treated as a strong indicator of systemic risk which arises from the country's banking sector. Nevertheless, when shifting focus to the subsample of positive rating signals, we expect that the empirical evidence on positive SIFI-to-sovereign or NB-to-sovereign rating spillovers becomes less significant among the countries in which bank rating upgrades are rare due to the breakout of European debt crisis.

As second part of our robustness test, we modify our original rating datasets (as shown in Table 1) by deleting the entries without rating actions and generating a new monthly sample structure of sovereign and bank ratings. Then the sovereign rating actions (including rating changes, watch and outlook placements) are re-linked with bank rating signals (including rating changes and watch placements) by applying the 3-month linkage rule. As a result, bank ratings issued later than three months prior to the respective sovereign rating change are omitted. Consistent with the test methodology employed by Williams et al. (2013), we then run a pooled regression with new model specifications (Eq. (5) and Eq. (6)) as follows:

$$\begin{aligned}
SUP_{i,c,t}^* &= \pi_1 * BANKUPNO\_1_{i,c} + \pi_2 * BANKUPNO\_2_{i,c} + \pi_3 * BANKDNNO\_1_{i,c} \\
&+ \pi_4 * BANKDNNO\_2_{i,c} + \pi_5 * SovRat_{i,c,t-1} + \kappa * Macro_{i,r,yt} + \nu_1 * GIIPS \\
&+ \nu_2 * Crisis + e_{i,c,t}; \quad e_{i,c,t} \sim N(0,1)
\end{aligned} \tag{5}$$



$$\begin{aligned}
SDN_{i,c,t}^* &= \omega_1 * BANKUPNO\_1_{i,c} + \omega_2 * BANKUPNO\_2_{i,c} + \omega_3 * BANKDNNO\_1_{i,c} \\
&+ \omega_4 * BANKDNNO\_2_{i,c} + \omega_5 * SovRat_{i,c,t-1} + \nu * Macro_{i,r,yt} + \rho_1 * GIIPS \\
&+ \rho_2 * Crisis + e_{i,c,t}; \quad e_{i,c,t} \sim N(0,1)
\end{aligned} \tag{6}$$

where  $SUP_{i,c,t}^*$  and  $SDN_{i,c,t}^*$  are unobserved latent variables linked to the observed ordinal response categories  $SUP_{i,c,t}$  and  $SDN_{i,c,t}$  in the measurement model:

$$SUP_{i,c,t} = \left[ \begin{array}{l} 0 \text{ (i.e. no sovereign rating change) if } SUP_{i,c,t}^* \leq \mu_1 \\ 1 \text{ (i.e. sovereign upgrade of 1 notch) if } \mu_1 \leq SUP_{i,c,t}^* \leq \mu_2 \\ 2 \text{ (i.e. sovereign upgrade of 2 or more notches) if } \mu_2 \leq SUP_{i,c,t}^* \end{array} \right]$$

$$SDN_{i,c,t} = \left[ \begin{array}{l} 0 \text{ (i.e. no sovereign rating change) if } SDN_{i,c,t}^* \leq \mu_1 \\ 1 \text{ (i.e. sovereign downgrade of 1 notch) if } \mu_1 \leq SDN_{i,c,t}^* \leq \mu_2 \\ 2 \text{ (i.e. sovereign downgrade of 2 or more notches) if } \mu_2 \leq SDN_{i,c,t}^* \end{array} \right]$$

where  $\mu_m$  are the thresholds to be determined using maximum likelihood estimation (MLE), along with parameters  $\pi_n$  and  $\omega_h$  subject to the constraint  $\mu_1 < \mu_2$ .

Compared with the previous two estimation models, there are two main differences. First,  $SUP_{i,c,t}$  or  $SDN_{i,c,t}$  takes the value of 0 only if a sovereign is either put on watch list, or on outlook list, such that no actual rating change has occurred. Second, we do not use the country and year dummies to control for fixed effects due to the new data structure in pooled regression estimation. Instead, we employ two dummy variables (*GIIPS* and *Crisis*) to control for country-specific and time-related differences, respectively.

#### 4. Empirical results

Panel A of Table 4 shows regression results based on Eq. (1) and Eq. (2) for pooled rating data issued by all the three CRAs for all European countries over the whole sample period. For the upgrade model with  $SUP$  as the dependent variable, the positive coefficient of the variable  $BANKUPNO\_2$  indicates that multiple bank rating upgrades have a positive impact

on the corresponding sovereign rating action. The negative and significant coefficient of *SovRat* indicates that the higher the initial sovereign rating level, the weaker the positive bank-to-sovereign spillover effect. The marginal effects (MEs) show that if the total number of upgraded banks up to three months prior to the sovereign rating action is 2 or more, the probability of a single-notch (multiple-notch) sovereign upgrade is increased by 0.94% (0.32%).

**(Insert Table 4)**

In case of the downgrade model with *SDN* as the dependent variable, we observe a positive and significant coefficient of *BANKDNNO\_2*, which provides evidence on the negative rating transmission channel. Since the coefficient of *SovRat* is negative and significant, this result is consistent with that in the positive transmission channel and confirms that sovereigns with a lower initial rating are more likely to be affected by bank rating downgrades. The marginal effects (MEs) show that if there are 2 or more bank downgrades up to three months prior to the sovereign rating action, the sovereign is 1.94% (1.54%) more likely to receive a single-notch (multiple-notch) rating downgrade. Furthermore, since the average absolute ME of *BANKDNNO\_2* (2.32%) in the downgrade model is higher than that of *BANKUPNO\_2* (0.84%) in the upgrade model, the negative bank-to-sovereign rating spillover effect appears to be stronger than the positive spillover effect among the European countries.

The pooled rating sample is further broken down into GIIPS versus non-GIIPS subsamples. Panel B of Table 4 does not show any evidence on positive bank-to-sovereign rating transmission among the GIIPS, but confirms the negative rating spillover effect, since the coefficient of *BANKDNNO\_2* is positive and significant at the 1% level in the downgrade model. Especially, the MEs illustrate that a GIIPS country is 2.56% (3.60%) more likely to

receive a single-notch (multiple-notch) sovereign downgrade following multiple bank downgrades within a 3-month period. Moreover, Panel C of Table 4 illustrate that both positive and negative rating transmission channels seem to exist in the non-GIIPS subsample: the coefficient of the variable *BANKUPNO\_2* in the upgrade model and the coefficient of *BANKDNNO\_2* in the downgrade model are both positive and significant at the 1% level. Furthermore, the average MEs in the downgrade model illustrate that the sovereign rating downgrades among the non-GIIPS countries are affected by the macroeconomic factors current acc bal. (0.13%) and fiscal balance (0.09%).

Next, we compare the results in Panel B with those in Panel C for upgrade and downgrade models, respectively. The sovereign upgrade models show that positive rating spillover effects only exist in the non-GIIPS countries, while the test results confirm the existence of negative rating transmission effects in both GIIPS and non-GIIPS subsamples. This is because bailouts of systemically relevant banks in the GIIPS countries (which could be result in bank upgrades) do not alleviate the problem of sustainability of sovereign debts and CRAs are still conscious of further deterioration of public finance in these countries. In contrast, an upgrade of demotic bank could be an undistorted signal of better credit condition in countries without lots of financial supports from ECB. Moreover, through comparing the average absolute MEs induced by *BANKDNNO\_2* in the downgrade model for the GIIPS subsample (4.11%) with that for the non-GIIPS subsample (1.54%), we conclude that the GIIPS sovereign ratings are more sensitive to domestic banking sector's downside credit risk than the ratings of the other European countries.

**(Insert Table 5)**

Table 5 summarizes regression results based on Eq. (1) and Eq. (2) for pooled rating data from the three CRAs for the pre-crisis period versus the crisis and post-crisis period. As

shown in Panel A, both positive and negative spillover effects do not exist in the pre-crisis period. On the contrary, there is empirical evidence on rating spillover effects during the crisis and post-crisis period. If there are 2 or more bank upgrades up to three months prior to the sovereign rating action, the probability of a single-notch (multiple-notch) sovereign upgrade is increased by 0.91% (0.48%). Similarly, the coefficient of *BANKDNNO\_2* is significant at the 1% level in the downgrade model. It shows that the sovereign is 2.34% (2.23%) more likely to receive a single-notch (multiple-notch) rating downgrade following multiple bank rating downgrades. Moreover, the regression results in Panel B show that the bank-to-sovereign negative spillover effects are more evident than the positive spillover effects since the crisis outbreak in 2009: the average ME of 3.05% associated with *BANKDNNO\_2* in the downgrade model is much larger than that of 0.93% associated with *BANKUPNO\_2* in the upgrade model.

**(Insert Table 6)**

Breaking down the full sample by CRA, the estimation results in Table 6 further provide evidence on agency-related differences in terms of both the existence of positive spillover effects and the degree of negative spillover effects. While the estimates for the Fitch subsample provide empirical support in favour of a positive bank-to-sovereign rating spillover effect, there is no significant evidence in the S&P and Moody's subsamples. Nevertheless, there is consistent evidence on the negative spillover effect among all three CRA subsamples, since the coefficient of *BANKDNNO\_2* is positive and significant at the 1% level in all three downgrade models. Moreover, the average marginal effect associated with multiple bank downgrades issued by Fitch (3.09%) is economically larger than the MEs by S&P (2.92%) and Moody's (1.81%). Thus, it seems that Fitch is more likely to downgrade a European country after releasing multiple domestic bank downgrades than S&P and Moody's.

## 5. Robustness check

We conduct a series of robustness tests to minimize the risk that our results are affected by potential endogeneity or methodology selection issue. First, Table 7 shows regression results on the basis of the long-term domestic currency sovereign and bank ratings<sup>3</sup>. Our baseline results remain unaffected. With respect to the full sample, the positive coefficient of the variable *BANKUPNO\_2* (*BANKUPNO\_2*) confirms the above finding of positive (negative) bank-to-sovereign rating spillover effect. Similarly, the results for GIIPS and non-GIIPS countries are consistent with those based on the analysis with foreign currency ratings (as shown in Table 3): in the GIIPS subsample, there is only evidence on the negative rating spillover effect; and in the non-GIIPS subsample, both positive and negative rating transmission effects prevail.

**(Insert Table 7)**

Second, in order to investigate the SIFI-to-sovereign and NB-to-sovereign rating spillover effects separately, we set up four independent variables for SIFIs and NBs, respectively. For this end, based on Eq. (3) for the sovereign upgrade model and Eq. (4) for the sovereign downgrade model, the results in Panel A of Table 8 for the full sample among 28 EU countries show that both multiple SIFI and NB rating changes spill over to sovereign ratings. While the average marginal effect associated with multiple SIFI upgrades (0.87%) is comparable with that associated with multiple NB upgrades (0.85%), the outcomes are different with respect to the negative transmission: If there are 2 or more SIFI downgrades up to three months prior to the sovereign rating action, the probability of a single-notch (multiple-notch) sovereign downgrade is increased by 1.82% (1.47%). These sovereign

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<sup>3</sup> Due to the space limit we only show the re-production of Table 3 with long-term domestic currency ratings using Eq. (1) and Eq. (2). The estimation results for pre-crisis versus crisis and post-crisis period and also GIIPS versus non-GIIPS subsample with domestic currency ratings do not show significant differences compared with Table 5 and Table 6, respectively. These additional robustness checks can be provided upon request.

downgrade probabilities led by SIFI downgrades are as twice much as those led by NB downgrades. This phenomenon provides evidence on our hypothesis that the negative bank-to-sovereign spillover effect is mainly driven by the multiple downgrades issued to SIFIs.

**(Insert Table 8)**

The full sample is then broken down into GIIPS (Panel B) versus non-GIIPS subsamples (Panel C). Consistent with prior results shown in Table 4 and Table 7, the regression outcomes again confirm that the positive bank-to-sovereign spillover effects only exist among the non-GIIPS countries. Moreover, since both `SIFIUPNO_2` and `NBUPNO_2` are significant at the 1% level and the average MEs associated with them are comparable, we cannot tell if the positive rating transmission is primarily induced by SIFIs or NBs in the non-GIIPS subsample. By contrast to the analysis of positive spillovers, the regression results from the GIIPS subsample illustrate significant SIFI-to-sovereign and NB-to-sovereign rating contagion effects, while the former (average ME = 3.71%) are much larger than the latter (average ME = 1.83%) from an economic perspective. Besides, among the non-GIIPS countries, since `SIFIDNNO_2` is significant at the 5% level and the coefficients of `SIFIDNNO_1`, `NBDNNO_1` and `NBDNNO_2` are insignificant, it seems that the rating contagion effects are only led by multiple SIFI downgrades. In sum, we conclude that the negative bank-to-sovereign spillover effects are mainly driven by multiple rating downgrades issued to SIFIs, and single bank downgrades do not have an impact on the respective sovereign rating.

Third, to ensure that the choice of estimation methodology does not have a significant impact on our key results, we corroborate bank-to-sovereign rating spillover effects based on the pooled regression model specifications (Eq. (5) and Eq. (6)) employed by Williams et al. (2013). Again, our previous results are robust to this variation. For the full sample of

European countries, as shown in Panel A of Table 9, the positive coefficient of the variable *BANKUPNO\_2* (*BANKDNNO\_2*) in the upgrade model (downgrade model) indicates that multiple bank rating upgrades (downgrades) have a significant impact on the corresponding sovereign rating action. Moreover, the coefficient of *SovRat* is negative and significant in both up- and downgrade regressions. This outcome again confirms that a country with a higher initial sovereign rating level is less exposed to the bank-to-sovereign spillover effect.

**(Insert Table 9)**

When comparing the MEs calculated for the pooled regression with those from our baseline results in Table 4, we observe that the former are much larger than the latter. The downgrade model for all EU countries may serve as an example: If there are two or more bank downgrades up to three months prior to the sovereign rating action of a European country, the sovereign is 11.43% (18.63%) more likely to receive a single-notch (multiple-notch) rating downgrade.

**(Insert Table 10)**

Fourth, Table 10 further describes additional estimation results for the sovereign rating samples generated with the 2-month and the 1-month linkage rule, respectively. In this part of the analysis, we use the baseline regression models (Eq. (1) and Eq. (2)) for this purpose. Typing in with Williams et al. (2013) and Alsakka et al. (2014), we originally apply a 3-month linkage rule to the sovereign rating dataset by generating a linkage between sovereign and bank ratings issued by the same CRA. However, it is necessary to test whether a change in the length of linkage window leads to biased results. Since a long linkage window could lead to a contaminated rating sample, we focus on the alternative 2-month and 1-month rules.

The test results for the shorter windows show that there is still evidence on bank-to-sovereign rating spillover effects in the full rating sample including all European countries. Interestingly, the shorter the linkage window is, the more severe the European sovereigns are exposed to systemic credit risks of domestic banking industry: the average ME of *BANKDNNO\_2* based on the 1-month rule is 4.81%, which is larger than that on the basis of the 2-month rule. In an analogue way, the average ME of *BANKDNNO\_2* based on the 2-month rule of 3.15% is larger than 2.32% by applying the 3-month rule (as shown in Panel A of Table 4). As a consequence, our main results regarding the existence of bank-to-sovereign rating spillover effects are robust to variations in the linkage window.

## 6. Conclusions

Being providers of a widely used measure of credit risk that can easily be benchmarked against market-implied measures derived from bond yields or CDS prices, rating agencies face the challenge of reacting promptly as well as adequately to the arrival of new relevant information concerning debtors' creditworthiness (Alsakka et al., 2014). In this context, the recent European debt crisis has put CRAs under scrutiny. By comparing the actions of the three major CRAs (S&P, Moody's, Fitch) during the pre-crisis period (Jan 2002 - Dec 2008) and the crisis and post-crisis period (Jan 2009 - Dec 2016), we provide empirical evidence on rating spillover effects from the banking industry to the sovereign sector within the European Union.

The first research question of our paper aims at investigating whether the bank-to-sovereign rating transmission channel exists. We find that the crisis and post-crisis period is characterized by a significant increase of both bank and sovereign rating actions than the pre-crisis period. When linking sovereign rating signals following respective domestic bank rating actions by up to three months, there are more sovereign downgrades than sovereign upgrades.



Moreover, the ordered probit regression analysis exhibits that both multiple bank rating upgrades and downgrades within a three-month period have a significant impact on the following sovereign rating changes in the same direction, and the negative rating spillover effect is more pronounced than the positive one, especially among the GIIPS countries.

Our second research question relates to an association of the outbreak of the European sovereign debt crisis with a material change in the intensity of rating spillover effects, which suggests a change in CRAs' rating behaviour. In the upgrade regression model, the results indicate that sovereign ratings are less sensitive to multiple bank upgrades during the crisis and post-crisis period. By contrast, the regression results for rating downgrades show that bank-to-sovereign negative spillover effects are more evident during 2009-2016. Therefore, we show that the severity of rating transmission effect is time-dependent despite of its existence in both sample periods.

The final research question addresses potential differences in the level of bank-to-sovereign spillover effects among the three leading credit rating agencies. Although negative rating spillover effects occur consistently for each of the three CRAs, sovereign ratings are more sensitive to multiple bank rating downgrades in the Fitch subsample than in the S&P and Moody's subsamples. Moreover, positive spillovers occur only in the Fitch subsample. These results suggest a more evident bank-to-sovereign transmission channel for ratings issued by Fitch than by the other two CRAs. Our results are robust to the changes in model specifications with respect to the currency type of ratings, the structure of regression models, and the approach used to link bank and sovereign ratings.

Our results demonstrate important policy implications. Our results lend support to the notion that potential pro-cyclical chain reactions in the rating processes might endanger financial system stability: As a signal of deterioration in a country's banking sector's overall

creditworthiness, the multiple bank rating downgrades may raise the expectation of fiscal rescue actions or large bailouts, which can be associated with subsequent sovereign rating downgrades, especially when bailouts require substantial increases in public debt levels. The sovereign downgrades tend to lower the rating ceiling for the country's domestic banks and in turn put further downgrade pressure on the banking sector. Therefore, closely monitoring the bank-to-sovereign rating transmission channel should be of particular importance to financial market supervisors to allow for an early intervention if such a negative rating feedback loop is starting to evolve.

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**Table 1: Descriptive characteristics for the pooled sovereign and bank rating data sample**

<i>Panel A: Distribution of sovereign and bank rating changes</i>				
<b>Country</b>	<b>Sovereign upgrades</b>	<b>Sovereign downgrades</b>	<b>Bank upgrades</b>	<b>Bank downgrades</b>
Austria	0	2	16	68
Belgium	2	4	34	61
Bulgaria	14	5	29	31
Croatia	1	7	7	13
Cyprus	14	23	8	32
Czech Republic	4	0	32	12
Denmark	1	0	8	26
Estonia	7	3	0	0
Finland	1	3	7	10
France	0	6	88	295
Germany	0	0	677	237
Greece	14	28	37	123
Hungary	5	14	16	39
Ireland	9	15	52	154
Italy	2	13	115	348
Latvia	15	12	2	6
Lithuania	14	8	4	6
Luxembourg	0	0	27	79
Malta	4	5	1	4
Netherlands	1	1	29	108
Poland	3	1	25	28
Portugal	4	15	15	89
Romania	16	2	40	19
Slovak Republic	14	2	26	10
Slovenia	11	12	21	39
Spain	7	15	91	358
Sweden	4	0	40	33
United Kingdom	0	4	137	412
<b>Total</b>	<b>167</b>	<b>200</b>	<b>1584</b>	<b>2640</b>

  

<i>Panel B: Macroeconomic explanatory variables</i>	
GPD per capita	GDP per capita for the previous year (Thousands of US\$)
GDP growth	Average annual real GDP growth for the previous three years (%)
Inflation	Average annual consumer price inflation growth for the previous three years (%)
Current acc bal.	Average annual current account balance relative to GDP for the previous three years (%)
Fiscal balance	Average annual central government deficit or surplus relative to GDP for the previous three years (%)
External debt	Total external debt relative to exports for the previous year (%)

*Notes:* The table presents summary statistics for the pooled bank and sovereign credit rating data sample, which covers rating signals issued by the three leading CRAs for 1088 European banks and 28 EU countries, respectively. Panel A shows the distribution of long-term foreign currency rating changes (up- and downgrades) by country for both sovereigns and banks within the whole sample period (Jan 2002 - Dec 2016). Panel B presents macroeconomic explanatory variables that are used in later sensitivity tests. The macroeconomic data are sourced from the World Bank's World Development Indicators database.

**Table 2: Breakdown of the sovereign and bank rating data sample by rating agency**

		S&P		Moody's		Fitch		Total		
Countries		28		28		26		28		
Rated banks		439		343		690		1088		
<i>Panel A: Pre-crisis period (Jan 2002 - Dec 2008)</i>										
Sovereigns	Upgrades	32	1.4%	24	1.0%	39	1.7%	95	1.3%	
	Downgrades	13	0.6%	3	0.1%	12	0.5%	28	0.4%	
	Positive watch	0	0.0%	10	0.4%	1	0.0%	11	0.2%	
	Negative watch	1	0.0%	1	0.0%	2	0.1%	4	0.1%	
	Positive outlook	14	0.6%	17	0.7%	31	1.3%	62	0.9%	
	Negative outlook	12	0.5%	5	0.2%	17	0.7%	34	0.5%	
	No rating signal	2280	96.9%	2292	97.4%	2250	95.7%	6822	96.7%	
	Observations	2352		2352		2352		7056		
Banks	Upgrades	285	2.2%	219	2.2%	207	1.5%	711	2.0%	
	Downgrades	157	1.2%	95	1.0%	139	1.0%	391	1.1%	
	Positive watch	31	0.2%	50	0.5%	22	0.2%	103	0.3%	
	Negative watch	60	0.5%	68	0.7%	18	0.1%	146	0.4%	
	No rating signal	12,547	95.9%	9,489	95.6%	13,048	97.1%	35,084	96.3%	
	Observations	13,080		9,921		13,434		36,435		
	<i>Panel B: Crisis and post-crisis period (Jan 2009 - Dec 2016)</i>									
	Sovereigns	Upgrades	35	1.3%	18	0.7%	19	0.7%	72	0.9%
Downgrades		67	2.5%	53	2.0%	52	1.9%	172	2.1%	
Positive watch		0	0.0%	1	0.0%	1	0.0%	2	0.0%	
Negative watch		27	1.0%	18	0.7%	14	0.5%	59	0.7%	
Positive outlook		8	0.3%	7	0.3%	18	0.7%	33	0.4%	
Negative outlook		14	0.5%	21	0.8%	44	1.6%	79	1.0%	
No rating signal		2537	94.4%	2570	95.6%	2540	94.5%	7647	94.8%	
Observations		2688		2688		2688		8064		
Banks	Upgrades	135	1.0%	117	0.9%	621	4.7%	873	2.2%	
	Downgrades	811	6.1%	629	4.9%	809	6.1%	2249	5.7%	
	Positive watch	35	0.3%	49	0.4%	39	0.3%	123	0.3%	
	Negative watch	197	1.5%	255	2.0%	210	1.6%	662	1.7%	
	No rating signal	12,072	91.1%	11,697	91.8%	11,628	87.4%	35,397	90.1%	
	Observations	13,250		12,747		13,307		39,304		

*Notes:* The table presents summary statistics for the credit rating data sample, which covers 1088 banks from 28 European countries. Panel A shows the distribution of end-of-month long-term foreign currency ratings (for both sovereigns and banks) as well as watch list and outlook signals (only for sovereigns) for the pre-crisis period (Jan 2002 - Dec 2008). Panel B illustrates the same sample statistics as in Panel A but for the crisis and post-crisis period (Jan 2009 - Dec 2016). Panel C presents macroeconomic explanatory variables that are used in later sensitivity tests. The data in Panel C are obtained from the World Bank's World Development Indicators database.

**Table 3: Descriptive characteristics for sovereign and bank rating actions by applying the 3-month linkage rule within the GIIPS vs. the non-GIIPS countries**

		S&P		Moody's		Fitch		Total	
<i>Panel A: GIIPS countries</i>									
Sovereigns	Upgrade by 1-notch	9	1.7%	2	0.4%	3	0.6%	14	0.9%
	Upgrade by > 1-notch	1	0.2%	2	0.4%	3	0.6%	6	0.4%
	Downgrade by 1-notch	18	3.4%	10	2.1%	13	2.6%	41	2.7%
	Downgrade by > 1-notch	14	2.6%	14	3.0%	15	3.1%	43	2.9%
	No rating change	491	92.1%	440	94.0%	457	93.1%	1388	93.0%
	Observations	533		468		491		1492	
Banks	Single upgrade	126	20.3%	86	16.9%	112	19.5%	324	19.0%
	Multiple upgrades	106	17.1%	77	15.1%	64	11.1%	247	14.5%
	Single downgrade	74	11.9%	75	14.7%	136	23.7%	285	16.7%
	Multiple downgrades	230	37.0%	183	35.9%	213	37.0%	626	36.7%
	No rating change	85	13.7%	89	17.5%	50	8.7%	224	13.1%
	Observations	621		510		575		1706	
<i>Panel B: Non-GIIPS countries</i>									
Sovereigns	Upgrade by 1-notch	12	1.0%	10	0.7%	19	1.8%	41	1.1%
	Upgrade by > 1-notch	1	0.1%	5	0.3%	1	0.1%	7	0.2%
	Downgrade by 1-notch	17	1.3%	15	1.0%	20	1.9%	52	1.4%
	Downgrade by > 1-notch	1	0.1%	10	0.7%	4	0.4%	15	0.4%
	No rating change	1230	97.5%	1485	97.4%	995	95.8%	3710	97.0%
	Observations	1261		1525		1039		3825	
Banks	Single upgrade	344	23.4%	281	17.3%	280	24.2%	905	21.3%
	Multiple upgrades	212	14.4%	161	9.9%	185	16.0%	558	13.1%
	Single downgrade	360	24.5%	408	25.2%	296	25.5%	1064	25.0%
	Multiple downgrades	354	24.1%	376	23.2%	265	22.9%	995	23.4%
	No rating change	199	13.5%	396	24.4%	133	11.5%	728	17.1%
	Observations	1469		1622		1159		4250	

*Notes:* The table presents summary statistics for foreign-currency sovereign and bank rating actions by applying the 3-month linkage rule within the GIIPS (Panel A) or the non-GIIPS countries (Panel B). The 3-month linkage rule implies that a sovereign rating signal is linked with bank rating actions within the same country up to 3 months prior to its issue date. The GIIPS countries include Greece, Italy, Ireland, Portugal and Spain, while the non-GIIPS countries contain the rest of 23 member countries of the EU. Sovereign rating upgrades (downgrades) are classified as single- or multiple-notch upgrades (downgrades). Bank rating upgrades (downgrades), which are issued within a 3-month period before the sovereign rating signal, are categorized as single and multiple upgrades (downgrades), respectively. No bank rating change means that at least one bank linked with sovereign rating is either put on the watch list or taken off watch status.



**Table 4: Ordered probit estimation results with Eq. (1) and Eq. (2) for the whole sample and two sub-samples split into GIIPS and non-GIIPS**

	<i>SUP</i>						<i>SDN</i>					
	Coef.	t-value	Marginal Effects				Coef.	t-value	Marginal Effects			
			Avr  Chg	0	1	2 ≤			Avr  Chg	0	1	2 ≤
<i>Panel A - All countries</i>												
BANKUPNO_1	0.15	0.81					-0.20	-1.40				
BANKUPNO_2	0.50	2.64***	0.84%	-1.26%	0.94%	0.32%	-0.46	-2.18**	1.55%	2.32%	-1.29%	-1.03%
BANKDNNO_1	0.01	0.04					0.22	1.50				
BANKDNNO_2	0.07	0.34					0.68	5.06***	2.32%	-3.48%	1.94%	1.54%
SovRat	-0.07	-2.04**	0.11%	0.16%	-0.12%	-0.04%	-0.07	-3.74***	0.22%	0.33%	-0.19%	-0.14%
GPD per capita	-0.01	-1.10					0.00	-0.50				
GDP growth	-0.02	-0.54					-0.01	-0.27				
Inflation	0.01	0.67					-0.01	-0.36				
Current acc bal.	0.07	1.98**	0.11%	-0.17%	0.13%	0.04%	-0.06	-2.26**	0.19%	0.29%	-0.16%	-0.13%
Fiscal balance	0.03	2.34**	0.05%	-0.08%	0.06%	0.02%	-0.01	-1.03				
External debt	0.00	-0.28					0.00	0.10				
D_Moody	-0.20	-1.44					0.00	-1.01				
D_Fitch	-0.08	-0.54					-0.08	#REF!				
Co & Y dummies	Yes						Yes					
	Pseudo R2		26.75%		# Obs.	5166	Pseudo R2		23.54%		# Obs.	5249
<i>Panel B - GIIPS</i>												
BANKUPNO_1	0.21	0.82					-0.14	-0.71				
BANKUPNO_2	0.42	1.70*					-0.22	-0.90				
BANKDNNO_1	0.45	1.62					-0.11	-0.40				
BANKDNNO_2	0.36	1.43					0.67	3.62***	4.11%	-6.16%	2.56%	3.60%
SovRat	-0.02	-0.23					-0.07	-2.22**	0.45%	0.68%	-0.28%	-0.40%
GPD per capita	0.00	-0.55					-0.01	-0.81				
GDP growth	-0.09	-1.09					-0.02	-0.41				
Inflation	0.04	0.35					0.21	2.45**	1.30%	-1.95%	0.81%	1.14%
Current acc bal.	0.11	1.80*					-0.06	-1.76*				
Fiscal balance	0.03	1.28					-0.04	-1.75*				
External debt	0.00	0.29					0.00	-0.15				
D_Moody	-0.41	-1.42					-0.10	-0.68				
D_Fitch	0.03	0.14					-0.06	-0.39				
Co & Y dummies	Yes						Yes					

	Pseudo R2			# Obs.				Pseudo R2			# Obs.		
	24.31%			1408				19.52%			1472		
<i>Panel C - Non-GIIPS</i>													
BANKUPNO_1	0.21	0.85						-0.44	-2.00**	0.96%	1.44%	-1.05%	-0.39%
BANKUPNO_2	0.69	2.59***	1.07%	-1.60%	1.27%	0.33%		-3.72	-21.52***	8.07%	12.10%	-8.81%	-3.29%
BANKDNNO_1	-0.17	-0.63						0.39	1.88*				
BANKDNNO_2	-3.45	-20.79***	5.33%	7.99%	-6.34%	-1.65%		0.71	3.44***	1.54%	-2.31%	1.68%	0.63%
SovRat	0.10	1.41						-0.11	-3.37***	0.25%	0.37%	-0.27%	-0.10%
GPD per capita	0.00	-0.08						0.01	1.08				
GDP growth	-0.01	-0.14						-0.02	-0.84				
Inflation	0.02	1.25						-0.11	-1.75*				
Current acc bal.	0.10	2.09**	0.16%	-0.24%	0.19%	0.05%		-0.06	-2.13**	0.13%	0.20%	-0.15%	-0.05%
Fiscal balance	0.03	1.06						0.04	2.86***	0.09%	-0.13%	0.10%	0.03%
External debt	-0.01	-0.80						0.00	-0.24				
D_Moody	-0.11	-0.55						-0.12	-0.77				
D_Fitch	-0.12	-0.65						-0.12	-0.72				
Co & Y dummies	Yes							Yes					
	Pseudo R2			# Obs.				Pseudo R2			# Obs.		
	32.42%			3758				27.59%			3777		

*Notes:* The table reports the results of the ordered probit estimations (Eq. (1) and Eq. (2)) with robust standard errors using pooled rating data from S&P, Moody's, and Fitch. Panel A shows the results for all European countries. Panel B shows the results for the sub-sample of the GIIPS countries (Greece, Italy, Ireland, Portugal and Spain), while Panel C shows the results for the sub-sample of the non-GIIPS countries. The dependent variable is SUP (SDN), which equals either 0, or 1, or 2 if the sovereign rating of a European country *i* is upgraded (downgraded) by 0, 1, or 2 or more notches in month *t*, respectively. BANKUPNO\_1 (BANKUPNO\_2) is a dummy variable that is set to 1 if the number of a European country's bank rating upgrades up to 3 months prior to month *t* is equal to one (more than one), and 0 otherwise. BANKDNNO\_1 (BANKDNNO\_2) is a dummy variable that is set to 1 if the number of a European country's bank rating downgrades up to 3 months prior to month *t* is equal to one (more than one), and 0 otherwise. SovRat is the numerical sovereign rating from the previous month based on the 20-point rating scale. The independent macroeconomic variables are GDP per capita, GDP growth, inflation rate, current account balance, fiscal balance and external debt (as defined in Table 1, Panel C). To control for differences across CRAs, D-Fitch (D-Moody) is set to 1 if Fitch (Moody's) assigns the respective ratings. Thus, S&P is used as the reference agency. Dummy variables of respective countries (Co) and years (Y) are also included. We further estimate and report the impact of each variable on the probability of a rating change (marginal effect), but only for variables with coefficients that are significant at least at the 5% level. The estimates of the two threshold parameters are significant at the 1% level in all cases and are not shown in the table. Asterisks indicate significance at the 10% (\*), 5% (\*\*), and 1% (\*\*\*) level, respectively.

**Table 5: Ordered probit estimation results with Eq. (1) and Eq. (2) for the pre-crisis period and for the crisis and post-crisis period**

	<i>SUP</i>						<i>SDN</i>					
	Coef.	t-value	Marginal Effects				Coef.	t-value	Marginal Effects			
			Avr  Chg	0	1	2 ≤			Avr  Chg	0	1	2 ≤
<i>Panel A - Pre-crisis period (Jan 2002 - Dec 2008)</i>												
BANKUPNO_1	0.03	0.17					-0.16	-0.41				
BANKUPNO_2	0.37	1.83*					0.55	1.47				
BANKDNNO_1	-0.42	-1.73*					0.31	0.70				
BANKDNNO_2	-3.66	-16.96***	9.52%	14.28%	-11.64%	-2.64%	0.80	1.60				
SovRat	-0.09	-2.78***	0.24%	0.36%	-0.29%	-0.07%	-0.68	-4.30***	0.44%	0.66%	-0.59%	-0.07%
GPD per capita	-0.01	-0.86					-0.06	-2.25**	0.04%	0.06%	-0.05%	-0.01%
GDP growth	0.14	3.53***	0.37%	-0.56%	0.46%	0.10%	0.60	1.09				
Inflation	0.00	0.49					-0.01	-0.08				
Current acc bal.	0.02	0.75					-0.42	-2.76***	0.27%	0.40%	-0.36%	-0.04%
Fiscal balance	0.00	0.58					-0.03	-0.44				
External debt	-0.01	-1.34					0.03	0.90				
D_Moody	0.02	0.32					0.63	1.30				
D_Fitch	0.12	0.67					0.33	0.91				
Co & Y dummies	Yes						Yes					
	Pseudo R2		23.02%		# Obs.	2,087	Pseudo R2		55.35%		# Obs.	2057
<i>Panel B - Crisis and post-crisis period (Jan 2009 - Dec 2016)</i>												
BANKUPNO_1	0.22	1.01					-0.20	-1.22				
BANKUPNO_2	0.79	4.10***	0.93%	-1.39%	0.91%	0.48%	-4.36	-29.53***	20.92%	31.38%	-16.05%	-15.33%
BANKDNNO_1	0.19	0.81					0.13	0.80				
BANKDNNO_2	0.18	0.77					0.63	4.35***	3.05%	-4.57%	2.34%	2.23%
SovRat	-0.14	-4.88***	0.16%	0.24%	-0.16%	-0.08%	-0.06	-2.84***	0.27%	0.41%	-0.21%	-0.20%
GPD per capita	-0.01	-1.18					0.00	0.55				
GDP growth	0.08	1.24					-0.02	-0.89				
Inflation	-0.08	-0.96					0.05	0.71				
Current acc bal.	0.06	2.18**	0.07%	-0.10%	0.07%	0.03%	-0.05	-1.36				
Fiscal balance	0.00	0.41					-0.02	-1.15				
External debt	0.00	0.53					0.00	0.66				
D_Moody	-0.38	-1.66					-0.08	-0.68				
D_Fitch	-0.03	-0.13					-0.10	-0.88				
Co & Y dummies	Yes						Yes					
	Pseudo R2		22.15%		# Obs.	3079	Pseudo R2		21.07%		# Obs.	3192

*Notes:* The table reports the results of the ordered probit estimations (Eq. (1) and Eq. (2)) with robust standard errors using pooled rating data from S&P, Moody's, and Fitch. Panel A shows the results for the pre-crisis period, while Panel B shows the results for the crisis and post-crisis period. The dependent variable is SUP (SDN), which equals either 0, or 1, or 2 if the sovereign rating of a European country  $i$  is upgraded (downgraded) by 0, 1, or 2 or more notches in month  $t$ , respectively. BANKUPNO\_1 (BANKUPNO\_2) is a dummy variable that is set to 1 if the number of a European country's bank rating upgrades up to 3 months prior to month  $t$  is equal to one (more than one), and 0 otherwise. BANKDNNO\_1 (BANKDNNO\_2) is a dummy variable that is set to 1 if the number of a European country's bank rating downgrades up to 3 months prior to month  $t$  is equal to one (more than one), and 0 otherwise. SovRat is the numerical sovereign rating from the previous month based on the 20-point rating scale. The independent macroeconomic variables are GDP per capita, GDP growth, inflation rate, current account balance, fiscal balance and external debt (as defined in Table 1, Panel C). To control for differences across CRAs, D-Fitch (D-Moody) is set to 1 if Fitch (Moody's) assigns the respective ratings. Thus, S&P is used as the reference agency. Dummy variables of respective countries (Co) and years (Y) are also included. We further estimate and report the impact of each variable on the probability of a rating change (marginal effect), but only for variables with coefficients that are significant at least at the 5% level. The estimates of the two threshold parameters are significant at the 1% level in all cases, and are not shown in the table. Where no coefficients are reported, there were insufficient observations for the respective independent variable. Asterisks indicate significance at the 10% (\*), 5% (\*\*) and 1% (\*\*\*) level, respectively.

**Table 6: Ordered probit estimation results with Eq. (1) and Eq. (2) for sub-samples split by rating agency**

	<i>SUP</i>						<i>SDN</i>					
	Coef.	t-value	Marginal Effects				Coef.	t-value	Marginal Effects			
			Avr  Chg	0	1	2 ≤			Avr  Chg	0	1	2 ≤
<i>Panel A - S&amp;P</i>												
BANKUPNO_1	0.37	1.39					-0.08	-0.37				
BANKUPNO_2	0.41	1.47					-0.36	-1.26				
BANKDNNO_1	-0.14	-0.46					0.38	1.24				
BANKDNNO_2	0.23	0.74					0.89	3.17***	2.92%	-4.38%	2.82%	1.56%
SovRat	0.01	0.16					-0.09	-2.17**	0.30%	0.45%	-0.29%	-0.16%
GPD per capita	-0.01	-0.80					-0.01	-0.62				
GDP growth	0.02	0.32					0.01	0.17				
Inflation	-0.01	-0.04					-0.05	-1.13				
Current acc bal.	0.20	3.52***	0.35%	-0.52%	0.45%	0.07%	-0.03	-0.73				
Fiscal balance	0.00	0.13					-0.02	-0.68				
External debt	0.01	0.70					0.01	0.93				
Co & Y dummies	Yes						Yes					
	Pseudo R2		28.43%		# Obs.	1,744	Pseudo R2		25.71%		# Obs.	1771
<i>Panel B - Moody's</i>												
BANKUPNO_1	0.20	0.57					0.07	0.26				
BANKUPNO_2	0.32	0.89					-4.35	8.64***	11.75%	17.62%	-7.65%	-9.97%
BANKDNNO_1	-0.37	-0.55					-0.03	-0.11				
BANKDNNO_2	0.68	1.52					0.67	3.12***	1.81%	-2.71%	1.18%	1.53%
SovRat	-0.02	-0.17					-0.01	-0.38				
GPD per capita	-0.01	-1.28					0.00	0.61				
GDP growth	0.01	0.15					-0.13	2.60***	0.35%	0.53%	-0.23%	-0.30%
Inflation	0.02	1.08					0.01	0.02				
Current acc bal.	-0.02	-0.33					-0.27	4.34***	0.72%	1.08%	-0.47%	-0.61%
Fiscal balance	0.20	3.21***	-0.05%	-0.33%	0.18%	0.15%	0.02	1.13				
External debt	0.03	1.51					0.00	0.26				
Co & Y dummies	Yes						Yes					

	Pseudo R2	38.17%		# Obs.	1944	Pseudo R2	30.99%		# Obs.	1974			
<i>Panel C - Fitch</i>													
BANKUPNO_1	0.57	1.85*				-0.49	-1.78*						
BANKUPNO_2	1.54	3.83***	2.97%	-4.46%	3.49%	0.97%	-0.48	-1.47					
BANKDNNO_1	0.66	1.90*					0.23	0.93					
BANKDNNO_2	-0.03	-0.05					0.79	3.37***	3.09%	-4.64%	2.63%	2.01%	
SovRat	-0.11	-2.15**	0.21%	0.32%	-0.25%	-0.07%	-0.10	-	2.92***	0.39%	0.58%	-0.33%	-0.25%
GPD per capita	0.00	-0.54					-0.01	-0.95					
GDP growth	-0.10	-1.58					0.04	0.83					
Inflation	-0.02	-1.06					0.01	0.67					
Current acc bal.	0.10	1.62					-0.04	-1.12					
Fiscal balance	0.01	0.43					-0.01	-0.65					
External debt	-0.03	-1.56					0.00	-0.30					
Co & Y dummies	Yes						Yes						
	Pseudo R2	35.57%		# Obs.	1478	Pseudo R2	23.29%		# Obs.	1504			

*Notes:* The three panels of this table report the results of the ordered probit estimations (Eq. (1) and Eq. (2)) with robust standard errors by using the sub-sample of rating data from S&P, Moody's, and Fitch, respectively. The dependent variable is SUP (SDN), which equals either 0, 1, or 2 if the sovereign rating of a European country  $i$  is upgraded (downgraded) by a rating agency by 0, 1, or 2 or more notches in month  $t$ , respectively. BANKUPNO\_1 (BANKUPNO\_2) is a dummy variable that is set to 1 if the number of a European country's bank rating upgrades up to 3 months prior to month  $t$  is equal to one (more than one), and 0 otherwise. BANKDNNO\_1 (BANKDNNO\_2) is a dummy variable that is set to 1 if the number of a European country's bank rating downgrades up to 3 months prior to month  $t$  is equal to one (more than one), and 0 otherwise. SovRat is the numerical sovereign rating from the previous month based on the 20-point rating scale. The independent macroeconomic variables are GDP per capita, GDP growth, inflation rate, current account balance, fiscal balance and external debt (as defined in Table 1, Panel C). To control for differences across CRAs, D-Fitch (D-Moody) is set to 1 if Fitch (Moody's) assigns the respective ratings. Thus, S&P is used as the reference agency. Dummy variables of respective countries (Co) and years (Y) are also included. We further estimate and report the impact of each variable on the probability of a rating change (marginal effect), but only for variables with coefficients that are significant at least at the 5% level. The estimates of the two threshold parameters are significant at the 1% level in all cases and are not shown in the table. Asterisks indicate significance at the 10% (\*), 5% (\*\*), and 1% (\*\*\*) level, respectively.

**Table 7: Ordered probit estimation results with Eq. (1) and Eq. (2) for the sample of domestic currency sovereign and bank ratings**

	<i>SUP</i>						<i>SDN</i>					
	Coef.	t-value	Marginal Effects				Coef.	t-value	Marginal Effects			
			Avr  Chg	0	1	2 ≤			Avr  Chg	0	1	2 ≤
<i>Panel A - All countries</i>												
BANKUPNO_1	0.39	2.13**	0.53%	-0.79%	0.61%	0.18%	-0.21	-1.48				
BANKUPNO_2	0.73	3.71***	0.97%	-1.46%	1.12%	0.34%	-0.27	-1.62				
BANKDNNO_1	0.17	0.76					0.31	2.21**	1.12%	-1.68%	0.96%	0.72%
BANKDNNO_2	0.20	0.81					0.70	5.28***	2.55%	-3.83%	2.18%	1.65%
SovRat	-0.12	-2.91***	0.16%	0.24%	-0.18%	-0.06%	-0.07	-4.19***	0.27%	0.40%	-0.23%	-0.17%
GPD per capita	-0.01	-2.20**	0.02%	0.03%	-0.02%	-0.01%	0.00	-0.41				
GDP growth	0.03	0.72					-0.02	-0.72				
Inflation	0.01	0.15					-0.03	-0.77				
Current acc bal.	0.07	2.27**	0.10%	-0.15%	0.12%	0.03%	-0.06	-2.47**	0.23%	0.34%	-0.20%	-0.14%
Fiscal balance	0.02	1.67*					-0.01	-1.06				
External debt	0.00	-0.33					0.00	0.43				
D_Moody	-0.26	-1.55					-0.10	-0.97				
D_Fitch	-0.01	-0.05					-0.05	-0.52				
Co & Y dummies	Yes						Yes					
Pseudo R2			29.99%		# Obs.	4,971	Pseudo R2		22.28%		# Obs.	5077
<i>Panel B - GHPS</i>												
BANKUPNO_1	0.45	1.70*					-0.13	-0.64				
BANKUPNO_2	0.34	1.11					-0.29	-1.20				
BANKDNNO_1	0.16	0.49					-0.08	-0.30				
BANKDNNO_2	0.35	1.26					0.74	3.87***	4.60%	-6.90%	2.98%	3.92%
SovRat	-0.08	-1.24					-0.07	-2.09**	0.44%	0.66%	-0.29%	-0.37%
GPD per capita	-0.04	-1.80*					0.00	-0.85				
GDP growth	-0.12	-1.78*					-0.03	-0.65				
Inflation	0.13	1.30					0.23	2.61***	1.43%	-2.15%	0.93%	1.22%
Current acc bal.	0.08	1.26					-0.04	-1.24				
Fiscal balance	0.01	0.46					-0.04	-1.87*				
External debt	0.00	0.19					0.00	-0.18				
D_Moody	-0.56	-2.08**	0.81%	1.22%	-0.82%	-0.40%	-0.06	-0.42				
D_Fitch	0.01	-0.02					-0.04	-0.29				

Co & Y dummies	Yes						Yes					
	Pseudo R2	25.62%		# Obs.		1378	Pseudo R2	19.81%		# Obs.		1448
<i>Panel C - Non-GIIPS</i>												
BANKUPNO_1	0.48	1.65*					-0.46	-2.15**	1.14%	1.71%	-1.24%	-0.47%
BANKUPNO_2	1.02	3.03***	1.25%	-1.88%	1.52%	0.36%	-0.29	-1.25				
BANKDNNO_1	0.24	0.86					0.48	2.48**	1.19%	-1.78%	1.29%	0.49%
BANKDNNO_2	-3.47	-8.16***	4.28%	6.42%	-5.19%	-1.23%	0.64	3.28***	1.57%	-2.35%	1.70%	0.65%
SovRat	-0.11	-2.15**	0.13%	0.20%	-0.16%	-0.04%	-0.13	-3.93***	0.33%	0.50%	-0.36%	-0.14%
GPD per capita	-0.01	-0.64					0.01	1.12				
GDP growth	0.09	1.62					-0.03	-1.20				
Inflation	0.00	0.25					-0.08	-1.47				
Current acc bal.	0.09	2.27**	0.11%	-0.16%	0.13%	0.03%	-0.07	-2.48**	0.17%	0.26%	-0.19%	-0.07%
Fiscal balance	0.05	2.52**	0.07%	-0.10%	0.08%	0.02%	0.03	2.44***	0.09%	-0.13%	0.09%	0.04%
External debt	0.00	-0.35					0.00	-0.15				
D_Moody	-0.09	-0.35					-0.15	-1.02				
D_Fitch	0.01	0.06					-0.04	-0.29				
Co & Y dummies	Yes						Yes					
	Pseudo R2	35.49%		# Obs.		3593	Pseudo R2	25.32%		# Obs.		3629

*Notes:* The table reports the results of the ordered probit estimations (Eq. (1) and Eq. (2)) with robust standard errors by using pooled long-term domestic currency rating data from S&P, Moody's, and Fitch. Panel A shows the results for all European countries, whilst Panel B and Panel C show the results for the GIIPS countries and the non-GIIPS countries, respectively. The dependent variable is SUP (SDN), which equals either 0, or 1, or 2 if the sovereign rating of a European country  $i$  is upgraded (downgraded) by a rating agency by 0, 1, or 2 or more notches in month  $t$ , respectively. BANKUPNO\_1 (BANKUPNO\_2) is a dummy variable that is set to 1 if the number of a European country's bank rating upgrades up to 3 months prior to month  $t$  is equal to one (more than one), and 0 otherwise. BANKDNNO\_1 (BANKDNNO\_2) is a dummy variable that is set to 1 if the number of a European country's bank rating downgrades up to 3 months prior to month  $t$  is equal to one (more than one), and 0 otherwise. SovRat is the numerical sovereign rating from the previous month based on the 20-point rating scale. The independent macroeconomic variables are GDP per capita, GDP growth, inflation rate, current account balance, fiscal balance and external debt (as defined in Table 1, Panel C). To control for differences across CRAs, D-Fitch (D-Moody) is set to 1 if Fitch (Moody's) assigns the respective ratings. Thus, S&P is used as the reference agency. Dummy variables of respective countries (Co) and years (Y) are also included. We further estimate and report the impact of each variable on the probability of a rating change (marginal effect), but only for variables with coefficients that are significant at least at the 5% level. The estimates of the two threshold parameters are significant at the 1% level in all cases and are not shown in the table. Where no coefficients are reported, there were insufficient observations for the respective independent variable. Asterisks indicate significance at the 10% (\*), 5% (\*\*) and 1% (\*\*\*) level, respectively.



**Table 8: Ordered probit estimation results with Eq. (3) and Eq. (4) in terms of separate treatment of SIFI and NB rating changes**

	<i>SUP</i>						<i>SDN</i>					
	Coef.	t-value	Marginal Effects				Coef.	t-value	Marginal Effects			
			Avr  Chg	0	1	2 ≤			Avr  Chg	0	1	2 ≤
<i>Panel A - All countries</i>												
SIFIUPNO_1	0.27	1.84*					-0.61	-1.67*				
SIFIUPNO_2	0.55	2.48**	0.87%	-1.31%	1.02%	0.29%	0.09	0.26				
NBUPNO_1	0.23	1.63					-0.23	-1.51				
NBUPNO_2	0.54	3.11***	0.85%	-1.28%	0.99%	0.29%	-0.56	-1.57				
SIFIDNNO_1	0.37	1.85*					0.01	0.10				
SIFIDNNO_2	0.55	1.96*					0.66	5.39***	2.19%	-3.29%	1.82%	1.47%
NBDNNO_1	-0.29	-1.58					0.22	1.89*				
		-										
NBDNNO_2	-3.91	15.13***	6.21%	9.31%	-7.23%	-2.08%	0.30	2.29**	1.01%	-1.51%	0.84%	0.67%
SovRat	-0.13	-6.25***	0.20%	0.30%	-0.23%	-0.07%	-0.06	-3.00***	0.19%	0.29%	-0.16%	-0.13%
GPD per capita	-0.01	-1.34					0.00	-1.09				
GDP growth	0.11	2.94***	0.17%	-0.25%	0.20%	0.05%	0.07	2.02**	0.25%	-0.37%	0.20%	0.17%
Inflation	0.00	0.31					0.01	0.70				
Current acc bal.	0.04	2.13**	0.06%	-0.09%	0.07%	0.02%	-0.02	-0.80				
Fiscal balance	0.00	0.85					-0.02	-1.37				
External debt	-0.01	-1.09					0.00	0.74				
D_Moody	-0.27	-1.71*					-0.14	-1.25				
D_Fitch	0.00	0.02					-0.12	-1.13				
Co & Y dummies	Yes						Yes					
	Pseudo R2		23.81%		# Obs.	5,054	Pseudo R2		26.24%		# Obs.	5146
<i>Panel B - GIIPS</i>												
SIFIUPNO_1	0.06	0.18					-3.65	-	21.05%	31.57%	-12.85%	-18.72%
SIFIUPNO_2	0.25	0.88					0.17	0.43				
NBUPNO_1	0.39	1.58					-0.28	-1.37				
NBUPNO_2	0.29	0.77					-0.49	-1.33				
SIFIDNNO_1	0.42	1.70*					0.08	0.39				
SIFIDNNO_2	0.70	1.83*					0.64	3.89***	3.71%	-5.56%	2.26%	3.30%
NBDNNO_1	-0.17	-0.62					0.05	0.27				

NBDNNO_2	-4.50	-	11.77***	8.39%	12.59%	-7.92%	-4.67%	0.32	2.02**	1.83%	-2.75%	1.12%	1.63%
SovRat	-0.03	-0.26						-0.08	-2.07**	0.43%	0.65%	-0.26%	-0.39%
GPD per capita	0.00	-0.00						0.00	-0.44				
GDP growth	0.04	0.34						0.02	0.27				
Inflation	0.03	0.14						0.26	2.18**	1.52%	-2.28%	0.93%	1.35%
Current acc bal.	-0.01	-0.18						0.01	0.26				
Fiscal balance	-0.01	-0.72						-0.04	-0.93				
External debt	0.00	-0.27						0.00	0.32				
D_Moody	-0.36	-1.23						-0.11	-0.72				
D_Fitch	0.09	0.34						-0.11	-0.71				
Co & Y dummies	Yes							Yes					
	Pseudo R2		24.77%			# Obs.	1401	Pseudo R2		23.94%		# Obs.	1465
<i>Panel C - Non-GIIPS</i>													
SIFIUPNO_1	0.47	1.75*						-0.41	-0.97				
SIFIUPNO_2	0.87	2.65***	1.17%	-1.76%	1.51%	0.25%		-2.38	-5.65***	4.91%	7.36%	-5.32%	-2.04%
NBUPNO_1	0.21	1.17						-0.37	-1.51				
NBUPNO_2	0.67	3.24***	0.91%	-1.36%	1.16%	0.20%		-3.71	-	7.65%	11.47%	-8.29%	-3.18%
SIFIDNNO_1	-0.07	-0.17						-0.05	-0.26				
SIFIDNNO_2	-3.46	-8.01***	4.67%	7.00%	-5.98%	-1.02%		0.54	2.56**	1.11%	-1.67%	1.20%	0.47%
NBDNNO_1	-0.39	-1.47						0.26	1.51				
NBDNNO_2	-3.77	-	21.48***	5.09%	7.63%	-6.52%	-1.11%	0.26	1.33				
SovRat	-0.14	-5.36***	0.19%	0.29%	-0.25%	-0.04%		-0.15	-3.85***	0.31%	0.47%	-0.34%	-0.13%
GPD per capita	-0.01	-1.24						0.00	-0.11				
GDP growth	0.18	3.62***	0.25%	-0.37%	0.31%	0.06%		0.26	3.82***	0.53%	-0.80%	0.58%	0.22%
Inflation	0.00	-0.20						-0.06	-0.50				
Current acc bal.	0.06	3.01***	0.09%	-0.13%	0.11%	0.02%		0.00	0.07				
Fiscal balance	0.02	1.44						0.08	3.21***	0.16%	-0.24%	0.17%	0.07%
External debt	-0.02	-1.43						0.00	-0.36				
D_Moody	-0.16	-0.78						-0.08	-0.45				
D_Fitch	-0.06	-0.32						-0.11	-0.63				
Co & Y dummies	Yes							Yes					
	Pseudo R2		31.44%			# Obs.	3653	Pseudo R2		32.63%		# Obs.	3681

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The table reports the results of the ordered probit estimations (Eq. (3) and Eq. (4)) with robust standard errors by using pooled long-term foreign currency rating data from S&P, Moody's, and Fitch. In this part of analysis, the bank rating signals issued to Systemically Important Financial Institutions (SIFIs) are treated separately compared to the rating signals issued to Normal Banks (NBs). Panel A shows the results for all European countries, whilst Panel B and Panel C show the results for the GIIPS countries and the non-GIIPS countries, respectively. The dependent variable is SUP (SDN), which equals either 0, or 1, or 2 if the sovereign rating of a European country  $i$  is upgraded (downgraded) by a rating agency by 0, 1, or 2 or more notches in month  $t$ , respectively. SIFIUPNO\_1 (SIFIUPNO\_2) is a dummy variable that is set to 1 if the number of a European country's SIFI rating upgrades up to 3 months prior to month  $t$  is equal to one (more than one), and 0 otherwise. SIFIDNNO\_1 (SIFIDNNO\_2) is a dummy variable that is set to 1 if the number of a European country's SIFI rating downgrades up to 3 months prior to month  $t$  is equal to one (more than one), and 0 otherwise. NBUPNO\_1 (NBUPNO\_2) is a dummy variable that is set to 1 if the number of a European country's NB rating upgrades up to 3 months prior to month  $t$  is equal to one (more than one), and 0 otherwise. NBDNNO\_1 (NBDNNO\_2) is a dummy variable that is set to 1 if the number of a European country's NB rating downgrades up to 3 months prior to month  $t$  is equal to one (more than one), and 0 otherwise. SovRat is the numerical sovereign rating from the previous month based on the 20-point rating scale. The independent macroeconomic variables are GDP per capita, GDP growth, inflation rate, current account balance, fiscal balance and external debt (as defined in Table 1, Panel C). To control for differences across CRAs, D-Fitch (D-Moody) is set to 1 if Fitch (Moody's) assigns the respective ratings. Thus, S&P is used as the reference agency. Dummy variables of respective countries (Co) and years (Y) are also included. We further estimate and report the impact of each variable on the probability of a rating change (marginal effect), but only for variables with coefficients that are significant at least at the 5% level. The estimates of the two threshold parameters are significant at the 1% level in all cases, and are not shown in the table. Where no coefficients are reported, there were insufficient observations for the respective independent variable. Asterisks indicate significance at the 10% (\*), 5% (\*\*) and 1% (\*\*\*) level, respectively.

**Table 9: Ordered probit estimation results with Eq. (5) and Eq. (6) for the whole sample and two sub-samples with respect to the European debt crisis**

	<i>SUP</i>						<i>SDN</i>					
	Coef.	t-value	Marginal Effects				Coef.	t-value	Marginal Effects			
			Avr  Chg	0	1	2 ≤			Avr  Chg	0	1	2 ≤
<i>Panel A - All countries</i>												
BANKUPNO_1	0.38	1.33					-0.02	-0.08				
BANKUPNO_2	1.21	3.98***	14.71%	-22.06%	14.37%	7.69%	-0.70	-1.87*				
BANKDNNO_1	-0.18	-0.58					0.54	2.28**	9.84%	-14.76%	5.61%	9.15%
BANKDNNO_2	-0.53	-1.75*					1.11	5.00***	20.04%	-30.06%	11.43%	18.63%
SovRat	-0.20	-4.94***	2.37%	3.55%	-2.31%	-1.24%	-0.08	-3.70***	1.40%	2.10%	-0.80%	-1.30%
GPD per capita	-0.03	-3.17***	0.32%	0.48%	-0.32%	-0.16%	-0.01	-1.90*				
GDP growth	0.07	1.32					-0.01	-0.42				
Inflation	-0.01	-1.16					-0.09	-1.91*				
Current acc bal.	0.07	2.34**	0.91%	-1.36%	0.88%	0.48%	-0.07	-3.16***	1.23%	1.84%	-0.70%	-1.14%
Fiscal balance	0.02	1.33					0.00	0.22				
External debt	0.00	0.12					0.00	-0.08				
D_Moody	-0.28	-1.09					-0.08	-0.46				
D_Fitch	-0.65	-2.92***	7.83%	11.75%	-7.65%	-4.10%	-0.56	-3.37***	10.22%	15.33%	-5.83%	-9.50%
GIIPS	0.50	1.87*					0.19	1.07				
Crisis	-0.76	-2.80***	9.18%	13.77%	-8.97%	-4.80%	-0.01	-0.03				
	Pseudo R2		33.34%		# Obs.	296	Pseudo R2		23.80%		# Obs.	383
<i>Panel B - Pre-crisis period (Jan 2002 - Dec 2008)</i>												
BANKUPNO_1	0.43	1.12					-0.47	-0.66				
BANKUPNO_2	1.23	2.99***	22.75%	-34.13%	22.53%	11.60%	NA					
BANKDNNO_1	-0.46	-0.95					1.18	1.69*				
BANKDNNO_2	NA						3.02	3.03***	20.67%	-31.00%	27.54%	3.46%
SovRat	-0.03	-0.44					-0.56	-3.00***	3.81%	5.72%	-5.08%	-0.64%
GPD per capita	-0.03	-2.22**	0.55%	0.83%	-0.55%	-0.28%	-0.15	-2.66***	1.06%	1.59%	-1.41%	-0.18%
GDP growth	0.04	0.50					-0.36	-2.12**	2.49%	3.73%	-3.32%	-0.41%
Inflation	0.01	0.68					-0.12	-1.06				
Current acc bal.	-0.04	-0.7					-0.32	-2.70***	2.22%	3.33%	-2.96%	-0.37%
Fiscal balance	0.01	0.51					0.03	1.25				
External debt	0.00	-0.08					0.07	1.43				
D_Moody	-0.26	-0.77					-0.06	-0.09				

D_Fitch	-0.60	-1.81*					0.03	0.04				
GIIPS	-0.99	-1.78*					0.93	1.09				
	Pseudo R2		24.22%		# Obs.	104	Pseudo R2		62.46%		# Obs.	76
<i>Panel C - Crisis and post-crisis period (Jan 2009 - Dec 2016)</i>												
BANKUPNO_1	0.84	1.82*					0.13	0.47				
BANKUPNO_2	2.10	5.03***	14.01%	-21.02%	13.38%	7.64%	NA					
BANKDNNO_1	0.04	0.10					0.46	1.67*				
BANKDNNO_2	-0.37	-0.94					1.01	4.29***	19.95%	-29.93%	9.43%	20.50%
SovRat	-0.34	-4.44***	2.25%	3.38%	-2.15%	-1.23%	-0.07	-3.32***	1.39%	2.08%	-0.66%	-1.42%
GPD per capita	-0.03	-2.93***	0.22%	0.33%	-0.21%	-0.12%	-0.01	-1.26				
GDP growth	0.13	1.72*					-0.02	-0.48				
Inflation	0.31	2.45**	2.07%	-3.11%	1.98%	1.13%	-0.13	-1.91*				
Current acc bal.	0.20	3.74***	1.31%	-1.96%	1.25%	0.71%	-0.07	-3.17***	1.44%	2.16%	-0.68%	-1.48%
Fiscal balance	0.00	0.15					0.00	0.02				
External debt	-0.01	-0.33					0.00	0.03				
D_Moody	-0.28	-0.64					0.03	0.13				
D_Fitch	-0.38	-0.92					-0.56	-3.12***	10.93%	16.40%	-5.17%	-11.23%
GIIPS	1.75	3.32***	11.53%	-17.45%	11.10%	6.03%	0.12	0.60				
	Pseudo R2		45.55%		# Obs.	192	Pseudo R2		19.83%		# Obs.	307

*Notes:* The table reports the results of the ordered probit regressions (Eq. (3) and Eq. (4)) with robust standard errors by using pooled long-term foreign currency rating data from S&P, Moody's, and Fitch. Panel A shows the results for all European countries. Panel B shows the results for the pre-crisis period, while Panel C shows the results for the crisis and post-crisis period. The dependent variable is SUP (SDN), which equals either 0, or 1, or 2 if the sovereign rating of a European country  $i$  is upgraded (downgraded) by a rating agency by 0, 1, or 2 or more notches in month  $t$ , respectively. BANKUPNO\_1 (BANKUPNO\_2) is a dummy variable that is set to 1 if the number of a European country's bank rating upgrades up to 3 months prior to month  $t$  is equal to one (more than one), and 0 otherwise. BANKDNNO\_1 (BANKDNNO\_2) is a dummy variable that is set to 1 if the number of a European country's bank rating downgrades up to 3 months prior to month  $t$  is equal to one (more than one), and 0 otherwise. SovRat is the numerical sovereign rating from the previous month based on the 20-point rating scale. The independent macroeconomic variables are GDP per capita, GDP growth, inflation rate, current account balance, fiscal balance and external debt (as defined in Table 1, Panel C). To control for differences across CRAs, D-Fitch (D-Moody) is set to 1 if Fitch (Moody's) assigns the respective ratings. Thus, S&P is used as the reference agency. GIIPS is a dummy variable equaling 1 if the sovereign rating signal originates from a GIIPS country; 0 otherwise. Crisis is a dummy variable equaling 1 if the sovereign rating signal falls into the crisis and post-crisis period from January 2009 to December 2016; 0 otherwise. We further estimate and report the impact of each variable on the probability of a rating change (marginal effect), but only for variables with coefficients that are significant at least at the 5% level. The estimates of the two threshold parameters are significant at the 1% level in all cases, and are not shown in the table. Where no coefficients are reported, there were insufficient observations for the respective independent variable. Asterisks indicate significance at the 10% (\*), 5% (\*\*) and 1% (\*\*\*) level, respectively.

**Table 10: Ordered probit estimation results for the sovereign rating samples in application of 2-month and 1-month linkage rule**

	<i>SUP</i>						<i>SDN</i>					
	Coef.	t-value	Marginal Effects				Coef.	t-value	Marginal Effects			
			Avr  Chg	0	1	2 ≤			Avr  Chg	0	1	2 ≤
<i>Panel A - Full sample in case of 2-month linkage</i>												
BANKUPNO_1	0.03	0.14					-0.32	-1.90*				
BANKUPNO_2	0.52	2.70***	0.91%	-1.37%	0.99%	0.38%	-0.80	-2.21**	2.82%	4.23%	-2.32%	-1.91%
BANKDNNO_1	0.05	0.27					0.42	2.72***	1.49%	-2.23%	1.22%	1.01%
BANKDNNO_2	-0.08	-0.34					0.89	6.12***	3.15%	-4.73%	2.59%	2.14%
SovRat	-0.07	-2.07**	0.13%	0.19%	-0.14%	-0.05%	-0.08	-3.86***	0.27%	0.40%	-0.22%	-0.18%
GPD per capita	-0.01	-1.33					0.00	-0.74				
GDP growth	#REF!	-0.15					0.00	0.08				
Inflation	0.01	0.48					0.01	0.31				
Current acc bal.	0.07	2.01**	0.13%	-0.20%	0.14%	0.06%	-0.04	-1.42				
Fiscal balance	0.03	2.32**	0.06%	-0.09%	0.07%	0.02%	-0.02	-1.79*				
External debt	0.00	-0.23					0.00	0.21				
D_Moody	-0.21	-1.39					-0.09	-0.87				
D_Fitch	-0.02	-0.27					-0.05	-0.45				
Co & Y dummies	Yes						Yes					
	Pseudo R2		28.15%		# Obs.	4,412	Pseudo R2		26.66%		# Obs.	4493
<i>Panel B - Full sample in case of 1-month linkage</i>												
BANKUPNO_1	0.15	0.76					-0.44	-2.03**	1.66%	2.49%	-1.36%	-1.13%
BANKUPNO_2	0.67	3.30***	1.28%	-1.92%	1.41%	0.51%	-0.65	-1.63				
BANKDNNO_1	-0.10	-0.47					0.58	3.22***	2.23%	-3.34%	1.83%	1.51%
BANKDNNO_2	-0.07	-0.24					1.26	7.34***	4.81%	-7.21%	3.94%	3.27%
SovRat	-0.06	-1.55					-0.10	-2.92***	0.32%	0.48%	-0.26%	-0.22%
GPD per capita	-0.01	-1.24					0.00	-0.14				
GDP growth	-0.03	-0.69					0.00	0.06				
Inflation	0.01	0.35					0.01	0.30				
Current acc bal.	0.04	0.99					-0.03	-0.98				
Fiscal balance	0.03	1.78*					-0.02	-1.13				
External debt	-0.01	-0.46					0.00	0.16				
D_Moody	-0.29	-1.76*					-0.13	-1.09				
D_Fitch	-0.15	-0.91					-0.14	-1.10				

Co & Y dummies	Yes			Yes			
	Pseudo R2	31.76%	# Obs.	3421	Pseudo R2	31.45%	# Obs.
							3501

*Notes:* The table reports the results of the ordered probit estimations with robust standard errors by using pooled rating data from S&P, Moody's, and Fitch with respect to two different linkage rules. Panel A and Panel B show the regression results for the sample in case of applying 1-month and 2-month linkage rule, respectively. The dependent variable is SUP (SDN), which equals either 0, or 1, or 2 if the sovereign rating of a European country *i* is upgraded (downgraded) by 0, 1, or 2 or more notches in month *t*, respectively. BANKUPNO\_1 (BANKUPNO\_2) is a dummy variable that is set to 1 if the number of a European country's bank rating upgrades up to 3 months prior to month *t* is equal to one (more than one), and 0 otherwise. BANKDNNO\_1 (BANKDNNO\_2) is a dummy variable that is set to 1 if the number of a European country's bank rating downgrades up to 3 months prior to month *t* is equal to one (more than one), and 0 otherwise. SovRat is the numerical sovereign rating from the previous month based on the 20-point rating scale. The independent macroeconomic variables are GDP per capita, GDP growth, inflation rate, current account balance, fiscal balance and external debt (as defined in Table 1, Panel C). To control for differences across CRAs, D-Fitch (D-Moody) is set to 1 if Fitch (Moody's) assigns the respective ratings. Thus, S&P is used as the reference agency. Dummy variables of respective countries (Co) and years (Y) are also included. We further estimate and report the impact of each variable on the probability of a rating change (marginal effect), but only for variables with coefficients that are significant at least at the 5% level. The estimates of the two threshold parameters are significant at the 1% level in all cases, and are not shown in the table. Asterisks indicate significance at the 10% (\*), 5% (\*\*) and 1% (\*\*\*) level, respectively.

## Appendix A: Ordered probit estimation results with Eq. (1) and Eq. (2) for the crisis period and post-crisis period (only for peer-review)

	SUP						SDN					
	Coef.	t-value	Marginal Effects				Coef.	t-value	Marginal Effects			
			Avr  Chg	0	1	2 ≤			Avr  Chg	0	1	2 ≤
<i>Panel A - Crisis period (Jan 2009 - Dec 2012)</i>												
BANKUPNO_1	NA						NA					
BANKUPNO_2	NA						NA					
BANKDNNO_1	0.71	1.23					0.14	0.71				
BANKDNNO_2	-4.82	-6.66***	0.97%	1.45%	-0.41%	-1.04%	0.75	4.75***	4.75%	-7.12%	3.38%	3.74%
SovRat	-0.09	-1.34					-0.10	-8.24***	0.61%	0.91%	-0.43%	-0.48%
GPD per capita	-0.29	-2.17**	0.06%	0.09%	-0.03%	-0.06%	0.00	0.12				
GDP growth	-0.03	-0.21					-0.01	-0.35				
Inflation	NA						NA					
Current acc bal.	NA						NA					
Fiscal balance	0.07	1.53					0.01	1.82*				
External debt	-0.11	-3.19***	0.02%	0.03%	-0.01%	-0.02%	0.00	0.17				
D_Moody	-5.30	-6.07***	1.07%	1.60%	-0.45%	-1.15%	0.01	0.12				
D_Fitch	-1.32	-1.72*					-0.14	-1.09				
Co & Y dummies	Yes						Yes					
	Pseudo R2		48.86%		# Obs.	1,835	Pseudo R2		15.28%		# Obs.	1940
<i>Panel B - Post-crisis period (Jan 2013 - Dec 2016)</i>												
BANKUPNO_1	0.33	1.33					-0.23	-0.79				
BANKUPNO_2	0.61	2.75***	1.54%	-2.31%	1.67%	0.64%	-4.05	19.32***	12.33%	18.50%	-13.16%	-5.34%
BANKDNNO_1	0.02	0.09					0.09	0.37				
BANKDNNO_2	0.34	1.44					0.61	2.64***	1.84%	-2.76%	1.96%	0.80%
SovRat	-0.07	-3.15***	0.17%	0.25%	-0.18%	-0.07%	-0.08	-3.30***	0.23%	0.35%	-0.25%	-0.10%
GPD per capita	0.00	-0.40					0.00	-0.38				
GDP growth	NA						NA					
Inflation	-0.30	-2.03**	0.75%	1.12%	-0.81%	-0.31%	-0.05	-0.58				
Current acc bal.	NA						NA					
Fiscal balance	0.00	-0.43					0.00	-0.45				
External debt	0.01	1.85*					0.01	1.21				
D_Moody	-0.24	-1.01					-0.26	-1.14				



D_Fitch	-0.05	-0.22			0.10	0.49		
Co & Y dummies	Yes				Yes			
	Pseudo R2	14.09%	# Obs.	1244	Pseudo R2	16.35%	# Obs.	1252

The table reports the results of the ordered probit estimations (Eq. (1) and Eq. (2)) with robust standard errors using pooled rating data from S&P, Moody's, and Fitch. Panel A shows the results for the crisis period (2009-2012), while Panel B shows the results for the post-crisis period (2013-2016). The dependent variable is SUP (SDN), which equals either 0, or 1, or 2 if the sovereign rating of a European country  $i$  is upgraded (downgraded) by 0, 1, or 2 or more notches in month  $t$ , respectively. BANKUPNO\_1 (BANKUPNO\_2) is a dummy variable that is set to 1 if the number of a European country's bank rating upgrades up to 3 months prior to month  $t$  is equal to one (more than one), and 0 otherwise. BANKDNNO\_1 (BANKDNNO\_2) is a dummy variable that is set to 1 if the number of a European country's bank rating downgrades up to 3 months prior to month  $t$  is equal to one (more than one), and 0 otherwise. SovRat is the numerical sovereign rating from the previous month based on the 20-point rating scale. The independent macroeconomic variables are GDP per capita, GDP growth, inflation rate, current account balance, fiscal balance and external debt (as defined in Table 1, Panel C). To control for differences across CRAs, D-Fitch (D-Moody) is set to 1 if Fitch (Moody's) assigns the respective ratings. Thus, S&P is used as the reference agency. Dummy variables of respective countries (Co) and years (Y) are also included. We further estimate and report the impact of each variable on the probability of a rating change (marginal effect), but only for variables with coefficients that are significant at least at the 5% level. The estimates of the two threshold parameters are significant at the 1% level in all cases, and are not shown in the table. Where no coefficients are reported, there were insufficient observations for the respective independent variable. Asterisks indicate significance at the 10% (\*), 5% (\*\*) and 1% (\*\*\*) level, respectively.