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Abstract

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Are risk-based capital requirements detrimental to corporate lending? Evidence from Europe*

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1. Introduction

Weak bank lending to the corporate sector and funding constraints of small and medium businesses are major causes of concern in many countries, including Europe (OECD, 2014). While the debate on the determinants of reduced bank lending to European corporates is still open, one of its causes could be the introduction of more stringent capital rules, consistent with what occurred in the US during the 1990-1992 credit crunch (Berger and Udell, 1994; Peek and Rosengren, 1995; Brinkmann and Horvitz, 1995).

Since 1988, bank capital requirements are based on risk-weighted measures of bank assets. Since 2004 (2006 in the European Union), risk-weights may be computed internally by banks, based on proprietary rating models that must be validated by supervisors. Since 2010, a substantial increase in capital levels (and capital quality, limiting the use of subordinated debt and hybrid capital) was requested to banks, making risk-based capital requirements more stringent than in the past.

By treating different exposures in a more (or less) conservative way, supervisory risk weights may affect the way banks allocate resources across asset types and counterparties. In this regard, Assonime-CEPR (2015) claim that, since the risk weights may prove comparatively higher for small and medium enterprises (SMEs, which in turn are more dependent on bank finance), the adverse effect of capital requirements on bank lending may be felt more strongly by this class of borrowers.

More generally, risk-weights may have generated a systematic bias against the provision of credit to non-financial companies, in favour of "safer" assets such as government bonds, interbank debt and mortgages (as well as of non-credit related businesses, such as securities trading). The European Stability Risk Board (ESRB, 2015) has recently raised the issue that zero risk weights for domestic sovereign exposures[1] may have led to over-investment by financial institutions in government debt, especially for banks headquartered in countries running high government debts[2]. The many amendments to risk-based capital requirements, which were proposed or implemented since the outbreak of the financial crisis, may have further biased the incentives for lenders to provide credit to the real economy, and therefore call for a thorough assessment. This is the case, e.g., for the new liquidity-related ratios coming into force in 2015 ("liquidity coverage ratio") and 2018 ("net stable funding ratio")[3].

Understanding the impact of capital regulations and risk weights on how banks allocate funds is of great importance, also in light of the concerns surrounding the way banks compute their "risk-weighted assets" (RWAs). The large discrepancies in average risk weights across banks and jurisdictions (see e.g. Basel Committee on Banking Supervision 2013; EBA 2013)[4] have prompted a widespread scepticism about the consistency of RWA-based methodologies, and cast doubts on the reliability of bank capital ratios. Particularly, there is a sense that banks relying on internal models for computing regulatory capital may use them to embellish their capital ratios.

This has led to draft regulations[5] whereby internal models would be constrained (e.g., by setting floors on default probabilities and loss rates) or removed altogether for wholesale portfolios (where defaults are too rare to allow for effective model back-testing). As a result, banks having invested heavily on internal ratings may be prevented from reaping all expected benefits (and forced to deleverage as floors inflate risk weights for their loans);

[1] In the case of banks headquartered in the Eurozone, the zero weight applies to all euro-denominated exposures towards Eurozone public sector.

[2] According to the report, banks in Eurozone countries affected by severe public budget constraints have gradually increased their Euro-denominated sovereign debt holdings (as a proportion of total assets) in the last six years. In contrast, banks from other Eurozone countries either reduced such exposures or kept them unchanged.

[3] In the computation of those ratios, government bonds are treated as "high quality liquid assets" that banks may hold to meet their liquidity requirements (with no minimum rating requirements for bonds issued by a bank's country of incorporation). Conversely, loans to corporates (and above all SMEs) negatively impact on future expected cash flows, leading to weaker liquidity ratios.

[4] See BIS (2013), Appendix 1, for a complete list of these studies.

[5] See Basel Committee on Banking Supervision (2016), Resti (2016).

additionally, risk measures may become biased by regulatory constraints, leading to poorer asset allocation. Such unwelcome developments may be especially felt by European lenders, which have been much keener on embracing internal ratings that their US counterparts.

In the near future, the Basel Committee is also expected to tackle the issue of sovereign exposures, by addressing the rules that currently assign zero risk weights to a bank's domestic public sector. The effect of such a measure might be beneficial for corporate lending, by curbing incentives towards over-investment in government debt. The details, however, remain to be seen, and there is a risk that the new rules may prove disruptive for heavily-indebted countries, causing a recessionary impact on the real economy.

Against this backdrop, this paper addresses two issues.

(1) As a preliminary step, we explore what drives the differences in RWAs across European banks. This is motivated by a growing body of literature that investigates the determinants of such discrepancies.[6] These contributions point to the fact that that reported capital ratios may mask differences in RWAs across individual banks that "might not entirely reflect genuine difference in risk-taking" (Bank of England, 2011). Particularly we are interested in understanding the extent to which differences in risk weights are explained by the intensity of adoption of internal ratings, measured as the share of a bank's loan portfolio falling under the internal ratings-based ("IRB") approach, both fundamental and advanced[7].

(2) As a second objective, we aim to assess the impact of RWA-based capital regulation on the way banks allocated funds in 2008-2014 (a period of extraordinary strain for European banks, due to the subsequence of two crisis episodes, the global banking crisis and the euro sovereign debt crisis). We first want to understand how banks relying on internal models allocated resources to corporates, to see whether (and to what extent) a shift from corporate loans to government bonds has taken place in those banks. Risk-based capital requirements are notoriously procyclical (Laeven and Majnoni 2003) and may favour a "capital crunch" in downturns.[8] In short, as credit quality suffers in recessions, bank risk-weighted exposures increase and, *coeteris paribus*, raise the capital needed to meet regulatory requirements (right when capital becomes more expensive and/or harder to find for weaker institutions). This may push banks to cut back loans, especially those to the riskiest counterparties, including corporates. Such concerns about the pro-cyclical nature of risk-based capital ratios are amplified by the introduction of internal rating models. Compared to external ratings, the latter are more risk-sensitive and react more quickly to adverse macroeconomic developments. Accordingly, banks adopting the IRB approach may prove more inclined to reduce corporate loans in bad times. Secondly, we turn to public sector exposures to see whether a shift from corporates to governments (Berger and Udell, 1994) has occurred in Europe during the euro debt crisis, leading to a slowdown in corporate lending (Altavilla et al., 2015)

We analyse the role played by risk-based capital requirements on corporate lending by looking at the nexus between internal rating models and the change experienced by corporate loans in 2008-2014. We also look at corporate exposures as a share of the bank's total credit portfolio (including banks, governments, specialised lending and retail borrowers), to explore whether a shift from risky corporate loans to "safe" government bonds has occurred. In addressing this issue, we account for alternative motivations (e.g. the moral suasion and the risk-

[6] Vallascas and Hagendorff (2013), using an international sample of large banks between 2000 and 2010, find that risk-weighted assets are ill-calibrated to a market measure of bank portfolio risk (i.e., bank asset volatility). Mariathasan and Merrouche (2014) examine the relationship between banks' approval for the internal ratings-based (IRB) approaches of Basel II and the ratio of risk weighted over total assets on an international sample of large banks. They find that risk-weight density decreases once internal models gain regulatory approval and conclude that part of this decline results from banks' strategic risk-modelling.

[7] Under the "fundamental IRB" approach, banks are free to estimate the obligors' PDs (probabilities of default) while other risk parameters are set by regulators, on the basis of a set of standard rules; under the "advanced IRB" approach, banks are allowed to estimate internally the PDs, LGDs ("loss given default", that is, the share of a loan that will not be paid back in the event of a default) and EADs ("exposure at default", e.g., the amount for which a credit line will be drawn when default occurs)

[8] The term "capital crunch" was coined to characterize the simultaneous shortage of capital and the contraction in the supply of new loans that affected banks in New England during the early 1990s recession in the US (Bernanke and Lown 1991; Peek and Rosengren, 1995).

shifting hypotheses) that might have caused an increase of resources allocated to government bonds in countries more exposed to sovereign risk during the euro sovereign crisis (Becker and Ivashina, 2016; Altavilla et al., 2015; Acharya et al., 2016).

We document several meaningful results.

We find that risk weights are affected by bank size, business models and asset mix. Precisely, higher risk weights are associated with smaller banks, engaging in the traditional deposits and loans business and showing a larger share of corporate loans. As expected, we also find that the adoption of internal ratings-based approaches is an important driver of bank risk-weighted assets. Lower risk weights appear to be positively linked to the banks' capital cushion, consistent with the hypothesis that banks reaping larger benefits from risk-weight optimization must maintain a higher capital buffer over regulatory minima. Finally, national segmentations explain a significant (albeit decreasing) share of the variability in risk weights.

We also uncover a negative impact of internal ratings on corporate exposures: namely, banks using IRB approaches more extensively appear to have reduced more (or increased less) their corporate loan portfolio during 2008-2014 (both in absolute terms and as a share of total credit exposures). Such effect proves slightly stronger for banks located in GIIPS countries[9] during the 2010-12 sovereign crisis. However, it does not apparently lead to a reallocation from corporate loans to government exposures, possibly because the latter are mostly associated with zero risk weights under the standardized approach (hence, the use of internal ratings cannot provide any further incentive to allocate more credit to the public sector). In fact, other motives than the use of internal ratings seem to prevail in explaining the banks' shift towards government bonds during the Eurozone crisis, including the so-called "financial repression" channel.

Our paper's contributions are several-fold. First, we contribute to the debate on determinants of risk-weighted assets (Vallascas and Hagendorff, 2013; Mariathasan and Merrouche, 2014) and expand a recent strand of literature on inconsistencies of internal ratings across banks (Behn et al., 2014; Plosser and Santos, 2014).

Second, we complement the literature on the nexus between risk based capital regulation and lending (Berger and Udell, 1994; Brinkmann and Horvitz, 1995, and, more recently, Bridges et al., 2014). We in particular complement a more closely related work by Behn et al. (2015) who uncover that a credit risk shock induce banks under IRM to reduce corporate lending by more than banks under the standardized approach with fixed risk weights.[10]

More generally, we add to the vast literature on bank lending channel. In covering years of severe distress, we in provide new evidence on the effect of crisis on credit supply (Albertazzi and Marchetti, 2010; Jimenez et al., 2014; Gambacorta and Ibanez, 2010; Bonaccorsi and Sette, 2012). By looking at corporate loans, we contribute to the literature on the real effects of financial crisis (Dell'Ariccia et al., 2008). By focusing on the impact of the euro sovereign crisis, we expand the contributions on effects and determinants of European banks' sovereign exposure (Popov and van Horen, 2013; Acharya et al., 2016; Becker and Ivashina, 2016). Interestingly, we do not find that a greater reliance on internal rating models has led to higher exposure to sovereigns, during the euro debt crisis, as suspected by, among others, Altavilla et al. (2015) and ESRB (2015).

Our paper carries several policy implications. First, as a significant share of risk-weight heterogeneity is still explained by national segmentations (as is IRB usage, which in turn drives a bank's average risk weight), supervisory efforts should continue, to ensure that the validation and calibration of internal models is carried out homogeneously across EU jurisdictions. Second, further attention should be paid to ensure that internal ratings are not too volatile, and do not generate PDs, and capital absorptions, that fluctuate widely with the economic cycle. Third, it should be borne in mind that, to some extent, the negative impact of internal ratings on loan supply is a

[9] Greece, Italy, Ireland, Portugal, and Spain.

[10] Focusing on German firm-bank relationships, they find that after the collapse of Lehman Brothers for a given firm loans by banks are reduced more when IRB ratings instead of fixed risk weights are used to determine capital charges.

sign that they have proved effective in capturing an increase in credit risk which actually took place. Accordingly, they are not to be dismantled or disempowered by hastily imposing exogenous risk floors.

The structure of this work is as follows. Section 2 describes the sample and sources of data. Section 3 discusses the determinants of a bank's average risk weight, focusing on the role played by internal ratings and national segmentations. Section 4 looks at the nexus between internal rating models and the way banks have changed credit exposures during the Eurozone crisis. Section 5 concludes.

2. Sample and data sources

We look at the 50 largest European banking groups (by total assets)[12] over the 2008-2014 period.[13] We use both financial statements and additional information taken from Pillar 3 reports. The latter include the incidence of different credit exposures (corporate, retail, banks, public sector entities) on each bank's capital requirements, as well as the approach used to measure credit risk (standardized or internal ratings-based). The banks in our sample are located in 17 countries (see Table 1); 48 are listed[14] and 49 adopt IFRS.[15]

[Insert Table 1 about here]

Accounting data are from Bureau van Dijk's Bankscope, capital market indicators come from Bloomberg, while Pillar 3 Reports were downloaded from individual bank websites. It is worth noting that, while Pillar 3 reports are compulsory for most banks, their content is not standardized and they are not based on a common reporting template; hence, individual data items provided by different banks had to be validated and reconciled by hand against a common data scheme. Table 2 reports sample statistics for the variables used in our analyses (a full description of each variable will be provided in Sections 3 and 4; a quick reference is available in the Appendix).

[Insert Table 2 about here]

3. Determinants of RWA

3.1. Key dependent variables and empirical strategy

Based on the sample outlined in Section 2, we will now look at the drivers behind a bank's average risk weight. In doing so, we will look at two different variables (see Appendix A.2 for formal definitions): *RWA_TA* (risk-weighted assets on total assets) and *RWA_EAD* (risk weighted assets for credit risk on exposure at default). The former has a very intuitive interpretation (as the bank's "average" risk weight); nevertheless it does not account for the fact that capital requirements (hence, risk-weighted assets) may also follow from risk exposures that are not captured by a bank's total assets (e.g., operational risk, as well as credit risk originating from off-balance sheet items). The latter only focuses on capital requirements against credit risk; the denominator includes on-balance sheet exposures as well as an estimate (based on regulatory parameters) of credit exposures originated by off-

[12] Some institutions, for which Pillar 3 data were not directly available, were excluded. The list of the banks in the sample is available in Appendix A.1.
[13] In fact, as some of the empirical analyses are referred to the growth rate or the change of variables compared to one year before, in these cases the observations span from 2009 to 2014.
[14] The two unlisted banks are DZ Bank AG and Rabobank.
[15] Credit Suisse Group AG adopts the US GAAP standards.

balance sheet items. As both ratios ideally are constrained between 0 to 100%, their odds ratios (*RWA_TA_OR*, *RWA_EAD_OR*) will be used in regressions, to ensure that they range from minus to plus infinity.

Our empirical strategy is the following. After looking at some univariate evidence, we will test for the main determinants of a bank's average risk weight by means of a multivariate model. Among such determinants, two will be further explored in the last part of this Section: national segmentations and IRB adoption.

3.2 Stylized facts and descriptive statistics

Figure 1 shows the change experienced in 2008-2012 by risk weight densities in countries having at least 3 banks in our sample. The reported riskiness of bank assets has decreased over time, notwithstanding the negative trend experienced by the real economy and financial markets. While some banks may have shifted their asset mix towards safer investments, it looks unlikely that all European institutions have simultaneously de-risked their balance sheets.

[Insert Figure 1 about here]

In order to explore the relationship between RWA densities and bank characteristics, we look at pairwise correlations on a univariate basis (see Table 3). *RWA_TA* and *RWA_EAD* are significantly correlated with most variables proxying for the banks' business models, risk measurement approaches, market-perceived risk and capital levels.

[Insert Table 3 about here]

Namely institutions with larger risk weights tend to be smaller (see Panel I), more focused on the traditional loans-and-deposits business, more exposed to retail and, to some extent, corporate portfolios (as opposed to financial institutions and the public sector). Lower risk weights involve a more extensive usage of IRB models, especially advanced ones (Panel II). This was expected, since Basel II allows banks to use IRB on a voluntary basis (subject to supervisory approval); accordingly, only institutions that foresee significant capital savings are willing to invest extensively on internal models.

Risk weights correlate significantly (albeit not perfectly – see Panel III) with most market-based risk measures, namely CDS spreads, Asset Volatility, WACC and Z-scores.[16] Additionally, banks having higher risk weights show a more significant level of ex-post credit risk, as measured by the impaired loans to total loans ratio.[17] Finally, risk-weights correlate inversely with risk-weighted capital. Banks reducing RWA density to relatively low levels are apparently required (by supervisors, investors or both) to hold a larger cushion of excess capital. A possible explanation is that institutions can obtain supervisory/market approval for more "aggressive" risk weights only by holding a larger capital buffer above the regulatory minimum. This may mean that banks (and, again, supervisors

[16] This marks a change relative to previous empirical tests (Vallascas and Hagendorff, 2013), where no significant link had emerged. However, our sample encompasses a long period of financial distress (including the subprime meltdown and the Eurozone crisis) that triggered considerable variance across banks and over time. This may make it easier for different risk indicators to convey similar signals.

[17] Unsurprisingly, no correlation emerges between risk weights and stock volatility. In fact, the latter may reflect a higher asset volatility (in which case, risk weights should increase), but also a higher leverage (which should be accompanied by lower risk weights). The link between stock volatility and risk weight is therefore ambiguous.

and investors) are bound by some sort of un-weighted capital ratio, where the product between the risk-weighted Tier 1 ratio and the average risk weight cannot deviate too much from some "optimal" target level.[18]

3.3 The determinants of a bank's average risk weight

We first look at the drivers of a bank's average risk weight by estimating the following OLS regression:

$$y_{it} = \alpha + \beta_1 \cdot Size_{it} + \beta_2 \cdot \text{Business model}_{i,t} + \beta_3 \cdot \text{IRB adoption}_{it} + \beta_4 \cdot \text{Cycle}_{it} + \\ + \beta_5 \cdot \text{Regulatory capital}_{it} + \boldsymbol{\varphi} \cdot \mathbf{Country}_i + \boldsymbol{\delta} \cdot \mathbf{Year}_t + \varepsilon_{it} \quad (1)$$

where:[19]

- y_{it} is, alternatively, *RWATA_OR* and *RWAEAD_OR*;
- *Size* is the natural log of total assets (in millions of Euros);[20]
- Business model includes three variables: *Deposits* (the deposits to total assets ratio), *Loans* (the loans to total assets ratio) and *Corporate Weight* (the ratio of corporate loans to total customer loans);[21]
- IRB adoption stands for variables indicating the share of a bank's loan portfolio that is covered by internal ratings. Our main variable here is *Heavy IRB User*, a dummy equal to one when the share of retail and corporate exposures under IRB approach in higher than 50%;
- Cycle stands for variables capturing the economic cycle. We use *GDP Growth*, the real GDP growth rate of the country where the bank is incorporated. We anticipate that the economic cycle may affect banks differently, depending on whether they use internal models for a significant portion of their loan portfolio. If this is the case, then a macroeconomic slowdown can be expected to worsen the obligors' internal ratings, leading to higher RWAs.[22] Conversely, RWAs under the standardized approach will react only partially (and slowly) to increased macroeconomic risks, as most bank exposures are unrated and command a flat weight, while external ratings are measured on a discrete scale and may stay unchanged in the short term. Accordingly, a "safe haven" effect may prevail, as banks cut on customer loans and shift to Treasury and interbank exposures, both commanding lower risk weights. To capture this asymmetry between heavy IRB users and banks relying on standardized models, we interact *GDP Growth* with *Heavy IRB User*;
- Regulatory capital is measured through *Tier 1 Ratio*, the ratio of the Tier 1 to risk-weighted assets; we focus on Tier 1 capital only since lower quality capital (Tier 2) has been perceived as hardly significant by investors and supervisors since the 2007-2009 bank crisis;
- Country and Year are two sets of dummy variables. They are equal to one if a bank has its headquarters in a given country (we only consider countries with at least three banks in our sample) and its data were observed in a given year (2008 is left out to avoid perfect multicollinearity). This allows for the general

[18] This, however, does not rule out the risk that, due to significant RWA manipulation, "banks with higher capital buffer […] may be undercapitalized in spite of holding capital above the minimum requirements" (Vallascas and Hagendorff, 2013), consistent with the theoretical underpinnings provided in Allen et al. (2011).
[19] Appendix A.2 provides a full list of the variables used throughout this paper, each one with a short description.
[20] To obtain comparable values, we convert banks' total assets into euros.
[21] Further covariates were tested (including return on assets and the share of non-interest income over total gross operating income) without improving the significance of the model.
[22] Furthermore, as the PDs associated with individual rating grades are calibrated on the empirical default rates experienced by the bank, the peak in default rates due to less favorable macroeconomic conditions will trigger an increase in the PDs associated with all rating grades. Accordingly, even if a borrower's rating stays unchanged, its risk-weight will increase, due to the rise in the related PD.

economic environment for a given time period, as well as for any country-specific features (e.g. institutional, regulatory or related to accounting) that may affect the RWA densities.

The results are shown in Table 4 for *RWATA_OR* (Columns 1-3) and *RWAEAD_OR* (Columns 4-6); standard error estimates are made heteroskedasticity-consistent by clustering errors at bank level.[23] In Columns 2 and 5 we test country dummies; Columns 3 and 6 also include year dummies.

[Insert Table 4 about here]

Estimation results corroborate our preliminary findings. As far as *RWATA_OR* is concerned (Column 1), banks showing higher risk weights are smaller (the coefficient of *Size* is negative and significant) and more involved in the traditional businesses, as shown by the coefficients of *Deposits* and *Loans*. The positive sign attached to *Corporate* suggests that *RWATA_OR* correlates directly to a bank's exposure to corporate portfolios. Consistent with the incentives deployed by Basel II, banks showing lower risk weights are heavy users of IRB models, as shown by the negative coefficient for *Heavy IRB User*. Furthermore, banks with lower risk weights are found to hold a larger capital buffer, as indicated by *Tier1*. As concerns *GDP Growth*, estimates confirm our expectations: a downturn leads to lower risk weights (due to the "safe haven" effect), but banks using IRB also experience an increase in RWA density (due to rating downgrades, as well as to the effect of higher default rates on their estimated PDs). A condition number of 4.3 suggests that multicollinearity is not a cause for concern.

Moving to *RWAEAD_OR* (Column 4), most results are confirmed, although *Size* loses statistical significance. This suggests that large banks may enjoy significant benefits, in terms of lower risk weights, through the internal models they use for market and operational risk.

Our results stay virtually unchanged when country variables enter the model (see Columns 2 and 5). Although only some country effects are significantly different from zero, a joint likelihood ratio test for all dummies shows that they cannot be considered redundant with a 95% (or even 99%) confidence level. The fact that national segmentations affect risk weights raises doubts on the consistency of RWA-validation methodologies across different jurisdictions and will further investigated below. Finally, year dummies are not significant at 95%.

3.4 Focus on national segmentations

To further investigate the role of national segmentations in explaining the variability observed for bank risk weights, we turn to a different class of models, known as hierarchical (or multi-level) models. Such models exploit the fact that our observations are repeated measures over time that can be grouped by banks, in turn nested into countries. Accordingly, one can fit a two-level model (where the intercept and one or more slopes differ across countries, with the difference being captured parsimoniously through random effects) as well as a three-level model (where the intercept and one or more slopes differ first across countries, then across banks). Figure 2 provides an intuitive representation of this class of models; a formal discussion can be found in (Raudenbush and Bryk, 1992).

[Insert Figure 2 about here]

[23] Clustering by country would leave our results virtually unchanged.

We first experiment with two-level models and test whether the explanatory variables in equation (1) should be associated with different slopes across countries. To ensure that results are stable and do not converge on local optima, we test one variable at a time, by means of a likelihood ratio. The outcome of the test (see Table 5, based on *RWA_TA_OR*[24]) strongly supports the hypothesis that the effect associated with the main determinants of bank risk weights differs across countries, suggesting some degree of national segmentation in the way a bank's size, business mix and internal models' usage drive capital requirements.

[Insert Table 5 about here]

We then estimate a three-level model where both banks and countries are used. Unlike in Table 4, we remove fixed effects on years and fit a slope on time instead ("*TIME*"), to capture each bank's "learning curve" in reducing risk-weights over time. This allows us to compute how much variance is explained by bank-specific differences, and how much relates to national segmentation, and to see how this decomposition evolves over time. We report results for *RWA_TA_OR*, based on the following model:

$$\begin{aligned} RWA\_TA\_OR_{ijk} = {} & \beta_{0jk} + \beta_{1jk} \cdot TIME + \beta_2 \cdot Size_{ijk} + \beta_3 \cdot Deposits_{ijk} + \beta_4 \cdot Loans_{ijk} + \\ & + \beta_5 \cdot Corporate\ Weight_{ijk} + \beta_6 \cdot Heavy\ IRB\ User_{ijk} + \\ & + \beta_7 \cdot Tier1_{ijk} + \varepsilon_{ijk} \end{aligned} \tag{2}$$

where *i* denotes observations, *j* denotes banks and *k* denotes countries, and where

$$\beta_{0jk} = \beta_{0jk} + \varepsilon_{0jk}$$

$$\beta_{1jk} = \beta_{1jk} + \varepsilon_{1jk}$$

and

$$\beta_{00k} = \gamma_{000} + \upsilon_{00k}$$

$$\beta_{10k} = \gamma_{10k} + \upsilon_{10k}$$

The results (Table 6) confirm most of the findings in Table 4, with risk weights decreasing for large, highly-capitalized banks where internal ratings are extensively used, and increasing for "plain vanilla" banks specializing in traditional loans and deposits. Furthermore, the coefficient associated with time is negative, indicating that banks have managed to achieve lower risk-weights over time by "fine-tuning" their internal rating models in order to maximize the benefits in terms of reduced capital requirements. The three-level model proves statistically significant compared to the corresponding two-level model (as shown by the LR test), meaning that segmentations exist, all other things being equal, both across countries and across banks.

[Insert Table 6 about here]

Using the estimates from Table 6, the variance in risk-weights across observations can be split into three components: variance across countries, variance across banks (within countries) and pure idiosyncratic noise (Goldstein et al., 2002). The results ("variance partition coefficients") are shown in Figure 3: one can see that the

[24] Results for *RWA_EAD_OR* are similar.

share of variance that can be attributed to national segmentations (which used to be above 50% at the beginning of our sample period) have been decreasing over time. This can be seen as a sign that the European supervisors' efforts to reduce national segmentations have, to some extent, proven successful.

[Insert Figure 3 about here]

3.5 Focus on IRB usage

IRB adoption (captured through *IRB Exposure Weight*) plays a significant role in the results shown in Table 4. We therefore look at its drivers over time and across banks by estimating the following OLS regression (again, with standard errors clustered at bank level):

$$\text{IRB share}_{it} = \alpha + \beta_1 \cdot Size_{it} + \beta_2 \cdot \text{Business model}_{it} + \beta_3 \cdot \text{Regulatory capital}_{it} + \boldsymbol{\varphi} \cdot \mathbf{Country}_i + \\ + \boldsymbol{\delta} \cdot \mathbf{Year}_t + \eta \cdot \text{Supervisory capture}_{it} + \varepsilon_{it} \quad (3)$$

where:

- IRB share is *IRB_E_W_OR*, the odds ratio of *IRB Exposure Weight*,[25] the share of total loans covered by internal ratings;
- *Size*, Business model, Regulatory capital, Country and Year retain the same meaning as in Equation (1);[26]
- Supervisory capture includes two variables, measured at national level, indicating the banking industry's lobbying power *vis à vis* the banks supervisor. *Bank GDP* (the ratio of bank total assets to GDP) indicates the banking system's importance for the national economy; *Bank Conc* is a measure of bank concentration (the market share of the country's top 3 banks in terms of total assets).[27]

Model 1 in Table 7 shows that internal models are used more extensively by large banks with less deposits, a higher share of retail loans and a larger capital cushion. Country dummies in Model 2 prove jointly significant, showing that national segmentations also affect the share of the loan portfolio covered by internal rating models.[28] In Model 3 we test whether IRB adoption responds to some structural characteristics of the national banking systems, leading to stronger supervisory capture. We find that the share of bank loans covered by internal ratings is significantly higher in countries where the banking sector is larger (compared to GDP) and more concentrated, so that lenders have more lobbying power *vis à vis* national supervisors. When *Bank GDP* and *Bank Conc* enter the model, the joint significance of country dummies drops below 90%; when the latter are removed (Model 4), the model's explanatory power remains virtually unchanged.

[Insert Table 7 about here]

[25] To prevent *IRB_E_W_OR* from reaching minus infinity, a 5% floor is imposed on *IRB Exposure Weight*. Since the latter never reaches one, no cap is required.

[26] Business model now also includes an additional variable, *Retail Weight*, indicating the share of total credit exposures allocated to retail loans. Unlike for other portfolios, risk weights for retail loans can only be computed either under the standardized approach (in which case, only two weights apply, for residential mortgages and for other retail exposures) or under the "advanced" internal-ratings approach (whereby a bank is in full control of all risk parameters, including probabilities of default, loss rates and credit conversion factors for unused credit lines). Accordingly, banks having a large share of retail loans may have a stronger incentive to migrate to IRB approaches.

[27] The values for *Bank GDP* and *Bank Conc* are taken from the EBA Aggregate statistical data (available at http://www.eba.europa.eu/) and the World Bank Financial Development and Structure Dataset, revised on November 2013 (available at http://go.worldbank.org/X23UD9QUX0), respectively. As a few values are not available, they are replaced with the closest year.

[28] Year dummies are omitted from Table 4, as they are never statistically significant at 90% or more.

4. Impact on bank lending

The period covered in our analysis, 2008-2014, is among the most turbulent ones in recent banking history. The overall equity market capitalization of the 46 banks in our sample that were listed throughout the whole period dropped from € 1,738,495 billion in 2008 to € 1,192,996 billion in 2014. Total assets for the same banks remained roughly unchanged, from € 10,117 billion to € 10,101 billion.

The bank lending channel in Europe was severely hit by the 2010-12 sovereign crisis. According to Acharya et al. (2016), the crisis may have negatively affected bank loans in three different ways: (*i*) the "balance sheet channel", (*ii*) the "risk-shifting", and (*iii*) the "financial repression". According to the first one, the increase in the risk of GIIPS sovereign debt translated into losses for banks (above all for those based in GIIPS countries), which were then required to deleverage, and thus might have reduced lending to the private sector. The risk-shifting motive states that GIIPS banks might have an incentive to increase their domestic sovereign debt holdings because of the relatively high return offered by these bonds (in the good state of the world), thus crowding-out lending to the private sector.[30] According to the financial repression (or moral suasion) hypothesis, GIIPS governments may have pressured domestic banks to increase their domestic sovereign bond holdings, as they found it difficult to refinance their debt (Becker and Ivashina, 2014; Altavilla et al., 2015; Broner et al., 2014 and Acharya and Steffen, 2015). Becker and Ivashina (2016) notice that between 2007 and 2013, the share of government debt held by the domestic banking sectors of Eurozone countries more than doubled; according to Chari et al. (2015) this was due to Eurozone peripheral governments responding to the drop in demand by foreign investors.

While we do not aim at disentangling those three channels, we start by testing whether the lending policy of the lenders in our sample (above all, of GIIPS banks during the sovereign crisis) was somehow affected by any of these mechanisms. We look both at the corporate portfolio (i.e., credit exposures towards non-financial companies other than SMEs) and at the sovereign portfolio (i.e., credit exposures towards governments and other public sector entities).

We consider two different measures: (*i*) Δ*Volume*: the growth rate of a given portfolio compared to one year before (e.g. 10% if the portfolio increases from 200 to 220 billion) and (*ii*) Δ*Weight*: the change in the share of the banks' total credit exposures that is absorbed by a given portfolio (e.g. 5% if the portfolio accounts for 35% of a bank's total credit exposures, versus 30% one year before).

In order to cast a first glance onto possible effects of the sovereign crisis in GIIPS countries, we analyze in Figure 4 the behavior of banks domiciled in GIIPS countries ("GIIPS") and in all other countries ("No GIIPS"). In Panel A we look at the mean values of the yearly percent change in a bank's corporate (Δ*Corporate Volume*) and sovereign exposures (Δ*Sovereign Volume*); Panel B shows the evolution of the mean value of the relative weight of corporate (*Corporate Weight*) and sovereign exposures (*Sovereign Weigh*t) over the overall credit portfolio.

Panel A shows a consistent reduction of the corporate exposure and a correspondent increase in the sovereign exposure, with this difference being more pronounced for GIIPS countries. This is confirmed by Panel B, where the weight of corporate exposures looks almost steady over time in core European economies, whereas it clearly decreases for banks located in peripheral countries. Variations for the remaining portfolios (not reported, to save space) are less dramatic, with retail loans over time and loans to institutions showing a modest reduction.

[30] Precisely, Acharya et al. (2016) look at weakly-capitalized GIIPS banks to test the risk-shifting hypothesis. Risky domestic sovereign bond holdings offer relatively high return and at the same time has a very high correlation with the banks' portfolio. The latter is important since a proper "risk-shifting asset" generates large losses only when the bank is in default anyway (which is true for the domestic sovereign bond holdings of GIIPS banks as they often exceed their core capital). In addition, Eurozone regulators consider these bonds to be risk-free and have removed the concentration limits for sovereign debt exposures, which allows large bets without having to provide equity capital.

[Insert Figure 4 about here]

In Panel I of Table 8 we split our sample between GIIPS banks observed in 2010-2012 ("*GIIPS Sovereign Crisis*") and all remaining observations ("*No GIIPS Sovereign Crisis*") and perform *t*-tests for the equality of the means. The results confirm that the reduction in corporate exposures is significantly more pronounced for *GIIPS Sovereign Crisis*, where the increase in sovereign exposures proves materially higher. In Panel II we perform a similar empirical exercise by comparing banks with a share of retail and corporate exposures under IRB approach higher than 50% ("*Heavy IRB user*") and all the remaining observations ("*Low IRB user*"). Interestingly, heavy IRB users appear to be headquartered in countries enjoying better macroeconomic conditions (as the drop in GDP is lower).

[Insert Table 8 about here]

This simple analysis does not take into account any difference among the 17 national banking industries in our sample, nor any change in macroeconomic conditions over time. Also, it does not account for time-invariant, bank-specific differences (e.g., the business model, institutional set-up, area of activity, etc.). In order to address these issues, following Acharya et al (2016), we estimate a set of panel regressions.

We first use the following specification:

$$y_{it} = \alpha + \beta \cdot GIIPS\ Sovereign\ Crisis_{it} + \boldsymbol{\gamma} \cdot \mathbf{X}_{it\text{-}1} + \boldsymbol{\varphi} \cdot \mathbf{Firm}_i + \boldsymbol{\delta} \cdot \mathbf{Year}_t + \varepsilon_{it} \qquad (4)$$

where our dependent variables are, alternatively, the growth rates of corporate and sovereign exposures (Δ*Corporate Volume* and Δ*Sovereign Volume*), as well as the changes in the weight of corporate and sovereign exposures (Δ*Corporate Weight* and Δ*Sovereign Weight*).

GIIPS Sovereign Crisis, is an indicator denoting banks incorporated in a GIIPS country during the 2010-2012 sovereign crisis. As an alternative to it, and consistent with the "financial repression" channel mentioned above, we use a variable called Δ*Foreign Investors Weight*, that is, the change over the previous year in the share of total government debt held by foreign investors[31]. As the role of foreign investors decreases (signaling a reduced willingness to invest in a country's government debt), we expect governments to step up pressure on domestic banks to subscribe sovereign debt (at the expense of corporate loans). We expect Δ*Foreign Investors Weight* and *GIIPS Sovereign Crisis* to be negatively correlated, hence to have an opposite effect on the dependent variables. Indeed, as documented in Table 8, GIIPS countries in 2010-2012 experienced a negative value for Δ*Foreign Investors Weight*, unlike the other observations in our sample.

Next to *GIIPS Sovereign Crisis* and Δ*Foreign Investors Weight*, we include bank-level control variables (the vector X in Equation 4) to capture other determinants of banks' activities: the quality of the bank assets (*Impaired Loans*), size (*Size*), and regulatory capital (*Tier 1 Ratio*). Moreover, we consider several control variables to capture any confounding factors. We include bank fixed effects to account for unobserved time-invariant bank heterogeneity and year fixed effects to control for systematic shocks that affect all banks in a given year.

Table 9 reports the estimates of Equation (4), with Δ*Corporate Volume* (Columns 1 and 2), Δ*Sovereign Volume* (3 and 4), Δ*Corporate Weight* (5 and 6), and Δ*Sovereign Weight* (7 and 8) as dependent variables. For each of

[31] We derive this variable from the sovereign investor base estimates by Arslanalp and Tsuda (2012 and 2014). Namely, we compute the share of total government debt held by foreign investors (*Foreign Investors Weight*) as sum of the share of total government debt held by foreign official sector, foreign banks and foreign non-banks.

these measures we run two regressions, using either *GIIPS Sovereign Crisis* (Columns 1, 3, 5, and 7) or Δ*Foreign Investors Weight* variable (2, 4, 6, and 8) to capture the impact of the sovereign crisis and of the financial repression channel.

Our results document a negative effect of the sovereign crisis on corporate credit exposures Columns 1 and 5) for banks domiciled in GIIPS countries. The same occurs when one looks at the change in foreign ownership of government debt: as foreign investors sell (or stop rolling over) issued by Eurozone's peripheral countries, banks fill the gap and corporate exposures get crowded out (Column 2 and 6). Symmetrically, a stronger growth in sovereign exposures is found for banks in GIIPS countries during the sovereign crisis (Columns 3 and 7) – or in countries/years with a sharp reduction in foreign ownership of government debt (Columns 4 and 8).

Interestingly, banks located in GIIPS countries have experienced an extra 6,9% annual drop in corporate loans in 2010-2012, all other things being equal; the same banks, over the same period, have witnessed an additional growth of 16,6% per year in sovereign exposures. When one looks at the standardized coefficients, large banks stands out as those most active in cutting corporate loans (possibly because they had to carry out a stronger adjustment because of their systemic relevance), even though the share of the corporate portfolio over total exposures is virtually unaffected by size.

[Insert Table 9 about here]

We now come to the role of capital regulations based on internal ratings, and test whether the latter affect the size and the composition of the shift in credit exposures experienced by the banks in our sample. We therefore estimate the following equation:

$$y_{it} = \alpha + \beta_1 \cdot GIIPS\ Sovereign\ Crisis_{it} + \beta_2 \cdot IRB\ Exposure\ Weight_{it\text{-}1} + \boldsymbol{\gamma} \cdot \mathbf{X}_{it\text{-}1} + \boldsymbol{\varphi} \cdot \mathbf{Firm}_i + \\ + \boldsymbol{\delta} \cdot \mathbf{Year}_t + \varepsilon_{it} \qquad (5)$$

adding *IRB Exposure Weight* (the share of a bank's loan portfolio that is covered by internal ratings) to the previous specification.

Our results (Table 10) show a significant link between IRB models and the change in corporate exposures: while *GIIPS Sovereign Crisis* and Δ*Foreign Investors Weight* remain significant, *IRB Exposure Weight* (Columns 1-2 5-6) has negative coefficients, indicating that banks making extensive use of internal ratings are more inclined to decrease (or less willing to increase) corporate loans. This reflects the fact that internal ratings, unlike agency ratings and "flat" weights used under the standardized approach, deteriorate quickly in the event of a cyclical downturn. Accordingly, the amount of regulatory capital absorbed by the corporate portfolio may quickly increase, inducing banks to cut on it to restore capital adequacy. Looking at standardized coefficients, one can see that Size is a key driver of the drop in corporate exposures.

Consistent with the fact that most sovereign exposures do not absorb regulatory capital, we find no significant link between the use of the Internal Ratings-Based approach and the dynamics of sovereign exposures (specifications 3-4 and 7-8).

[Insert Table 10 about here]

Finally, in order to check if the link between IRB usage and corporate loans[32] intensifies when banks face a sovereign debt crisis, we estimate an additional specification, similar to Equation (5), where we also interact *GIIPS Sovereign Crisis* and *IRB Exposure Weight*. The results are shown in Table 11 (Columns 1 and 2) and indicate that IRB models prove slightly more detrimental to loan growth for GIIPS banks during 2010-2012. In the remaining two columns (3-4) GIIPS Sovereign Crisis is replaced by an indicator variable capturing the sign of Δ*Foreign Investors Weight* (where Δ*Foreign Investors Weight*<0 denotes financial repression). Albeit in most cases the coefficients for *IRB Exposure Weight* and *Heavy IRB User* are more negative when Δ*Foreign Investors Weight* is less than zero, a test for the equality of coefficients shows that they are not statistically different from each other.

[Insert Table 11 about here]

5. Conclusions

Motivated by the debate on the determinants of the recent credit crunch in Europe, we study the impact of capital regulations and risk weights on how banks allocated funds during 2008-2014. We address two main issues. Firstly, we analyse what drives the differences in average risk weights across European banks. Secondly, we explore the nexus between greater reliance on internal rating models, corporate lending and sovereign exposures. We aim at understanding whether banks, as suggested by the capital crunch literature, shifted funds from risky loans to "safe" government bonds in times of sovereign stress, and whether IRB usage made this shift more or less pronounced.

We find that risk weights are affected by bank size, business models and asset mix. Precisely, higher risk weights are associated with smaller banks engaging in the traditional deposits and loans business, and showing a larger share of corporate loans. As expected, we also find that the adoption of internal ratings-based approaches is an important driver of bank risk-weighted assets. Lower risk weights appear to be positively linked to the banks' capital cushion, consistent with the hypothesis that banks reaping larger benefits from risk-weight optimization must maintain a higher capital buffer over regulatory minima. Finally, national segmentations explain a significant (albeit decreasing) share of the variability in risk weights.

We also uncover a negative impact of internal ratings on corporate exposures: namely, banks using IRB approaches more extensively appear to have reduced more (or increased less) their corporate loan portfolio during 2008-2014 (both in absolute terms and as a share of total credit exposures). Such effect proves slightly stronger for banks located in GIIPS countries during the 2010-12 sovereign crisis. However, it does not apparently lead to a reallocation from corporate loans to government exposures, possibly because the latter are mostly associated with zero risk weights under the standardized approach (hence, the use of internal ratings cannot provide any further incentive to allocate more credit to the public sector). In fact, other motives than the use of internal ratings seem to prevail in explaining the banks' shift towards government bonds during the Eurozone crisis, including the so-called "financial repression" channel.

The negative impact of internal ratings onto corporate lending in 2008-2014 raises the issue of the pro-cyclicality of risk-based capital requirements and internal ratings (Basel Committee on Banking Supervision, 2011). By making banks more risk sensitive, internal ratings induce lenders to cut back their loans in bad times, the more so if they are headquartered in financially-stressed countries.

Our results point to a number of interesting policy implications.

First, as a significant share of risk-weight heterogeneity is still explained by national segmentations (as is IRB usage, which in turn drives a bank's average risk weight), supervisory efforts should continue, to ensure that the

[32] We skip this test in the case of sovereign exposures, as the latter have proved unaffected by IRB usage in Table 10.

validation and calibration of internal models is carried out homogeneously across EU jurisdictions. One should therefore welcome the efforts by the EBA and the Single Supervisory Mechanism to ensure that IRB models are scrutinized homogeneously across countries.

Second, further attention should be paid to ensure that internal ratings are not too volatile, and do not generate PDs, and capital absorptions, that fluctuate widely with the economic cycle. While this stream of work was part of the Basel Committee's and CEBS' original proposals after the financial crisis[33], it appears to have been dropped, to some extent, in favor of different approaches (where capital requirements adjust to the cycle through the so-called "capital conservation" and "countercyclical" buffers). Yet one may argue that, as capital buffers may prove hard to unwind in times of financial distress without triggering market panic, they can only be a partial solution to pro-cyclicality risks, and more work on reducing ratings' volatility is still called for.

Third, it should be borne in mind that, to some extent, the negative impact of internal ratings on loan supply is a sign that they have proved effective in capturing an actual increase in credit risk over 2008-2014. Accordingly, while internal ratings should be calibrated in order to avoid over-reliance and excessive swings in capital requirements over the cycle, they are not to be dismantled or disempowered by hastily imposing exogenous risk floors. European banks have invested heavily on the IRB approach, while their supervisors have developed a unique expertise in validating and monitoring internal rating systems: ways should be found to defend such investments by mending the internal models' weaknesses and restoring their credibility. The risk of not doing so is that Europe ends up lending more to the wrong enterprises, increasing liquidity until the next credit crisis, while leaving productivity growth lagging behind.

[33] See Basel Committee on Banking Supervision (2009), Committee of European Banking Supervisors (2009).

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Appendix

A.1 Banks in the sample:

Allied Irish Banks Plc
Alpha Bank AE
BNP Paribas
Banca Carige SpA
Banca Monte dei Paschi di Siena SpA-Gruppo Monte dei Paschi di Siena
Banca Popolare dell'Emilia Romagna
Banca Popolare di Milano SCaRL
Banco Bilbao Vizcaya Argentaria SA
Banco Comercial Português, SA-Millennium BCP
Banco Espirito Santo SA
Banco Popolare - Società Cooperativa-Banco Popolare
Banco Santander SA
Banco de Sabadell SA
Bank of Ireland-Governor and Company of the Bank of Ireland
Bankinter SA
Barclays Plc
Caixabank, S.A.
Commerzbank AG
Credit Suisse Group AG
Crédit Agricole S.A.
Crédit Industriel et Commercial - CIC
DZ Bank AG-Deutsche Zentral-Genossenschaftsbank
Danske Bank A/S
Deutsche Bank AG
Dexia
DnB ASA
Eurobank Ergasias SA
HSBC Holdings Plc
ING Groep NV
Intesa Sanpaolo
Jyske Bank A/S (Group)
KBC Groep NV/ KBC Groupe SA-KBC Group
Lloyds Banking Group Plc
National Bank of Greece SA
Natixis
Nordea Bank AB (publ)
OTP Bank Plc
Piraeus Bank SA
Pohjola Bank plc-Pohjola Pankki Oyj
Powszechna Kasa Oszczednosci Bank Polski SA - PKO BP SA
Rabobank Nederland-Rabobank Group
Royal Bank of Scotland Group Plc (The)
Skandinaviska Enskilda Banken AB
Société Générale
Standard Chartered Plc
Svenska Handelsbanken
Swedbank AB
UBS AG
UniCredit SpA
Unione di Banche Italiane Scpa-UBI Banca

A.2 Definition of Variables:

Dependent Variables:

- $RWA\_TA: \frac{Risk-Weighted\ Assets}{Total\ Assets}$
- $RWA\_EAD: \frac{Risk-Weighted\ Assets\ for\ Credit\ Risk}{Exposure\ at\ Default}$
- $\Delta Corporate\ Weight_t: \left(\frac{Corporate\ Exposure}{Overall\ Exposure}\right)_t - \left(\frac{Corporate\ Exposure}{Overall\ Exposure}\right)_{t-1}$
- $\Delta Sovereign\ Weight_t: \left(\frac{Sovereign\ Exposure}{Overall\ Exposure}\right)_t - \left(\frac{Sovereign\ Exposure}{Overall\ Exposure}\right)_{t-1}$
- $\Delta Corporate\ Volume_t: \ln(Corporate\ Exposure_t) - \ln(Corporate\ Exposure_{t-1})$
- $\Delta Sovereign\ Volume_t: \ln(Sovereign\ Exposure_t) - \ln(Sovereign\ Exposure_{t-1})$

Source: Banks' Pillar III reports

Key Explanatory Variables:

- $Standard\ Exposure\ Weight_t: \frac{Loans\ under\ Standardized\ Approach_t}{Total\ Loans_t}$
- $AIRB\ Exposure\ Weight_t: \frac{Loans\ under\ Advanced\ Internal\ Ratings\ Based\ Approach_t}{Total\ Loans_t}$
- $FIRB\ Exposure\ Weight_t: \frac{Loans\ under\ Fundamental\ Internal\ Ratings\ Based\ Approach_t}{Total\ Loans_t}$
- $IRB\ Exposure\ Weight_t: \frac{Loans\ under\ Internal\ Ratings\ Based\ Approach_t}{Total\ Loans_t}$
- *Heavy IRB User*$_t$: Dummy variable equal to one if the bank's ratio of retail and corporate exposures under Internal Ratings Based Approach to total retail and corporate exposures in year t is higher than 50%, zero otherwise
- $Corporate\ Weight_t: \left(\frac{Corporate\ Exposure}{Overall\ Exposure}\right)_t$
- $Retail\ Weight_t: \left(\frac{Retail\ Exposure}{Overall\ Exposure}\right)_t$
- $Institutions\ Weight_t: \left(\frac{Institutions\ Exposure}{Overall\ Exposure}\right)_t$
- $Sovereign\ Weight_t: \left(\frac{Sovereign\ Exposure}{Overall\ Exposure}\right)_t$
- $Tier1_t: \frac{Tier1\ Capital_t}{Risk\ Weighted\ Assets_t}$

Source: Banks' Pillar III reports

- $Impaired\ Loans_t$: $\frac{Impaired\ Loans_t}{Total\ Loans_t}$ (Source: Bankscope)
- $Size_t$: ln($Total\ Assets_t$) Source: Bankscope
- $Deposits_t$: $\frac{Customer\ Deposits_t}{Total\ Assets_t}$ (Source: Bankscope)
- $Loans_t$: $\frac{Total\ Loans_t}{Total\ Assets_t}$ (Source: Bankscope)
- ROA_t: *Return on Assets*$_t$ (winsorized) (Source: Bankscope)
- *Asset Volatility*$_t$: the volatility of the asset returns, that is, the daily changes in the fair value of assets over the following year (as the fair value of assets is unobservable, its volatility is derived from the price and volatility of equity, using an estimate of leverage taken from the bank's financial statement) (Sources: Bankscope and Bloomberg)
- *Equity Volatility*$_t$: the volatility of the equity returns, that is, the daily changes in the stock price over the following year (Source: Bloomberg)
- *CDS Spread*$_t$: the average CDS spread of the bank in year t (Source: Bloomberg)
- *Z Score*$_t$: yearly z-score computed as the average of the monthly stock returns on assets plus average market capital ratio divided by standard deviation of return on assets (Sources: Bankscope and Bloomberg)
- *WACC*$_t$: the weighted average cost of capital of the bank in year t (Source: Bloomberg)
- *Bank Conc*$_t$: *Share of Total Assets of the largest 3 banks* (Source: EBA Aggregate statistical data)
- $Bank\ GDP_t$: $\frac{Total\ Bank\ Assets_t}{GDP_t}$ (Source: World Bank Financial Development and Structure Dataset)
- *GIIPS Sovereign Crisis*: Dummy variable equal to one if the bank is domiciled in Greece, Ireland, Italy, Portugal or Spain, and the observation refers to the 2010-2012 years, zero otherwise
- *GDP Growth*$_t$: ln(GDP_t) – ln(GDP_{t-1}) (Source: World Bank)
- $\Delta Foreign\ Investors\ Weight_t$: $\left(\frac{Sovereign\ Debt\ Held\ by\ Foreigners}{Sovereign\ Debt}\right)_t - \left(\frac{Sovereign\ Debt\ Held\ by\ Foreigners}{Sovereign\ Debt}\right)_{t-1}$

(Source: Arslanalp and Tsuda, 2012, 2014)

Figures and Tables

Figure 1. Changes Experienced in 2008-2014 by RWA_TA (left panel) and RWA_EAD (right panel)

Results are reported only for countries having at least 3 banks in the sample

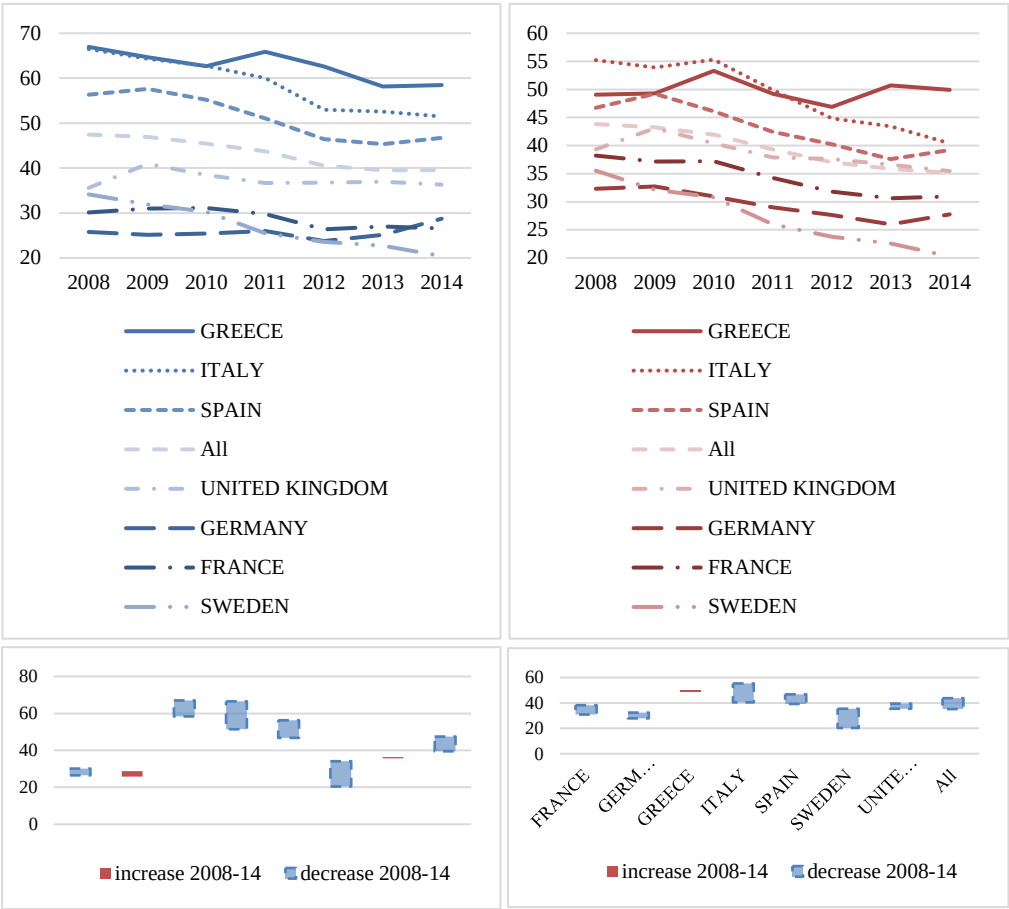


Figure 2. Representation of the Hierarchical Models

The figure shows the logic behind two-level hierarchical models (where data are clustered by bank) and three-level hierarchical models (where data are first clustered by bank, then by country). By way of example, but without loss of generality, the figure assumes that hierarchical estimates are associated with the intercept and the slope associated with the first explanatory variable.

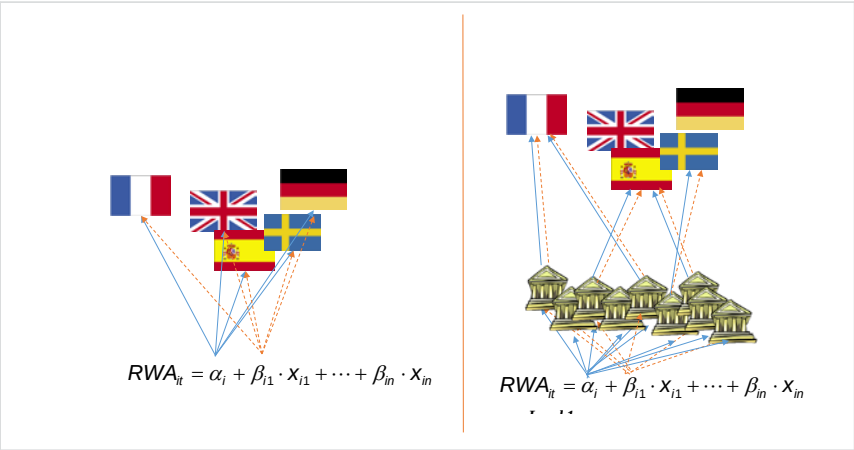


Figure 3. Decomposition of the Variance in Risk-Weights

The figure shows how variance can be decomposed across the three levels in model (2), countries, banks and pure idiosyncratic noise, for different years in our sample period. See Goldstein et al. (2002) for details.

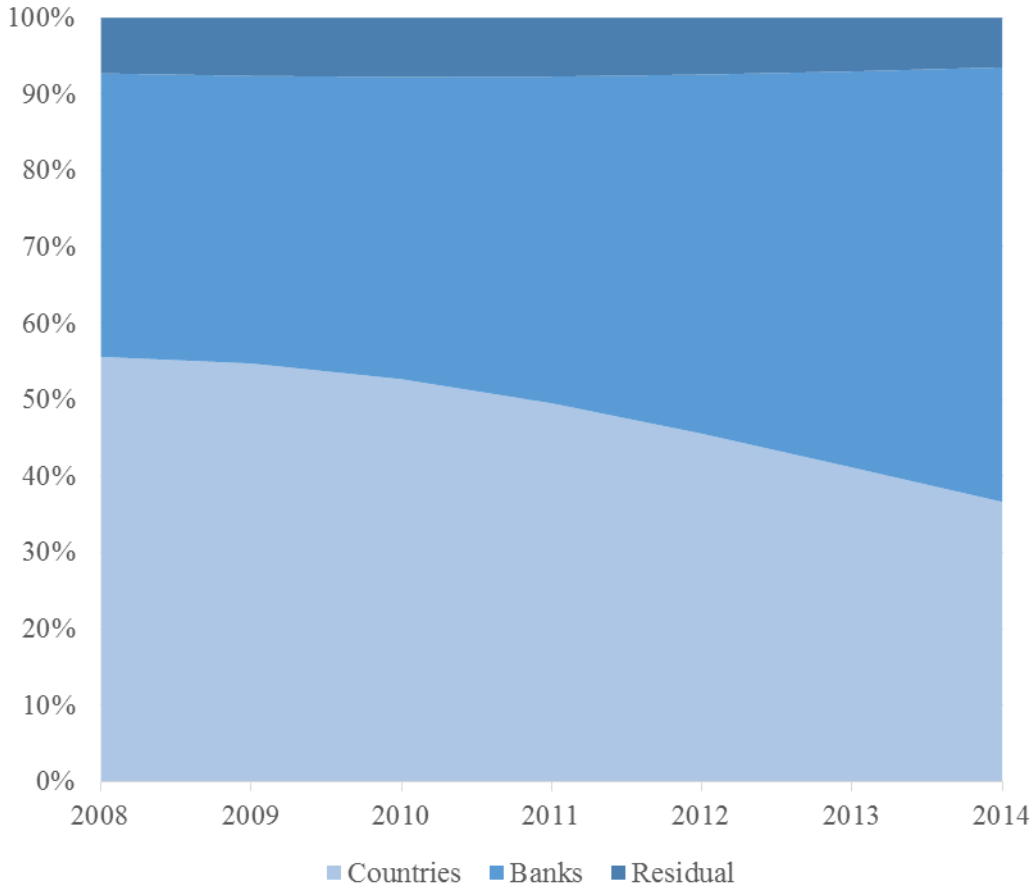
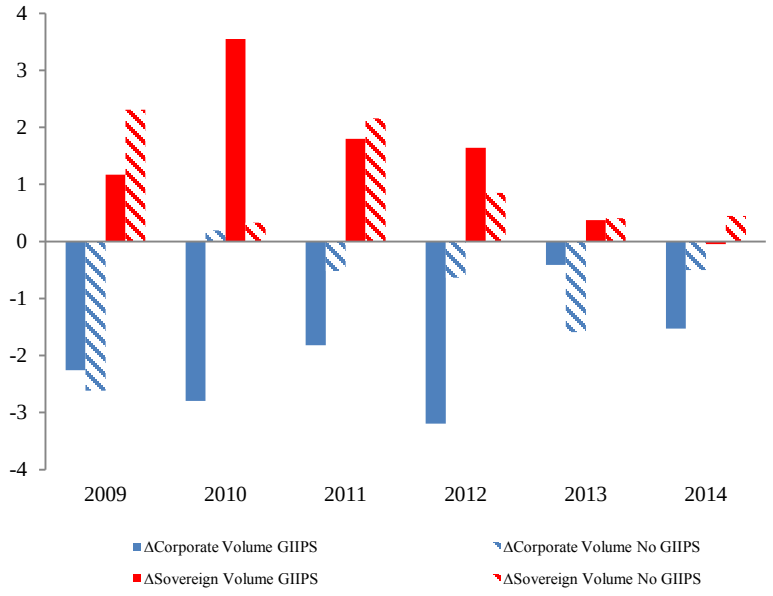


Figure 4. Evolution of Lending Volume in 2009-2014

This figure shows the mean values of the change in a bank's volume of corporate (ΔCorporate Volume) and sovereign exposure (ΔSovereign Volume) [Panel A] and the evolution of the mean value of a bank's weight of corporate (Corporate Weight) and sovereign exposure (Sovereign Weight), over the overall bank's credit exposure [Panel B] for the banks in our sample that are domiciled in GIIPS countries (GIIPS) or in all the other countries (No GIIPS).

Panel A: Δ*Volume*



Panel B: *Weight*

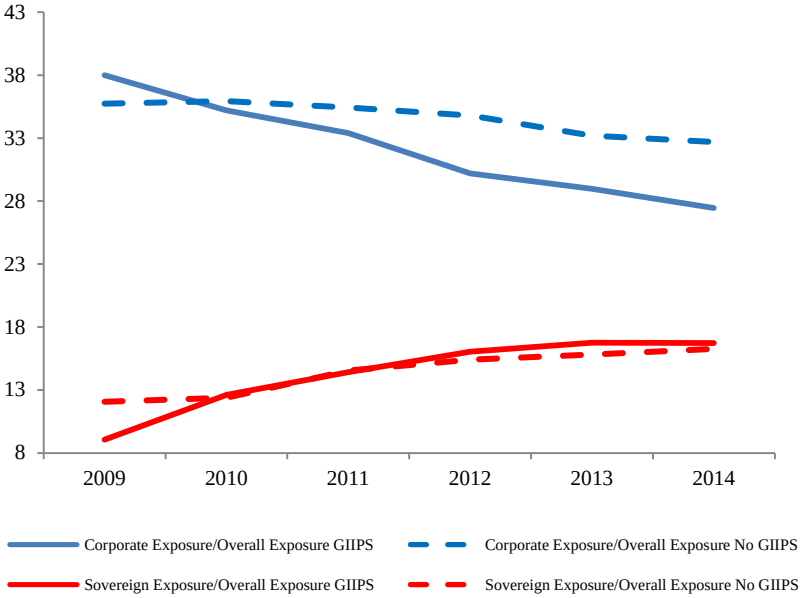


Table 1. Sample composition

Country	*Banks in the sample*
Belgium	2
Denmark	2
Finland	1
France	5
Germany	3
Greece	4
Hungary	1
Ireland	2
Italy	8
Netherlands	2
Norway	1
Poland	1
Portugal	2
Spain	5
Sweden	4
Switzerland	2
United Kingdom	5
Total	*50*

Table 2. Sample Descriptive Statistics

This table presents mean, standard deviation (in parentheses), minimum, and maximum of the variables. The number of observations is reported in brackets. Variables are defined in Appendix A.2.

Variable	Min	Mean	Max
RWA_TA [348]	13.972	43.309 (17.548)	82.866
RWA_EAD [348]	13.259	39.510 (12.279)	76.418
Δ*Corporate Weight* [286]	-19.462	-1.221 (4.084)	18.681
Δ*Sovereign Weight* [297]	-8.223	1.166 (3.196)	22.751
Δ*Corporate Volume* [286]	-0.870	-0.027 (0.174)	0.781
Δ*Sovereign Volume* [295]	-0.765	0.129 (0.332)	2.516
Standard Exposure Weight [348]	1.881	43.972 (30.109)	100
FIRB Exposure Weight [348]	0	9.346 (16.986)	91.962
AIRB Exposure Weight [348]	0	45.757 (30.548)	98.119
IRB Exposure Weight [348]	0	56.082 (30.052)	98.119
Corporate Weight [348]	3.243	34.436 (9.803)	54.903
Sovereign Weight [347]	0	13.583 (6.183)	33.627
Retail Weight [348]	0.000	30.549 (12.255)	60.587
Institutions Weight [347]	0.864	11.566 (9.348)	48.161
Tier1 [348]	-6.700	11.745 (3.640)	22.400
Impaired Loans [348]	0.362	7.176 (7.547)	44.863
Size [348]	10.310	12.539 (1.252)	14.738
Deposits [348]	3.97	50.08 (15.555)	94.66
Loans [348]	12.227	53.243 (17.217)	81.677
ROA [348]	-12.367	0.0568 (1.335)	4.429
Asset Volatility [333]	0.000	0.001 (0.002)	0.017
Equity Volatility [240]	1.046	3.426 (1.536)	10.344
CDS Spread [307]	28.719	256.550 (321.293)	1999.402
Z Score [286]	-1.514	2.506 (2.066)	12.416
WACC [240]	0.416	3.857 (2.061)	13.366
GDP Growth [348]	-8.539	-0.310 (2.687)	6.557
Foreign Investors Weight [348]	0.085	0.452 (0.171)	0.839
Δ*Foreign Investors Weight* [298]	-0.260	-0.002 (0.043)	0.132

Table 3: Pairwise correlations between risk-weighted asset densities and bank characteristics

This table reports the pairwise correlation coefficients between the risk-weighted asset densities measures (*RWA_TA* and *RWA_EAD*) and the business models and economic/supervisory environment variables (in Panel I); the risk models variables (in Panel II); and the control and risk variables (in Panel III). Variables are defined in Appendix A.2.

***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively, of a test for the linear relationship between the two variables in the population.

	RWA_TA	*RWA_EAD*
(Panel I) - Business models and economic/supervisory environment		
Size	-62.9%***	-50.4%***
Deposits	42.7%***	34.8%***
Loans	71.2%***	55.0%***
Retail Weight	22.0%***	15.6%***
Corporate Weight	0.4%	2.7%
Institutions Weight	-27.3%***	-24.9%***
Sovereign Weight	-17.3%***	-16.0%***
ROA	-6.9%	-3.0%
(Panel II) - Risk models		
Standard Exposure Weight	74.0%***	71.0%***
IRB Exposure Weight	-74.1%***	-71.0%***
FIRB Exposure Weight	-9.9%*	-11.9%**
AIRB Exposure Weight	-66.1%***	-61.6%***
(Panel III) - Capital and risk		
Tier1	-55.7%***	-57.7%***
Equity Volatility	1.6%	5.9%
CDS Spread	38.7%***	30.6%***
WACC	25.1%***	23.5%***
Impaired Loans	34.2%***	30.9%***
Asset Volatility	19.8%***	19.0%***
Z Score	-23.7%***	-30.1%***

Table 4. Risk-Weighted Assets Densities and Bank Characteristics

This table reports the coefficients and the standardized coefficients based on standard errors corrected for clustering at the bank level of OLS regressions. The dependent variables, *RWATA_OR* and *RWAEAD_OR*, are the logarithmic transformation ("odds ratio") of the risk weight densities, *RWA_TA* and *RWA_EAD*, respectively. The explanatory variables are: the Log of Total Assets (*Size*); the ratio of Total Deposits to Total Assets (*Deposits*); the ratio of Total Loans to Total Assets (*Loans*); the ratio of the Corporate Loans to Total Loans (Corporate Weight); the ratio of the Tier 1 to Risk-weighted Assets (*Tier1*); a dummy variable denoting banks with a ratio of retail and corporate exposures under Internal Ratings Based Approach to total retail and corporate exposures higher than 50% (*Heavy IRB User*); the real growth rate of the GDP of the country where a bank is incorporated (*GDP Growth*). France, Germany, Greece, Italy, Spain, Sweden and UK are country dummies (for all countries with at least 3 banks in our sample).
***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	(1)		(2)		(3)		(4)		(5)		(6)	
	RWATA_OR		*RWATA_OR*		*RWATA_OR*		*RWAEAD_OR*		*RWAEAD_OR*		*RWAEAD_OR*	
	Coef	*Std. Coef.*	*Coef*	*Std. Coef.*	*Coef*	*Std. Coef.*	*Coef*	*Std. Coef.*	*Coef*	*Std. Coef.*	*Coef*	*Std. Coef.*
Constant	0.597		0.482		0.438		0.170		0.230		0.280	
Size	-0.119**	-0.191	-0.139***	-0.222	-0.138***	-0.221	-0.131	-0.073	-0.060	-0.140	-0.066	-0.155
Deposits	0.012***	0.241	0.008***	0.176	0.009**	0.172	0.006***	0.184	0.004*	0.111	0.004*	0.124
Loans	0.016***	0.353	0.017***	0.384	0.017***	0.383	0.006**	0.196	0.009***	0.277	0.008***	0.261
Corporate Weight	0.008**	0.110	0.012***	0.155	0.013***	0.159	0.005	0.099	0.008**	0.147	0.007**	0.131
Tier1	-0.074***	-0.344	-0.054***	-0.251	-0.058***	-0.271	-0.060***	-0.412	-0.046***	-0.314	-0.043***	-0.295
Heavy IRB User	-0.350**	-0.182	-0.306*	-0.159	-0.303*	-0.158	-0.423***	-0.322	-0.438***	-0.333	-0.418***	-0.318
GDP Growth	0.024	0.085	0.037**	0.128	0.046**	0.160	0.037*	0.188	0.036**	0.180	0.039**	0.199
Heavy IRB User × GDP Growth	-0.044*	-0.124	-0.042**	-0.120	-0.044**	-0.124	-0.058**	-0.239	-0.049***	-0.205	-0.046***	-0.192
France			0.074	0.028	0.060	0.023			0.181	0.102	0.192	0.108
Germany			-0.137	-0.041	-0.151	-0.046			-0.040	-0.018	-0.039	-0.017
Greece			0.264	0.092	0.289	0.100			0.039	0.02	0.071	0.036
Italy			0.166	0.078	0.161	0.075			0.022	0.015	0.059	0.040
Spain			0.146	0.056	0.141	0.054			0.109	0.061	0.125	0.070
Sweden			-0.437***	-0.152	-0.439***	-0.152			-0.267**	-0.135	-0.271**	-0.137
UK			0.267*	0.103	0.264*	0.101			0.313**	0.176	0.313**	0.176
dummy year 2009					0.159	0.071					0.084	0.055
dummy year 2010					0.115*	0.051					0.084	0.055
dummy year 2011					0.074	0.033					-0.03	-0.019
dummy year 2012					0.097	0.043					-0.007	-0.004
dummy year 2013					0.074	0.033					-0.044	-0.028
dummy year 2014					0.097	0.043					-0.058	-0.038
Adj. R^2	0.784		0.820		0.822		0.647		0.690		0.698	
Joint *F*	53.95		51.66		70.18		23.65		18.91		19.77	
No. of Obs.	348		348		348		348		348		348	
Condition number	4.3		5.3		6.4		4.3		5.3		6.4	

Table 5. Two-level hierarchical models

Reported are LR tests for county-specific slopes in model (1), using a random effects model (with country-specific random effects on the intercept) as the null hypothesis. The explanatory variables are the Log of Total Assets (*Size*); the ratio of Total Deposits to Total Assets (*Deposits*); the ratio of Total Loans to Total Assets (*Loans*); the ratio of the Corporate Loans to Total Loans (*Corporate Weight)*; the ratio of the Tier 1 to Risk-weighted Assets (*Tier 1*); a dummy variable denoting banks with a ratio of retail and corporate exposures under Internal Ratings Based Approach to total retail and corporate exposures higher than 50% (*Heavy IRB User*); the real growth rate of the GDP of the country where a bank is incorporated (GDP Growth).

Variable for which different slopes across countries are tested	Log-likelihood	*LR* test compared with random effect model	*p*-value
None (random effect model)	-55.135		
Size	-44.495	21.280	0.000
Deposits	-32.861	44.548	0.000
Loans	-28.550	53.170	0.000
Corporate Weight	-39.149	31.972	0.000
Tier1	-51.117	8.036	0.005
Heavy IRB User	-52.830	4.610	0.099
GDP Growth	-55.122	0.026	0.986
Heavy IRB User × GDP Growth	-54.415	1.440	0.486

Table 6. Three-level hierarchical model

The table reports the coefficients and standard errors of a three-level hierarchical model (model (2)) where data are clustered by bank, then by country. The explanatory variables are the year when bank data are observed (Time), the Log of Total Assets (*Size*); the ratio of Total Deposits to Total Assets (*Deposits*); the ratio of Total Loans to Total Assets (*Loans*); the ratio of the Corporate Loans to Total Loans (*Corporate Weight*); the ratio of the Tier 1 to Risk-weighted Assets (*Tier 1*); a dummy variable denoting banks with a ratio of retail and corporate exposures under Internal Ratings Based Approach to total retail and corporate exposures higher than 50% (*Heavy IRB User*); the real growth rate of the GDP of the country where a bank is incorporated (GDP Growth). A likelihood ratio test is used to compare the model to a two-level model, where data are clustered by bank only.

	Coef	Std. Error	95% confidence interval	
Constant	0.646	0.545	-0.423	1.715
Time	-0.021	0.010	-0.094	-0.002
Size	-0.154	0.039	-0.231	-0.078
Deposits	0.006	0.002	0.003	0.009
Loans	0.022	0.002	0.017	0.026
Corporate Weight	0.003	0.002	-0.001	0.007
Tier1	-0.023	0.003	-0.030	-0.016
Heavy IRB User	-0.297	0.045	-0.385	-0.209
GDP Growth	0.141	0.006	0.003	0.025
Heavy IRB User × GDP Growth	-0.159	0.007	-0.029	-0.003
Random-effects parameters: banks				
Variance (Time)	0.002	0.001	0.001	0.004
Variance (Constant)	0.079	0.225	0.045	0.138
Covariance (Constant, Time)	-0.003	0.003	-0.009	0.003
Random-effects parameters: countries				
Variance (Time)	0.0002	0.0004	0.000	0.006
Variance (Constant)	0.106	0.054	0.039	0.291
Covariance (Constant, Time)	-0.002	0.004	-0.010	0.005
Variance (residual)	0.013	0.001	0.011	0.156
Log-likelihood for 3-level model	110.642			
Log-likelihood for 2-level model	105.103			
Likelihood ratio	11.080			
p-value	0.011			

Table 7. Internal Ratings Based Approach Usage and Bank Characteristics

This table reports the coefficients and the standardized coefficients based on standard errors corrected for clustering at the bank level of OLS regressions. The dependent variable, *IRB_E_W_OR*, is the logarithmic transformation ("odds ratio") of IRB Exposure Weight (the ratio of Loans under internal ratings-based models to Total Loans). The explanatory variables are: the Log of Total Assets (*Size*); the ratio of Total Deposits to Total Assets (*Deposits*); the ratio of Total Loans to Total Assets (*Loans*); the ratio of the Corporate Loans to Total Loans (Corporate Weight); the ratio of Retail Loans to Total Loans (*Retail Weight*); the ratio of the Tier 1 to Risk-Weighted Assets (*Tier1*); the market share of the three top banks by total assets in the country of incorporation of a given bank (*Bank Conc*); and the ratio of bank total assets to GDP in the country of incorporation of a given bank (*Bank GDP*). France, Germany, Greece, Italy, Spain, Sweden and UK are country dummies (for all countries with at least 3 banks in our sample).
***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	(1) *IRB_E_W_OR*		(2) *IRB_E_W_OR*		(3) *IRB_E_W_OR*		(4) *IRB_E_W_OR*	
	Coef	Std. Coef.	Coef	Std. Coef.	Coef	Std. Coef.	Coef	Std. Coef.
Constant	-7.397***		-6.645***		-10.220***		-11.044***	
Size	0.536***	0.394	0.601***	0.442	0.545***	0.401	0.583***	0.429
Deposits	-0.025**	-0.229	-0.025**	-0.227	-0.015	-0.135	-0.012	-0.114
Loans	-0.022*	-0.226	-0.017	-0.170	-0.009	-0.089	-0.013	-0.130
Corporate Weight	0.019*	0.110	0.019*	0.107	0.015	0.084	0.012	0.070
Retail Weight	0.034***	0.246	0.022	0.157	0.018	0.133	0.020	0.145
Tier1	0.141***	0.301	0.067**	0.144	0.070**	0.150	0.077***	0.166
France			-0.965*		0.154			
Germany			-1.111**		-0.477			
Greece			-1.142*		-0.688			
Italy			-1.641***		-0.666			
Spain			-0.438		0.069			
Sweden			-0.043		-0.335			
UK			-0.467		0.292			
Bank Conc					0.036***	0.278	0.036***	0.281
Bank GDP					0.130**	0.147	0.183***	0.207
Adj. R^2	0.583		0.674		0.700		0.678	
Joint *F*	14.550		16.593		17.848		16.334	
Condition number	3.2		4.0		6.3		3.4	
No. of Obs.	348		348		348		348	

Table 8. Preliminary Analysis of Lending Volume Changes

This table reports mean values of the change in a bank's volume of corporate (Δ*Corporate Volume*) and sovereign exposure (Δ*Sovereign Volume*), and the change in a bank's weight of corporate (Δ*Corporate Weight*), and sovereign exposure (Δ*Sovereign Weight*), over the overall bank's exposure; the change in the percentage of the sovereign debt of the country where a bank is incorporated held by foreign investors for banks domiciled (Δ*Foreign Investors Weight*); and the growth rate of the GDP of the country where a bank is incorporated in (*GDP Growth*) for banks domiciled in GIIPS countries and observed in the 2010-2012 period (*GIIPS Sovereign Crisis*) and for all the other banks (*No GIIPS Sovereign Crisis*) in Panel I; and for banks with a ratio of retail and corporate exposures under Internal Ratings Based Approach to total retail and corporate exposures higher (*Heavy IRB User*) and lower (*Low IRB User*) than 50% in Panel II. The number of observations is reported in parentheses. The value in brackets is the *t*-statistic for testing the equality of variable means.
***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively.

	Panel I			Panel II		
	GIIPS Sovereign Crisis		*No GIIPS Sovereign Crisis*	*Heavy IRB User*		*Low IRB User*
		[*t* statistic]			[*t* statistic]	
Δ*Corporate Volume*	-0.075		-0.014	-0.018		-0.063
	(63)		(223)	(227)		(59)
		[2.474]**			[-1.771]*	
Δ*Sovereign Volume*	0.209		0.108	0.118		0.176
	(62)		(233)	(237)		(58)
		[-2.146]**			[2.204]	
Δ*Corporate Weight*	-2.603		-1.066	-1.184		-2.212
	(63)		(235)	(238)		(60)
		[2.873]***			[-1.87]*	
Δ*Sovereign Weight*	2.330		0.930	1.086		1.785
	(63)		(234)	(237)		(60)
		[-2.821]***			[1.371]	
Δ*Foreign Investors Weight*	-0.030		0.005	-0.0025		-0.0003
	(63)		(235)	(238)		(60)
		[6.066]***			[0.343]	
GDP Growth	-1.415		-0.085	-0.044		-1.645
	(63)		(235)	(238)		(60)
		[3.341]***			[-3.977]***	

Table 9. Lending Volume and Composition and the Sovereign Crisis

This table presents bank level regressions. The dependent variable is the percent change in a bank's volume of corporate, Δ*Corporate Volume* (Columns 1-2), and sovereign exposure, Δ*Sovereign Volume* (Columns 3-4), and the change in a bank's weight of corporate, Δ*Corporate Weight* (Columns 5-6), and sovereign exposure, Δ*Sovereign Weight* (Columns 7-8), over the overall bank's exposure, respectively. *GIIPS Sovereign Crisis* is a dummy variable which is equal to one if the bank is domiciled in a GIIPS country and the observation refers to the 2010-2012 years, zero otherwise. Δ*Foreign Investors Weight* is the change in the percentage of the sovereign debt of the country where a bank is incorporated held by foreign investors. *Impaired Loans* is the ration of a bank's impaired loans to total assets. *Size* is the logarithm of a bank's total assets. *Tier1* is the ratio of a bank's Tier1 capital to risk weighted assets. *GDP Growth* is the growth rate of the GDP of the country where a bank is incorporated. Standardized coefficients are shown in parentheses. Standard errors are adjusted for heteroskedasticity and clustered at the bank level.
***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ*Corporate Volume*		Δ*Sovereign Volume*		Δ*Corporate Weight*		Δ*Sovereign Weight*	
GIIPS Sovereign Crisis	-0.069*		0.166**		-2.327**		1.763**	
	(-0.165)		(0.204)		(-0.249)		(0.204)	
Δ*Foreign Investors Weight*$_t$		0.422*		-1.729***		19.250***		-21.893***
		(0.106)		(-0.227)		(0.218)		(-0.269)
Impaired Loans$_{t-1}$	-0.002	-0.001	0.003	0.001	0.043	0.076	-0.000	-0.017
	(-0.077)	(-0.038)	(0.060)	(0.020)	(0.074)	(0.131)	(0.000)	(-0.031)
Size$_{t-1}$	-0.449***	-0.444***	-0.180	-0.193	-1.076	-0.889	1.365	1.198
	(-3.281)	(-3.245)	(-0.682)	(-0.731)	(-0.355)	(-0.293)	(0.486)	(0.427)
Tier1$_{t-1}$	0.008*	0.009**	-0.010	-0.015	0.154	0.208	-0.165	-0.217
	(0.168)	(0.189)	(-0.110)	(-0.164)	(0.146)	(0.197)	(-0.169)	(-0.222)
GDP Growth$_{t-1}$	0.004	0.005	0.044**	0.042**	0.206	0.227*	0.506***	0.487***
	(0.063)	(0.079)	(0.367)	(0.350)	(0.149)	(0.164)	(0.396)	(0.382)
Constant	5.019***	4.907***	2.383	2.630	5.425	1.816	-11.366	-8.472
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Bank Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
R^2	0.439	0.439	0.256	0.280	0.248	0.263	0.191	0.230
Number of observations	286	286	295	295	298	298	297	297
Number of banks	49	49	50	50	50	50	50	50

Table 10. Lending Volume and Composition, Sovereign Crisis, and the Use of Internal Based Ratings

This table presents bank level regressions. The dependent variable is the percent change in a bank's volume of corporate, Δ*Corporate Volume* (Columns 1 and 2), and sovereign exposure, Δ*Sovereign Volume* (Columns 3 and 4), and the change in a bank's weight of corporate, Δ*Corporate Weight* (Columns 5 and 6), and sovereign exposure, Δ*Sovereign Weight* (Columns 7 and 8), over the overall bank's exposure, respectively. *GIIPS Sovereign Crisis* is a dummy variable which is equal to one if the bank is domiciled in a GIIPS country and the observation refers to the 2010-2012 years, zero otherwise. Δ*Foreign Investors Weight* is the change in the percentage of the sovereign debt of the country where a bank is incorporated held by foreign investors. *IRB Exposure Weight* is the ratio of a bank's loans under internal ratings based approach to its total loans. *Impaired Loan*s is the ration of a bank's impaired loans to total assets. *Size* is the logarithm of a bank's total assets. *Tier1* is the ratio of a bank's Tier1 capital to risk weighted assets. *GDP Growth* is the growth rate of the GDP of the country where a bank is incorporated. Standardized coefficients are shown in parentheses. Standard errors are adjusted for heteroskedasticity and clustered at the bank level.
***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ*Corporate Volume*		Δ*Sovereign Volume*		Δ*Corporate Weight*		Δ*Sovereign Weight*	
GIIPS Sovereign Crisis	-0.077*		0.166**		-2.449**		1.818**	
	(-0.184)		(0.204)		(-0.262)		(0.211)	
Δ*Foreign Investors Weight*$_t$		0.420**		-1.732***		19.131***		-21.838***
		(0.106)		(-0.227)		(0.217)		(-0.268)
IRB Exposure Weight$_{t-1}$	-0.002***	-0.002***	-0.0003	-0.001	-0.046**	-0.040**	0.021	0.017
	(-0.351)	(-0.351)	(-0.027)	(-0.091)	(-0.365)	(-0.317)	(0.180)	(0.146)
Impaired Loans$_{t-1}$	-0.003	-0.001	0.003	0.001	0.028	0.066	0.007	-0.012
	(-0.022)	(-0.007)	(0.011)	(0.004)	(0.009)	(0.022)	(0.002)	(-0.004)
Size$_{t-1}$	-0.463***	-0.456***	-0.182	-0.197	-1.315	-1.091	1.479	1.284
	(-9.733)	(-9.586)	(-1.993)	(-2.158)	(-1.248)	(-1.036)	(1.518)	(1.318)
Tier1$_{t-1}$	0.008*	0.009**	-0.011	-0.015	0.149	0.205	-0.163	-0.215
	(0.307)	(0.345)	(-0.219)	(-0.298)	(0.256)	(0.353)	(-0.303)	(-0.400)
GDP Growth$_{t-1}$	0.003	0.004	0.043**	0.042**	0.191	0.214*	0.513***	0.493***
	(0.047)	(0.063)	(0.358)	(0.350)	(0.138)	(0.155)	(0.402)	(0.386)
Constant	5.326***	5.177***	2.428	2.725	11.027	6.537	-14.022	-10.478
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Bank Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
R^2	0.452	0.450	0.256	0.281	0.259	0.271	0.194	0.232
Number of observations	286	286	295	295	298	298	297	297
Number of banks	49	49	50	50	50	50	50	50

Table 11. Lending Volume and Composition and the Use of Internal Based Ratings over the Sovereign Crisis

This table presents bank level regressions. The dependent variable is the percent change in a bank's volume of corporate, Δ*Corporate Volume* (Columns 1 and 2), and the change in a bank's weight of corporate, Δ*Corporate Weight* (Columns 3 and 4) over the overall bank's exposure, respectively. *GIIPS Sovereign Crisis* is a dummy variable which is equal to one if the bank is domiciled in a GIIPS country and the observation refers to the 2010-2012 years, zero otherwise. Δ*Foreign Investors Weight* is the change in the percentage of the sovereign debt of the country where a bank is incorporated held by foreign investors. *IRB Exposure Weight* is the ratio of a bank's loans under internal ratings based approach to its total loans. *Impaired Loans* is the ration of a bank's impaired loans to total assets. *Size* is the logarithm of a bank's total assets. *Tier1* is the ratio of a bank's Tier1 capital to risk weighted assets. *GDP Growth* is the growth rate of the GDP of the country where a bank is incorporated. Standardized coefficients are shown in parentheses. Standard errors are adjusted for heteroskedasticity and clustered at the bank level. The *p*-value associated to the chi-squared statistics of a test for equality of coefficients is reported in brackets below each relevant couple of coefficients.
***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)
	Δ*Corporate Volume*		Δ*Corporate Weight*	
IRB Exposure Weight$_{t-1}$ × (*GIIPS Sovereign Crisis*=0)	-0.002**		-0.020	
	(-0.414)		(-0.187)	
IRB Exposure Weight$_{t-1}$ × (*GIIPS Sovereign Crisis*=1)	-0.003***		-0.089***	
	(-0.327)		(-0.434)	
	[0.0672]		[0.0015]	
IRB Exposure Weight$_{t-1}$ × (Δ*Foreign Investors Weight*$_t$>0)		-0.0022**		-0.028
		(0.000)		(0.000)
IRB Exposure Weight$_{t-1}$ × (Δ*Foreign Investors Weight*$_t$<0)		-0.0021**		-0.044**
		(0.000)		(0.000)
		[0.6053]		[0.1599]
Impaired Loans$_{t-1}$	-0.002	-0.002	0.027	0.061
	(-0.077)	(-0.077)	(0.046)	(0.105)
Size$_{t-1}$	-0.455***	-0.457***	-1.062	-0.979
	(-3.325)	(-3.340)	(-0.350)	(-0.323)
Tier1$_{t-1}$	0.009**	0.009**	0.208	0.204
	(0.189)	(0.189)	(0.197)	(0.194)
GDP Growth$_{t-1}$	0.001	0.003	0.037	0.127
	(0.016)	(0.048)	(0.028)	(0.095)
Constant	5.184***	5.199***	6.977	5.425
Year Fixed Effects	YES	YES	YES	YES
Bank Fixed Effects	YES	YES	YES	YES
R^2	0.4541	0.4417	0.2759	0.2464
Number of observations	286	286	298	298
Number of banks	49	49	50	50