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The credibility of European banks' risk-weighted capital: structural differences or national segmentations?

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The credibility of European banks' risk-weighted capital: structural differences or national segmentations?*

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ABSTRACT

Supranational institutions, academics and market analysts have increasingly questioned the reliability of bank risk-weighted assets (RWAs), a cornerstone of the system of minimum capital ratios designed by the Basel Committee on Banking Supervision. In fact, significant differences can be found in the banks' average risk weights, both over time and across countries. Such differences can be explained by several factors, some of which may reflect the actual risk content of bank's assets, while others may conceal distortions due to "RWA tweaking" and supervisory segmentations. We analyze a sample of 50 large European banks between 2008 and 2012 and document several meaningful findings. First, risk weights are affected by the banks' size, business model and asset mix. Second, the adoption of internal ratings based (IRB) approaches is (as expected) a powerful driver of bank risk-weighted assets. Third, lower risk weights are positively linked to the banks' capital cushion. Fourth, IRB adoption is more widespread in countries where supervisory capture is potentially stronger, due to a banking industry that is both larger (compared to GDP) and concentrated. Fifth, regulatory risk weights are not disconnected from market-based measures of bank risk.

JEL Classification: G21, G28

Keywords**:** Banks, capital, risk-weighted assets, regulation, Basel accords.

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1 Introduction

Strengthening capital ratios has become a priority in the aftermath of the 2007-2009 financial crisis. Recent regulatory reforms (i.e., Basel III), however, have primarily focused on improving the numerator of the capital ratios (by requiring banks to hold more high quality capital), while limited changes have been suggested to the denominator, i.e., to the risk-based weights used in the computation of the bank's risk-weighted assets (RWAs).[1] Nevertheless, the RWAs of large banks worldwide have shown remarkable discrepancies, weakening the credibility of risk-based capital measures.

Several studies have been published on RWA heterogeneity (see Section 2 for details). Regulators have highlighted wide variations in the ratio of RWAs to total assets (i.e. the average risk weight, often referred to as "RWA density") across banks: cross-country differences also look significant, prompting questions about the consistency of risk measurement methodologies across jurisdictions. Further doubts on the reliability of RWAs have been raised by academic studies. In the same vein, market participants have questioned the comparability of capital ratios, arguing that banks may not be as capitalized as suggested by risk-based measures (The Economist, 2012). Investors and rating agencies have increasingly focused on "adjusted" capital ratios, which reduce the heterogeneity across banks by imposing floors and caps to the risk weights used (de Longevialle, 2008). Regulators have endorsed the use of "plain", un-weighted capital ratios as a backstop against the opportunistic use of risk-weighted measures. In fact, the Basel Committee has recently announced that it will review the measurement of RWAs

[1] The Basel Committee (BCBS 2011, p. 31) estimates that RWA under Basel III will increase by not more than 23% for large banks relative to Basel II.

and formulate policy responses to foster greater consistency across banks and jurisdictions (BCBS, 2013*a* and 2013*b*). A similar mandate has been assigned to the European Banking Authority by article 78 of the 4th Capital Requirements Directive.

Against this backdrop, our work aims to address several issues: first, to gain a better understanding of why there are material differences in RWA densities, and whether they are legitimate;[2] second, to investigate how the adoption of internal ratings (one of the key drivers behind a bank's average risk weight) is affected by bank characteristics and supervisory style; third, to assess the relationship (if any) between RWAs and some market-derived risk indicators, embedding the investors' views on individual banks. In doing so, we check the effect of national specificities on RWA discrepancies (Le Leslè and Avramova, 2012).

We analyze a sample of large European banks between 2008 and 2012. Our results, presented in detail in Section 4, document several meaningful findings. First, risk weights are affected by the banks' size, business model and asset mix; additionally, lower risk weights are the result of internal ratings adoption (as expected) and are positively linked to the banks' capital cushion. Second, the extent to which a bank is allowed to use internal ratings depends both on its characteristics (e.g., its size) and by the amount of industry lobbying faced by its national supervisor. Third, regulatory risk weights are not disconnected from market-based measures of bank risk. Overall, national segmentations play a significant role in explaining the above mentioned relationships.

[2] The Bank of England (2011) argues that "evidence from the recent crisis suggests that the observed variations in RWAs might not entirely reflect genuine difference in risk-taking."

Our findings contribute to the debate on RWA (and capital ratios) and expand the empirical evidence on this topic. A better understanding of the drivers behind the perceived inequalities in bank risk weights may help restore the credibility of the RWA-based regulatory framework, reducing investors' skepticism and its many adverse consequences. This includes the shift towards over-simplified indicators based on unadjusted total assets, the demand for higher capital ratios to compensate for their low perceived reliability, the risk that financially sound institutions get rationed in their ability to raise equity and to stay in business.

The paper is organized as follows. Section 2 illustrates the institutional background and related literature. Section 3 describes our data sample. Section 4 presents the main empirical results. Section 5 concludes.

2 Background and related literature

Regulations require banks to hold a minimum amount of own funds ("regulatory capital") to offset losses that may originate from their risky investments. Capital requirements must therefore increase with the riskiness of a bank's assets; this is achieved by converting the face value of assets into a risk-weighted equivalent. The first international accord on bank capital (so-called "Basel I", issued in 1988) had devised a simple set of risk weights ranging from 0% for credit exposures towards OECD governments and public sector entities (where no regulatory capital was required) to 100% for loans to individuals and non-financial companies. While this scheme made it easier to implement the accord across different jurisdictions, it proved simplistic over time, as well as prone to

regulatory arbitrage. E.g., a "flat" 100% risk weight for all non-financial companies meant that banks could focus on high-risk borrowers in order to maximize interest revenues in the short term, while increasing future defaults and credit losses.

The second accord on bank capital ("Basel II", in 2004) allowed for further diversification in the risk-weights: the latter could now be differentiated, within the same exposure type (e.g., companies, banks or governments), depending on the actual credit risk of individual borrowers. To estimate the risk weight of each obligor, banks could choose between credit agency ratings and their own internal assessments,[3] subject to validation by national supervisors.

Since 2004, a growing number of banks have opted for the internal-ratings based ("IRB") approach. Many of them have achieved substantial benefits in terms of lower capital consumption, compared to the standardized approach based on agency ratings. This has contributed to the distrust towards IRB models, and investors have started to look at "RWA tweaking" as a suspicious practice.

The 2007-2009 Great Financial Crisis has reinforced the belief that RWAs may have helped banks disguise a rising credit bubble by keeping their stated capital ratios artificially high. The third international accord on bank capital ("Basel III", agreed in late 2010) has thus imposed a cap on the banks' "plain" (un-weighted) leverage ratio, in an attempt to curb biases due to opportunistic/flawed internal ratings.

Empirical studies point to significant divergences in RWA density across banks and jurisdictions. A first strand of literature, largely based on descriptive analyses and mostly

[3] Since 1996 internal models could also be used to compute regulatory capital against market risk.

emanated from public bodies (including EBA, IMF and BCBS) and market analysts (Barclays Capital 2011; BNP Paribas 2011) has looked at factors explaining RWA differences[4]. Le Leslè and Avramova (2012) distinguish between bank-specific factors that reflect actual risk-taking (e.g., the business model or asset quality) and factors unrelated to bank risks (e.g., due to institutional, accounting, and regulatory variables). BCBS (2013*b*) finds that the banks' modeling choices are an important driver of risk-weights for market risk. Based on a top-down quantitative exercise on a large sample of European banks, EBA (2013) finds that about 50% of the divergence can be explained by simple factors (i.e., share of assets covered by the IRB approach, standardized weights, portfolio mix, defaulted credit exposures). It also finds that differences in the implementation of the IRB approach are due to managerial and supervisory practices. Ledo (2011) finds that, although some divergences are justified, there is still scope for a more level playing field, mainly through closer international coordination among supervisors in the validation of IRB models. Arroyo et al. (2012) also emphasize the role of the IRB validation process in explaining cross-country discrepancies. Furthermore, they highlight the limitation of the most used RWA density measure (the RWA/TA ratio), which may give rise to spurious differences among banks, and propose an alternative indicator[5]. Cannata et al. (2012) propose a methodology to disentangle the main factors underlying RWA differences. Using supervisory data for a sample of Italian lenders, they show that a large portion of cross-bank variance is explained by the business mix of

[4] See BCBS (2013*a*), Appendix 1, for a complete list of these studies.
[5] This is in some respects similar to our RWAEAD indicator (see Section 3 below).

individual institutions and by the so called "roll-out effect" (i.e. the joint use of standardised and IRB approaches within the same bank).

A second strand of literature explores the link between RWA-based capital and the banks' actual risk, measured by several indicators. Demirgüç-Kunt et al. (2010) find that capital was positively related to banks' stock returns during the subprime crisis. Beltratti and Stulz (2012) show that large banks with more capital and higher reliance on deposits in 2006 experienced higher stock returns during the crisis, but did show better risk indicators (idiosyncratic volatility and distance-to-default). Kato et al. (2010) find evidence that, for systemically important banks, stock returns in the crisis years were uncorrelated to the Tier 1 capital ratio.

Das and Sy (2012) look at an international sample of depositary institutions in 2004-2010 to see whether investors look at RWAs when pricing bank risk. They find that banks with lower risk weights performed better during the US and Euro crises, but this relationship is weaker in Europe where more banks use IRB models. For large banks, investors care less about RWAs, but reward lower reliance on wholesale funding and better asset quality. Additionally, they show that RWAs do not predict market-based risk measures (including stock return volatility, beta and idiosyncratic volatility[6]), although there is evidence of a positive relationship before the crisis.

Beltratti and Paladino (2013) use a sample of large international banks in 2005-2011 to test whether the cost of equity (proxied with a bank's beta) affects RWA density. They

[6] These measures focus on risk for equity holders, while RWAs measure the riskiness of a bank's assets as a whole, and therefore should affect both a bank's equity and its debt. In §5 we will consider risk measures related to a bank's assets (asset volatility) and to its overall debt/equity mix (weighted average cost of capital).

find that a higher cost of equity prompts lower risk weights. This suggests that banks may artificially inflate their capital ratios when equity is more expensive. Looking at a sub-sample of international banks using the advanced IRB approach, they also find that – as the share of assets covered by IRB models increases – RWA density drops and capital becomes more expensive.

Vallascas and Hagendorff (2013) use a sample of international banks in 2000-2010 to assess the risk sensitivity of capital requirements to bank risk under Basel I and II, testing whether RWAs increase with asset return volatility. They find that the risk sensitivity of RWA-based capital is low, and increased only marginally with the advent of Basel II. Additionally, Basel II had an asymmetric impact on low-risk and high-risk banks. While the former have reduced their capital requirements through the IRB approach, the latter were not pushed to hold significantly more capital. As a result, riskier banks hold an insufficient amount of capital, while banks showing a large capital buffer (in excess of the minimum requirements) report lower risk weights for any given level of risk.[7]

Mariathasan and Merrouche (2013) test whether first-time adopters of IRB models have intentionally under-reported risks. They look at a panel of international banks in 2004-2010 and investigate how risk weights respond when IRB is introduced. They find that reported risk declines upon IRB adoption, and that this effect is more significant for weakly capitalized banks. This supports the view that capital-constrained banks may use the IRB approach *strategically* to improve the capital ratios. Mariathasan and Merrouche

[7] This is consistent with the theoretical framework provided by Allen et al. (2011), where banks may be undercapitalized in spite of holding capital above the minimum requirements.

also find that higher levels of supervisory scrutiny are typically associated to better risk reporting.

3 Data sources and sample description

We look at the 50 largest European banking groups (by total assets in 2012)[8] over a 5-year window (2008-2012). We use both financial statements and additional information taken from Pillar 3 reports. The latter include the incidence of different risk types (market, credit, operational) and portfolios (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[9] and 49 adopt IFRS.[10] We complement financial statement and Pillar 3 data with a number of risk measures based on capital market indicators: stock return volatility, asset volatility,[11] weighted average cost of capital for listed banks, and CDS (credit default swap) spreads for banks that are referenced by actively-traded contracts.

[Insert Table 1 about here]

Accounting data are from Bureau van Dijk's Bankscope, capital market indicators come from Bloomberg and Markit, while Pillar 3 Reports were downloaded from individual

[8] Some institutions, for which Pillar 3 data were not directly available, were excluded.
[9] The two unlisted banks are DZ Bank AG and Rabobank.
[10] Credit Suisse Group AG adopts the US GAAP standards.
[11] As in Vallascas and Hagendorff (2013).

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 studies. This includes risk weights (Panel I), business models and economic/supervisory environment (Panel II), risk models (Panel III), market-derived risk measures and capitalization (Panel IV).

Further comments on the table are provided in Section 4; in the remainder of this section, we focus on Panel I only (risk weights), where two alternative indicators are reported.

In the former ("RWATA") risk-weighted assets are divided by total assets, as reported in banks' balance sheet:

$$RWATA = \frac{\text{Risk Weighted Assets}}{\text{Total Assets}}$$

This ratio 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)[12] 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).

This leads us to our second indicator ("RWAEAD"), which is based on Pillar 3 information:

[12] Since a bank minimum capital requirement is equal to 8% of its RWAs, the latter correspond to 12.5 times the bank's risk-weighted assets.

$$RWATA = \frac{\text{RWA for Credit Risk}}{\text{EAD for Credit Portfolio}}$$

This ratio 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-balance sheet items. While its scope may be less general than for RWATA, its numerator and denominator look more consistent, since both refer to credit-related risks.[13]

[Insert Table 2 about here]

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 seems to have 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]

[13] RWAs against credit risk account for a large percentage of total RWAs (84% in our sample).

4 Main results

4.1 Univariate analysis

In order to explore the relationship between RWA densities and bank characteristics, we first look at pairwise correlations on a univariate basis (see the last two columns of Table 2). We find that RWATA and RWAEAD are significantly correlated with most variables proxying for the banks' business models and operating environment, risk measurement approaches, market-perceived risk and capital levels.

Institutions with larger risk weights tend to be smaller (see Panel II), 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). Risk weights increase as the real economy decelerates and tend to be lower in countries where the banking industry is larger (compared to GDP) and more concentrated.

Lower risk weights involve a more extensive usage of IRB models, especially advanced ones (Panel III). 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 IV) with most market-based risk measures, namely CDS spreads, Asset Volatility, WACC and Z-scores. 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. 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.[14]

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 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.[15]

4.2 Multivariate analysis

4.2.1 Factors affecting the RWA density

We first look at the drivers of RWA density by estimating the following OLS regression:

$$LN[RW_{i,t}/(1-RW_{i,t})] = f(SIZE_{i,t}, Business\ model_{i,t}, IRB\ adoption_{i,t}, Real\ economy, Regulatory\ capital_{i,t}, Countries, Years) + \varepsilon_{i,t} \quad (1)$$

[14] 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.

[15] 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).

Where:[16]

- *LN*[RW/(1–RW)] is a logarithmic transformation ("odds ratio") of our risk-weight variables (RW can be both RWATA and RWAEAD; the odds ratio are then labeled RWATA_OR and RWAEAD_OR). This transformation ensures that the dependent variable can take any value between minus and plus infinity;
- *SIZE* is the natural log of total assets (in millions of Euros);[17]
- *Business model* includes three variables: DEPOSITS (the deposits to total assets ratio), LOANS (the loans to total assets ratio), CORPORATE (the ratio of corporate loans to total customer loans) and RETAIL (the ratio of retail loans to total customer loans);[18]
- *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 "HIGH_RETCORP_IRB", a dummy equal to one when the share of corporate and retail loans under the IRB approach exceeds the sample median. We focus on retail and corporate portfolios because they are the ones where internal models usually prove more beneficial in terms of capital relief (Le Leslè and Avramova, 2012). In fact, most loans to institutions benefit from high external ratings, while exposures to governments receive a zero risk weight according to European rules.

[16] As noted above, Table A.1 in Appendix A provides a full list of the variables used throughout this paper, each one with a short description.
[17] To obtain comparable values, we convert banks' total assets into euros.
[18] 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.

- *Real economy* includes GDP_GROWTH (the real annual GDP growth rate for the country where a bank has its main headquarters). The effect of GDP_GROWTH on risk weights is ambiguous. On one hand, as the economic environment deteriorates banks may decrease lending and switch to safer investments (e.g., government bonds), leading to a drop in the average RWA density. On the other hand, for banks under the IRB approach, an economic slowdown may trigger higher default rates, leading to an increase in the borrowers' estimated probabilities of default (PDs), which are used to compute regulatory capital. To disentangle those two effects, we interact GDP_GROWTH with HIGH_RETCORP_IRB; the interacted variable is aimed to capture the effect of GDP changes for heavy IRB users.

- *Regulatory capital* is measured through TIER1_RWA, 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;

- *Countries and Years* 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 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 t RWA densities.

The results are shown in Table 3 for RWATA_OR (Columns I-III) and RWAEAD_OR (Columns IV-VI); standard error estimates are made heteroskedasticity-consistent by clustering errors at bank level.[19] In Columns (II) and (V) we test country dummies; Columns (III) and (VI) also include year dummies. To check for multicollinearity issues, we also report the maximum variance inflation factor ("VIF") and the condition number of the correlation matrix.[20]

[Insert Table 3 about here]

Estimation results corroborate our univariate findings. As far as RWATA_OR is concerned (Column I), 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 HIGH_RETCORP_IRB.[21] Furthermore, banks with lower risk weights are found to hold a larger capital buffer, as indicated by TIER1_RWA. As concerns GDP_GROWTH, estimates confirm our expectations (although statistical significance is mixed): a

[19] Clustering by country would leave our results virtually unchanged.
[20] A common rule of thumb requires that variance inflation factors be below 5, and condition numbers below 10, for heteroskedasticity concerns to be negligible (Belsley, 1984; Friendly and Kwan, 2009).
[21] As an alternative to HIGH_RETCORP_IRB, we have tested IRB_LOANS (the share of credit exposures for which the IRB approach has been adopted), coming to very similar results. We have chosen to stick to HIGH_RETCORP_IRB for the sake of consistency, as the latter is also interacted with GDP_GROWTH in our model.

downturn leads to lower risk weights (due to a "safe haven" effect), but banks using IRB also experience an increase in RWA density due to the effect of higher default rates on their estimated PDs.

Moving to RWAEAD_OR (Column IV), most results are confirmed, although DEPOSITS and LOANS lose statistical significance. This suggests that banks involved in the traditional business of raising deposits and issuing loans are less penalized once one focuses on credit-related risk weights (losing sight of the capital relief caused by, e.g., the internal models for market and operational risk).

Our results stay virtually unchanged when country variables enter the model (see Columns II and V). 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. Finally, year dummies are not significant at 95% (although they are at 90%, see Columns III and VI).

4.2.2 Factors affecting IRB adoption

IRB adoption (captured through HIGH_RETCORP_IRB) plays a significant role in the results shown in Table 3. 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):

$$IRB\ share_{i,t} = f(\mathrm{SIZE}_{i,t},\ Business\ model_{i,t},\ Regulatory\ capital_{i,t},\ Countries, \qquad (2)$$

$$Years, Supervisory\ capture_i) + \varepsilon_{i,t}$$

where:

- *IRB share* is the odds ratio of IRB_LOANS,[22] the share of total loans covered by internal ratings;
- *SIZE*, *Business model*, *Regulatory capital*, *Countries* and *Years* retain the same meaning as in Equation (1);[23]
- *Supervisory capture* includes two variables, measured at national level, indicating the banking industry's lobbying power *vis à vis* the banks supervisor. BANKGDP (the ratio of bank total assets to GDP) indicates the banking system's importance for the national economy; BANKCONC is a measure of bank concentration (the market share of the country's top 3 banks in terms of total assets).[24]

[Insert Table 4 about here]

[22] To prevent IRB_LOANS_OR from reaching minus infinity, a 5% floor is imposed on IRB_LOANS. Since the latter never reaches one, no cap is required.

[23] We are not testing the impact of GDP growth on IRB adoption because we do not have strong expectations there. Although moving to internal ratings may involve stronger benefits when the economy is booming (as PDs are lower, and so is capital consumption), banks shifting to the IRB approach cannot easily switch back. Accordingly, there is limited room for "tactical" moves dictated by economic upturns. Unsurprisingly, GDP_GROWTH would be statistically insignificant if one were to add it to the variables tested in Table 4.

[24] The values for BANKGDP and BANKCONC are taken from the EBA Aggregate statistical data (available at http://www.eba.europa.eu/supervisory-convergence/supervisory-disclosure/aggregate-statistical-data) 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.

Model (1) in Table 4 shows that internal models are used more extensively by large banks with less deposits and a larger capital cushion. Country dummies in Model (2) prove jointly significant, showing that national segmentations exist, above and beyond the characteristics of individual banks.[25] 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* the national supervisors. When BANKGDP and BANKCONC 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.

4.2.3 The link between risk weights and market-derived risk measures

We now go back to some of the market-derived risk measures shown in Table 2 (Panel IV), to see whether their relationship with regulatory risk weights can be further explored on a multivariate basis.

We consider two actual market-based indicators (WACC and CDSSPREAD), as well as two proxies estimated through a mix of accounting and market data (ASSETVOL and ZSCORE).

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

WACC is the weighted rate of return that a bank ideally has to pay on its debt/equity mix. While the cost of debt is based on CDS spreads,[26] the cost of equity is generated through a standard market model.[27]

CDSSPREAD is the yearly mean of daily quotes for 5-year credit default swap contracts denominated in euros (with a "modified-modified" restructuring clause) for senior unsecured debt, as reported in the Markit database.[28]

ASSETVOL indicates asset volatility, estimated through a standard KMV approach (see e.g. Keenan and Sobehart, 1999, Sobehart et al., 2000) and captures the risk of a change in the value of a bank's assets.

ZSCORE is the Z-score, computed following Boyd and Graham (1988), Boyd and Runkle (1993), and Boyd et al. (1993). This is defined as the ratio between a bank's return on assets (ROA) plus its capital-to-assets ratio (the numerator) and the standard deviation of the asset returns (the denominator). [29] ZSCORE measures the adequacy of the capital buffer protecting bank creditors, taking into account also the past volatility of net profits; accordingly, a high Z-Score denotes low risk for investors and vice versa.

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[26] In line with Berndt and Obreja (2010), we rely on default swap spreads instead of corporate bond yield spreads as the source for prices of default risk. The latter are in fact more strongly affected by illiquidity, taxes, and various market-microstructure effects. As CDS spreads are risk premia and do not include the cost of risk-free funds, the latter is estimated through 5-year swap rates. We use euro-denominated swaps for all banks in our sample except for those based in the UK and in Switzerland, where a liquid market exists for swaps denominated in local currencies.

[27] The cost of equity, as well as the weights for equity and debt, are taken from the Bloomberg database.

[28] Following Schneider et al. (2010), we keep the yearly mean of the daily quotes only if the percentage of missing spreads (which in our definition includes stale spreads) does not exceed 15%.

[29] In many previous studies, the Z-Score has been computed as a purely accounting-based measure. However, this means that the standard deviation of the bank's returns on assets must be computed using yearly (or quarterly) financial data. As most banks in our sample are listed, we follow De Nicolò (2001) and Iannotta et al. (2007), using monthly stock market data to compute Z-Scores. Further details on the difference between our "market-adjusted" Z-Scores and accounting-based ones can be found in Boyd and Graham (1988).

WACC and Asset Volatility capture the overall risk of a bank's assets (and therefore are conceptually closer to regulatory risk weights); CDS and Z-Score instead follow a partially different perspective as they focus on credit risk for debt holders.

For each of these four market-derived risk measures, we estimate the following model:

$$MDRM_{i,t} = f(Risk\ weights_{i,t}, SIZE_{i,t}, Business\ model_{i,t}, Controls_{i,t}, Countries, Years) + \varepsilon_{i,t} \quad (2)$$

where:

- *MDRM* is the market-derived risk measure (in turn: WACC, CDSSPREAD, ASSETVOL and ZSCORE);
- *Risk weights* includes RWATA and RWAEAD. Since the two variables are strongly correlated, we orthogonalize the latter by regressing it on RWATA and taking the residuals (henceforth "RWAEAD_O");
- *SIZE*, *Business model*, *Countries* and *Years* retain the same meaning as in Equation (1) above;
- *Controls* includes the bank's un-weighted capital ratio ("EQUITY_RATIO"), the ratio of impaired loans to total loans ("IMPAIRED LOANS") and the return on assets ("ROA"). We also control for national GDP growth, to see whether economic cycle considerations are priced in by market participants.

To allow enough time for bank characteristics to affect marked-based risk measures, the latter are recorded with a one-year delay. This means that, e.g., when all covariates are measured in 2010, the dependent variable refers to 2011 and so on.

Our main results are shown in Table 5. For each market-derived risk measure we present a full model (where all independent variables are tested) and a reduced one, where the least significant variables are gradually removed, and only those with a p-value below 10% are retained.

Most market-based risk measures are affected by regulatory risk weights, the only exception being Z-Scores.[30]. Higher risk weights lead to an increase in WACC and CDS spreads, and are accompanied by a rise in Asset Volatility.

Banks more focused on "core" commercial banking (retail and corporate loans) seem to be perceived as less risky. This may sound counterintuitive at first sight, but could follow from the market's distrust with wholesale-oriented business models, which have proved heavily exposed to government debt and interbank loans. Although market-based indicators improve for banks more inclined to traditional lending activities, they also get significantly worse as impaired loans increase. Stronger GDP growth and higher ROAs reduce risk according to CDS spreads and WACC. Country and time dummies are highly significant. As concerns the latter, asset volatility improves in 2010-2011, as stock volatility goes back to normal after the shock induced by the Lehman collapse, and higher capital ratios constrain the effect of leverage on asset returns. WACC and CDS spreads, however, remain adversely affected until 2012, due to the Eurozone sovereign crisis. Country dummies show that, even controlling for some structural and environmental variables, regulatory risk-weights translate into market based-risk measures in a way that is affected by national specificities. Italian banks, e.g., are less penalized by market-

[30] As a matter of fact, Z-scores are not a true market variable being based on an estimate involving accounting data and a number of working assumptions).

derived risk measures than their comparatively high regulatory risk-weights would suggest. The opposite holds, to some extent, for Greek lenders.

5 Final remarks

A lively debate, involving institutions, academics and market analysts, has questioned the reliability of risk-weighted assets (and the related capital ratios). Reported risk weights have experienced a steady decline in 2008-2012, a period when bank risks have hardly been decreasing; furthermore, material differences exist across banks and jurisdictions. As a result, one may wonder whether regulatory risk weights are truthful indicators of bank riskiness.

In principle, differences over time and across institutions can be explained by several factors, some of which may reflect the actual risk content of bank's assets, while others may conceal distortions due to "RWA tweaking" and supervisory segmentations.

We have analyzed a sample of large European banks between 2008 and 2012 and our results point to several meaningful findings. First, risk weights are affected by the banks' size, business model and asset mix. Second, IRB adoption is (as expected) another powerful driver of risk-weighted assets. Third, lower risk weights are positively linked to the banks' capital cushion. Fourth, IRB adoption is more widespread in countries where supervisory capture is potentially stronger, due to a banking industry that is both larger (compared to GDP) and more concentrated. Fifth, regulatory risk weights are not entirely disconnected from market-based measures of bank risk. Overall, country effects play a clear role in explaining the banks' risk weights; national segmentations are also found in

the relationship between risk-weights and market-derived risk indicators. All this seems to hint at some form of national segmentation that deserves further analysis.

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Appendix A

Table A.1. Variable names and descriptions

Variable	*Description*
AIRB_LOANS	AIRB / total loans (%)
ASSETVOL	Asset Volatility (bps)
BANKCONC	Bank concentration: share of total assets by the top 3 banks (%)
BANKGDP	Bank assets on GDP
CDSSPREAD	CDS spreads (bps)
CORPORATE	Loans to corporate customers / total loans (%)
DEPOSITS	Deposits / total assets (%)
EQUITY_RATIO	Equity (at book value) / Total assets
FIRB_LOANS	FIRB / total loans (%)
GDP_GROWTH	GDP growth (real, %)
GOVERNMENTS	Loans to governments and central banks / total loans (%)
HIGH_RETCORP_IRB	Dummy equal to one if the share of retail and corporate exposures covered by internal ratings exceeds the sample median
IMPAIRED_LOANS	Impaired loans / loans (%)
INSTITUTIONS	Loans to financial institutions / total loans (%)
IRB_LOANS	IRB / total loans (%)
IRB_LOANS_OR	Odds ratio of RWAEAD = log(RWAEAD) / (1 - log(RWAEAD))
LOANS	Loans / total assets (%)
RETAIL	Loans to retail customers / total loans (%)
ROA	Return on assets (winsorised between 5th and 95th percentile, %)
RWAEAD	Risk-weighted assets for credit risk on exposure at default
RWAEAD_O	RWAEAD orthogonalised with respect to RWAEAD
RWAEAD_OR	Odds ratio of RWAEAD = log(RWAEAD) / (1 - log(RWAEAD))
RWATA	Risk-weighted assets on total assets
RWATA_OR	Odds ratio of RWATA = log(RWATA) / (1 - log(RWATA))
SIZE	Log of total assets
STANDARD	Standard / total loans (%)
TIER1_RWA	Tier 1 / RWA (%)
VOLATILITY	Stock return volatility (%)
WACC	Weighted average cost of capital (%)
ZSCORE	Z-Score

Tables and Figures

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 and pairwise correlation between risk-weighted asset density and bank characteristics

(I) - Risk-weight densities							Correlation with	
	Mean	Median	Max	Min	Sigma	Obs	RWATA	RWAEAD
RWATA	44.8	43.2	82.9	14	18.3	250	100.00%	88.1%***
RWAEAD	41.1	39.8	76.4	16.9	12.2	250	88.1%***	100.00%
(II) - Business models and economic/supervisory environment							Correlation with	
	Mean	Median	Max	Min	Sigma	Obs	RWATA	RWAEAD
SIZE	12.5	12.5	14.7	10.3	1.3	250	-65.4%***	-52.5%***
DEPOSITS	48.6	48.7	94.7	4	15.2	250	45.3%***	37.5%***
LOANS	53.9	59.3	81.7	12.2	17.8	250	74.4%***	57.6%***
RETAIL	30.3	31.4	11.9	0.0	58.8	250	25.2%***	16.7%***
CORPORATE	35.8	36.1	9.5	6.3	54.9	250	2.30%	6.60%
INSTITUTIONS	12.2	10.0	9.4	0.9	48.2	250	-30.5%***	-28.6***
GOVERNMENTS	12.0	11.9	6.0	0.0	28.6	250	-18.7%***	-17.6%***
ROA	0.1	0.3	0.6	-1.6	0.9	250	-0.4%	-0.2%
GDP_GROWTH	-0.6	0	6.6	-8.5	2.9	250	-27.6%***	-24.8%***
BANKCONC	72.5	71.9	96.1	42.1	13.3	250	-36.9%***	-46.3***
BANKGDP	3.9	3.3	10.2	0.8	2.1	250	-39.7***	-30.8***
(III) - Risk models							Correlation with	
	Mean	Median	Max	Min	Sigma	Obs	RWATA	RWAEAD
STANDARD	45	37.3	100	1.9	30.6	250	74.2%***	69.6%***
IRB_LOANS	55	62.7	98.1	0	30.6	250	-74.2%***	-69.6%***
FIRB_LOANS	10.5	0	92	0	18.1	250	-9.90%	-12.0%*
AIRB_LOANS	43.5	47.7	98.1	0	30.7	250	-67.1%***	-61.0%***
(IV) – Market-derived risk measures and regulatory capital							Correlation with	
	Mean	Median	Max	Min	Sigma	Obs	RWATA	RWAEAD
VOLATILITY	3.4	3.1	10.3	1	1.5	240	1.60%	5.90%
CDSSPREAD	274.0	146.1	353.2	28.7	1999.4	218	34.8%***	25.0%***
WACC	6.4	5.6	3.1	2.9	21.2	250	41.1%***	32.4%***
IMPAIRED_LOANS	5.8	4.4	32.6	0.4	5.3	250	33.8%***	30.1%***
ASSETVOL	15.8	10.1	172.1	1.6	20.8	277	14.1%**	12.6%*
ZSCORE	2.5	2.4	12.4	-1.5	2.1	286	-18.7%***	-24.4%***
TIER1_RWA	11	10.8	21.3	-6.7	3.5	250	-55.5%***	-55.2%***

Reported are the mean, median, min, max, standard deviation, number of observations of the main variables and their correlation with the risk weighted asset densities (RWATA and RWAEAD). A full legend of all variable names is provided in Table A.1. ROA was winsorized between the 5^{th} and 95^{th} percentile due to some extreme outliers for Greek banks.

***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively. Risk indicators in panel (IV) may also include data for 2013, hence the number of observations may exceed 250.

Table 3. Risk-weighted assets densities and bank characteristics

	(I) RWATA_OR		(II) RWATA_OR		(III) RWATA_OR		(IV) RWAEAD_OR		(V) RWAEAD_OR		(VI) RWAEAD_OR	
	Coef	*Std. Coef.*	*Coef*	*Std. Coef.*	*Coef*	*Std. Coef.*	*Coef*	*Std. Coef.*	*Coef*	*Std. Coef.*	*Coef*	*Std. Coef.*
Constant	0.912		0.920		0.874		0.490		0.746		0.792	
SIZE	-0.164***	-0.208	-0.184***	-0.234	-0.181***	-0.230	-0.083**	-0.105	-0.121***	-0.154	-0.123***	-0.156
DEPOSITS	0.012***	0.180	0.009**	0.130	0.008**	0.125	0.007**	0.103	0.005	0.075	0.005	0.074
LOANS	0.015***	0.273	0.017***	0.298	0.017***	0.299	0.004	0.076	0.006*	0.102	0.005*	0.097
CORPORATE	0.011**	0.101	0.014***	0.129	0.014***	0.135	0.008**	0.072	0.009**	0.082	0.008**	0.076
RETAIL	0.000	0.000	0.001	0.013	0.001	0.008	0.001	0.006	0.002	0.023	0.001	0.058
HIGH_RETCORP_IRB	-0.391***	-0.196	-0.329**	-0.165	-0.332**	-0.166	-0.346***	-0.173	-0.302***	-0.151	-0.300***	-0.150
TIER1_RWA	-0.060***	-0.213	-0.048***	-0.169	-0.056***	-0.197	-0.045***	-0.158	-0.037***	-0.131	-0.036**	-0.129
GDP_GROWTH	0.015	0.043	0.021*	0.061	0.040*	0.116	0.012	0.035	0.005	0.013	0.011	0.031
GDP_GROWTH× HIGH_RETCORP_IRB	-0.032**	-0.067	-0.026*	-0.053	-0.030**	-0.063	-0.026*	-0.054	-0.011	-0.023	-0.011	-0.022
France	-		0.012		-0.022		-		0.124		0.120	
Germany	-		-0.141		-0.179		-		-0.007		-0.013	
Greece	-		0.157		0.209		-		-0.086		-0.055	
Italy	-		0.146		0.132		-		0.115		0.131	
Spain	-		0.016		0.010		-		-0.011		0.002	
Sweden	-		-0.372***		-0.376***		-		-0.203*		-0.207*	
UK	-		0.313**		0.317**		-		0.331***		0.333***	
Joint *F* on country dummies	-		4.350***		4.520***				2.620**		2.210**	
dummy year 2009	-		-		0.216*		-		-		0.085	
dummy year 2010	-		-		0.112*		-		-		0.060	
dummy year 2011	-		-		0.086		-		-		-0.040	
dummy year 2012	-		-		0.124		-		-		-0.041	
Joint *F* on year dummies	-		-		2.260*		-		-		2.350*	
Adj. R^2	0.809		0.833		0.835		0.636		0.672		0.676	
Joint *F*	43.7***		52.4***		49.6***		15.4***		15.4***		16.8***	
Max VIF	2.82		3.93		5.44		2.82		3.93		5.44	
Condition number	3.59		4.43		5.91		3.59		4.93		5.91	

Reported are 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, RWATA and RWAEAD, respectively. The explanatory variables are defined as follows:

SIZE	the Log of Total Assets
DEPOSITS	the ratio of Total Deposits to Total Assets
LOANS	the ratio of Total Loans to Total Assets
CORPORATE	the ratio of the Corporate Loans to Total Loans
RETAIL	the ratio of the Retail Loans to Total Loans
HIGH RETCORP IRB	a dummy equal to one if the share of retail and corporate exposures covered by internal ratings exceeds the sample median
TIER1 RWA	the ratio of the Tier 1 to Risk-weighted Assets
GDP GROWTH	the percentage change – over previous year – in the country's real GDP

We also include year and country dummies for countries with at least 3 banks.

***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 4. Determinants of IRB adoption

	(I) IRB_LOANS_OR		(II) IRB_LOANS_OR		(III) IRB_LOANS_OR		(IV) IRB_LOANS_OR	
	Coef	*Std. Coef.*	*Coef*	*Std. Coef.*	*Coef*	*Std. Coef.*	*Coef*	*Std. Coef.*
Constant	-7.035***		-6.421***		-9.639***		-10.943***	
SIZE	0.542***	0.689	0.617***	0.784	0.550***	0.715	0.579***	0.752
DEPOSITS	-0.025**	-0.375	-0.023**	-0.349	-0.013	-0.197	-0.011	-0.167
LOANS	-0.021	-0.380	-0.018	-0.316	-0.010	-0.187	-0.012	-0.213
CORPORATE	0.009	0.083	0.013	0.119	0.008	0.439	0.004	0.219
RETAIL	0.029**	0.344	0.015	0.180	0.011	0.646	0.014	0.823
TIER1_RWA	0.144***	0.508	0.057*	0.200	0.064*	0.224	0.075***	0.262
France	-		-1.024**		0.066		-	
Germany	-		-1.240***		-0.575		-	
Greece	-		-1.045		-0.474		-	
Italy	-		-1.759***		-0.758*		-	
Spain	-		-0.256		0.255		-	
Sweden	-		0.260		0.030		-	
UK	-		-0.446		0.120		-	
Joint *F* on country dummies	-		7.1***		1.47			
BANKCONC	-		-		0.032***	0.425	0.040***	0.532
BANKONGDP	-		-		0.148***	0.311	0.183***	0.384
Adj. R^2	0.577		0.685		0.711		0.692	
Joint *F*	13.6***		17.4***		22.1***		18.0***	
Max VIF	2.66		3.76		5.14		2.90	
Condition number	3.16		4.04		6.77		3.43	

Reported are the coefficients of OLS regressions with standard errors corrected for clustering at the bank level. The dependent variable (IRB_LOANS_OR) is the odds ratio of the ratio between Loans subject to internal ratings and Total Loans (IRB_LOANS). Explanatory variables are defined as follows:

SIZE	the Log of Total Assets
DEPOSITS	the ratio of Total Deposits to Total Assets
LOANS	the ratio of Total Loans to Total Assets
CORPORATE	the ratio of the Total Corporate Loans to Total Loans
RETAIL	the ratio of the Total Retail Loans to Total Loans
TIER1_RWA	the ratio of the Tier 1 to Risk-weighted Assets
BANKCONC	the market share (by total assets) of the country's top 3 banks
BANKONGD	the ratio of the country's bank total assets to GDP

We also include year and, for countries with at least 3 banks, country variables.
***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 5. Market-based risk measures, risk-weighted asset densities, and bank characteristics

	(I) WACC	(II) WACC	(III) CDSSPREAD	(IV) CDSSPREAD	(V) ASSETVOL	(VI) ASSETVOL	(VII) ZSCORE	(VIII) ZSCORE
Constant	4.368	4.683***	-6.926	95.461	0.283	0.385***	5.739**	5.649**
RWATA	0.058***	0.057***	4.283**	4.838***	0.006**	0.006***	-0.002	-
RWAEAD_O	0.021	-	3.229*	-	-0.002	-	-0.051***	-
SIZE	0.044	-	11.168	-	0.006	-	-0.301**	-0.239*
DEPOSITS	0.023*	0.034***	-1.655	-	0.001	-	0.013	-
LOANS	-0.011	-	1.127	-	-0.004*	-0.004*	-0.023*	-0.021*
CORPORATE	-0.059***	-0.056***	-3.476***	-3.199**	-0.006*	-0.005**	0.009	-
RETAIL	-0.025**	-0.033***	-1.480	-	-0.001	-	0.031***	0.031***
EQUITY_RATIO	0.165*	-	12.303	-	0.006	-	0.018	-
IMPAIRED_LOANS	0.088***	0.103***	1.339	-	0.021***	0.023***	-0.043	-
ROA	-1.268***	-1.031***	-157.699***	-154.972***	-0.023	-	0.647***	0.971***
GDP_GROWTH	-0.443***	-0.405***	-54.415***	-53.869***	0.013	0.014**	0.001	-
France	-1.401***	-1.265**	-44.343	2.307	-0.088	-0.105**	1.297*	0.840
Germany	-0.239	-0.408	14.972	17.092	-0.107	-0.110*	-0.051	-0.224
Greece	3.117***	2.713***	456.616***	416.998***	-0.212**	-0.220**	-1.988***	-2.058***
Italy	-2.863***	-2.647***	-212.308***	-159.102***	-0.193***	-0.188***	-0.298	-0.503
Spain	-0.252	-0.352	-0.738	8.875	-0.025	-0.035	0.028	-0.121
Sweden	0.683*	0.438	21.107	23.899	0.288*	0.275*	1.464***	1.461***
UK	-0.266	-0.149	-109.032***	-107.656***	-0.124**	-0.126**	0.936**	0.695
Joint *F* on country dummies	13.69***	26.31***	24.37***	70.94***	2.05*	2.55**	9.38***	22.30***
Dummy year 2009	-1.945***	-1.636***	-213.656***	-201.897***	-0.105**	-0.094**	0.029	-0.003
Dummy year 2010	2.280***	2.316***	355.872***	363.994***	-0.188***	-0.188***	-1.040***	-1.139***
Dummy year 2011	0.773	0.790	282.872***	277.278***	-0.234***	-0.223***	0.937***	0.994***
Dummy year 2012	-0.994***	-0.927***	32.252	27.874	-0.163***	-0.150***	1.825***	1.834***
Joint *F* on year dummies	17.10***	15.79***	14.69***	21.47***	18.74***	15.93***	19.88***	22.85***
No. of obs.	250	250	219	219	231	231	239	239
Adj. R^2	0.790	0.783	0.846	0.841	0.436	0.427	0.581	0.520
Joint *F*	186.1***	135.1***	735.1***	363.8***	19.3***	13.4***	40.7***	33.0***
Max VIF	5.00	3.88	6.71	4.02	7.45	4.39	5.25	3.70
Condition number	6.07	4.50	7.11	4.13	7.24	4.87	6.06	4.09

Reported are the coefficients of OLS regressions with standard errors corrected for clustering at the bank level. The dependent variables are the bank risk measures: the weighted average cost of capital (WACC), the average of the daily 5-year senior debt CDS mid quotes during the following year (CDSSPREAD), 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) (ASSETVOL), and the 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 (ZSCORE). Explanatory variables are defined as follows:

RWATA	the ratio of the Risk-Weighted Assets to Total Assets as reported in banks' balance sheet
RWAEAD_O	the value of the ratio of the Risk-Weighted Assets due to credit risk to an estimate of total (balance sheet and off-balance sheet) credit risk exposures.
SIZE	the Log of Total Assets.
DEPOSITS	the ratio of Total Deposits to Total Assets.
LOANS	the ratio of Total Loans to Total Assets.
CORPORATE	the ratio of Corporate Loans to Total Loans.
RETAIL	the ratio of Retail Loans to Total Loans.
EQUITY RATIO	the ratio of Book value of Equity to Total Assets.
IMPAIRED_LOANS	the ratio of Impaired Loans to Gross Loans.
ROA	the Return on average Assets.
GDP_GROWTH	the percentage change – over previous year – in the country's real GDP.

We also include year and, for countries with at least 3 banks, country variables. ROA was winsorized between the 5^{th} and 95^{th} percentile due to some extreme outliers for Greek banks.
***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Figure 1. Change in RWATA in 2008-2012.

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