Banks risk-weights and cost of equity *

Andrea Beltratti[a*]   Giovanna Paladino[b]

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[a]Bocconi University, Department of Finance, Via Rontgen 1, 20100, Milano;
[b]IntesaSanpaolo and Luiss University;
*Corresponding Author: Andrea Beltratti, Department of Finance, Bocconi University, Via Rontgen 1, 20100 Milan, tel. +39 02 5836 5561
E-mail addresses: andrea.beltratti@unibocconi.it (A. Beltratti), giovanna.paladino@intesasanpaolo.com(G. Paladino).

Abstract

Banks use internal models to optimize risk weights and better account for the specific risk of each asset class. As the choice of a set of risk weights affects the regulatory capital ratio, economic theory suggests that banks should optimize their risk weights accounting for the cost and benefit of holding equity capital. Banks with a higher cost of equity, and banks with better growth opportunities, should be more aggressive in reducing risk weights. We consider a large panel of international banks and find that, after controlling for a number of bank and country characteristics, a higher cost of equity and better growth opportunities have a negative relation with the ratio between risk-weighted assets and total assets and with the share of credit risk evaluated though internal models. The results are obtained in the context of endogeneity-robust econometric procedures and across several specifications. We also find that banks that are more aggressive in terms of such optimization have a subsequent lower return on equity and are more likely to have raised capital during the credit crisis.

1. **Introduction**

Risk-based capital regulation sets a minimum ratio between equity capital and risk-weighted assets (RWAs). In the original version, so called Basel I, weights were imposed externally by the regulator. The resulting capital ratio could not account for cross-bank and cross-country heterogeneity. In the Basel II regulation, banks are given the possibility to choose their own weights by means of internal risk models, subject to a preliminary evaluation on the part of national regulation authorities. Previous research by regulators and practitioners has shown that RWAs present considerable international heterogeneity, see the Basel Committee on Banking Supervisions (2013), the European Banking Authority (2013), Le Leslé and Avramova (2012), Cannata, Casellina and Guidi (2012), Keefe, Bruyette and Woods (2011), Barclays (2012), Mediobanca (2012). Two non-mutually exclusive explanations have been offered for the observed heterogeneity: bank characteristics and country characteristics. We put forward another hypothesis for explaining international differences: the cost of equity capital.

Our conjecture is based on the observation that regulatory capital positively depends on risk weights. The equity capital needed to comply with regulatory requirements is the most expensive source of financing. This opens the possibility that, when determining their risk weights, banks try to reduce the quantity of capital that is needed to support a given level and structure of total assets[1]. A favourable set of weights reduces the total amount of RWAs, making existing capital more likely to comply with existing regulation. We use the term "risk weight optimization" to refer to the choice of risk weights leading to actual capital ratios. Among the costs of such optimization we find the increase in risk-taking associated with a lower capital to asset ratio, and the use of resources to develop internal models. Among the benefit is the saving in the use of equity that represents an expensive source of financing. The benefits of such optimization may potentially be even larger if there is a positive relation between the quantity and the cost of equity capital, as empirically shown by Baker and Wurgler (2013) for U.S. banks. The decrease in risk weights increases the Tier 1 ratio

[1]Blum (2008) supports the use of a leverage ratio as a supplementary restriction to Basel II requirements, noticing that 'risky banks have a strong incentive to hide the fact that they are risky in order to economize on costly capital'.

given existing equity. However, the decrease in risk weights may allow a bank to avoid a capital increase, forced by regulators or markets, that could push the Tier 1 ratio to an even higher level, with an associated bigger increase in the cost of equity. By reducing risk weights rather than increasing capital, a bank may limit the increase in the Tier 1 ratio and the cost of equity[2].

There are several reasons why our hypothesis is relevant. First, banks should not let the cost of equity drive risk weights to levels where the resulting capital base cannot properly support risk. Weights should be set at a level that is right for the true risk associated with the bank, in such a way to put it in a position to resist severe negative shocks. Regulators impose risk weight floors whose purpose is to prevent intermediaries to use such models to artificially decrease capital. There is little available empirical evidence about this point, except for Das and Sy (2012) who find no relation between RWAs and market measures of banks' risk during the credit crisis of 2007-2008. This evidence is consistent with the possibility that risk weights do not properly reflect actual risks. Second, a negative relation between risk weights and the cost of equity capital may decrease the observed correlation between risk and capital in the cross section and may prevent the existence of an international level playing field, especially if regulators do not coordinate their actions. Third, researchers want to understand to what extent differences in risk weights documented by practitioners and regulators are simply mechanical reactions to bank and country factors or are actually motivated by an optimizing behaviour on the part of banks. The cost of equity capital is an element that may explain why banks use internal models characterized by different sets of weights.

Several studies have spent considerable effort in characterizing international differences in risk weights across banks, but have generally not tried to understand what are the economic reasons driving banks' efforts in weight optimization, and have not entertained the hypothesis that the cost of capital is an important factor. Our contribution in this paper is to use panel data on a sample of international banks and test whether a higher cost of equity capital is associated with a more intense effort to optimize risk weights. Our paper differs from the existing literature. First, we do not

[2] Baker and Wurgler (2013) however only study U.S. banks, which are not part of the Basel II framework.

simply describe differences across banks but formulate an hypothesis that is tested on the basis of econometric models. We try to better understand risk weight optimization and highlight a key element, the cost of equity capital, that could drive it. Second, our sample, represented by an unbalanced panel data of 548 banks from 45 countries over the period 2005-2011, is much larger than the ones considered in other studies, and can reveal differences arising from several countries differing significantly in terms of economic and institutional environments. Third, our econometric methodology looks at a wide variety of specifications and estimation models, including GMM applied to a dynamic panel framework to account for potential endogeneity of variables like the cost of equity capital and proxies for the business model. Fourth, we consider a wide range of bank and country characteristics that have been highlighted by researchers as potential drivers of heterogeneity in risk weights. Fifth, for a large subset of 86 banks, we are able to collect information regarding the share of exposure at default (EAD) subject to internal rating models from their Pillar III annual reports[3] (for the years 2008-2011) and use it as an alternative metric to the standard ratio between risk-weighted assets and total assets (so called density).

Our empirical analysis shows that the cost of equity capital is indeed a significant factor in explaining RWA optimization on the part of banks: the larger the cost of capital the lower the RWA density. We also find that the better are growth opportunities the more intense is risk weight optimization, as banks try to build up a capital cushion that may be used to finance future growth. Other factors work as expected: more traditional business models and smaller banks are characterized by higher risk weights. The results are robust to using as a dependent variable the share of EAD subject to internal models. In an attempt to understand the general implications of this optimization activity, we find that banks that are characterized by more intense optimization have lower return on equity and have raised more capital during the credit crisis.

Our paper is complementary to the literature on the cost of capital and financial structure, see e.g. Kashyap, Stein and Hanson (2010), Baker and Wurgler (2013) and Kisin and Manela

[3]Basel II defines three pillars, the third of which requires disclosure of the types and amounts of risk taken by the banks, see Dermine (2009).

(2013), that look at the impact of increased capital requirements on the cost of bank capital. We study the reaction of banks to the cost of capital. Our results are also relevant for the study of what Basel II considers the third pillar of regulation, market discipline, that should control for excessive risk-taking on the part of managers, see Hughes and Mester (2012), and for the literature on bank opacity, see Flannery et al. (2004). Cost of capital-induced modifications of risk weights may increase opacity of banks and prevent stock market investors from implementing market discipline. Finally, the paper is important for understanding how banks manage their capital ratios. Berger et al. (2008) consider equity issuance, share repurchase and retained earnings whereas we look at the internal risk models and their impact on the density.

The plan of the paper is the following. Section 2 describes RWA optimization and discusses the main hypotheses to be tested in the empirical work; section 3 describes the data, section 4 presents the results of the empirical analysis, based on both a static panel methodology and a dynamic GMM system. Section 5 presents robustness and further insights, while section 6 concludes.

2. **Determinants of RWA weights**

Banks face a capital dilemma. From a stability perspective, capital is necessary to absorb losses and thus to increase the distance to default. From a performance perspective, banks also need to realize an acceptable rate of return on capital, that can be more easily achieved through leverage and the reduction of the ratio between equity capital and total assets[4]. In order to prevent managers from pursuing excessive leverage, and the associated level of risk, regulators set a minimum ratio between capital and risk-weighted assets[5].

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[4]Economic theory offers conflicting predictions about the relation between bank capital and value. In the standard Modigliani-Miller world there is no relation between the two, but agency costs may produce a negative relation, see e.g. Diamond and Rajan (2001). However, Mehran and Thakor (2010) claims there is a positive relation between capital and value, and Allen et al. (2011) show that banks may use costly capital to commit to asset monitoring.

[5]There is a broad literature, largely associated with the 2008 credit crisis, suggesting that regulation should look at the ratio between capital and assets as well as the actual amount of capital in order to force banks to respect the minimum levels through capital accumulation rather than asset disposure. See Admati and Hellwig (2013) for a general discussion.

Under the Basel II approach, regulators leave some flexibility in the determination of risk-weighted assets through internal risk-based (IRB) models, that allow banks to classify their assets in a relatively large number of classes. The probability of default (PD) is estimated by the bank, whereas the other relevant parameters like the loss given default (LGD), exposure-at-default (EAD) and maturity (M) can be provided by the regulator itself (Foundation IRB or FIRB) or estimated by banks and validated by supervisors (Advanced IRB or AIRB). Unlike in the original Standardised Approach[6], in IRB risk weights are continuous function of the risk parameters. It follows that banks, particularly those following AIRB, have considerable flexibility in measuring assets risk (RWA optimization). The purpose of this flexibility lies in the awareness that managers know the specific characteristics of their assets better than the regulator, and as a result can use their information set to properly measure risks. Several studies have however pointed out the existence of factors, associated with bank characteristics and country characteristics, that may explain part of the heterogeneity in risk weights across banks.

The first factor - *bank characteristics* - assumes that differences in risk weights are attributable to heterogeneity in banks' operations, particularly to the difference between commercial banks and investment banks, see Le Leslé and Avramova (2012). Commercial banks have a model that is intensive in terms of lending to corporations, especially SMEs, that carry large risk weights to compensate for higher probabilities of default. Banks may optimize and partially offset this effect. In principle, banks could decide to equalize the risk-corrected return on equity across asset classes, and decide to downplay a given activity if the associated risk weights imply a heavy use of capital. However, this may apply to asset classes in the context of the same business model (for example, residential mortgages and loans to SMEs), but is unlikely to induce a bank to move across boundaries, for example pushing a commercial bank to become an investment bank. It is much easier for banks to act on the way risk is computed, by convincing regulators to authorize them to

[6] Under the Standardised Approach risk weights depend on the external ratings, the number of risk buckets is small and for past-due loans some degree of discretion can be exercised by national authorities in reducing the risk weight according to the level of provisioning of each loan.

use favourable internal models. Indeed, Cannata, Casellina and Guidi (2012) focuses on credit risk and shows that a large part of interbank dispersion across Italian banks is due to the use of the internal-rating based approach (IRB).

The second - *country characteristics* - posits that the main drivers of international differences in risk weights are represented by country characteristics. Banks mainly operating in one country need to take into account several elements of their environment, such as laws and industrial structure, to fine tune their risk weights. Borrowers' risk can be of paramount importance, as an increase in the average default probability of borrowers implies a revision of bank's PD and thus higher RWA[7]. So long as rating systems are responsive to changes in borrowers' default risk, risk weighted assets (and consequently capital requirements) will increase increase (decrease) if the economy shrinks (expands) (Catarineu-Rabell et al., 2005). Creditor' protection is also relevant: stronger creditor rights are associated with increased lending to a wider and potentially riskier set of borrowers (Djankov et al., 2007) and with higher bank risk-taking (Houston et al., 2010) but also with lower corporate risk-taking (Acharya et al., 2011). The latter is due to risk aversion on the part of the management trying to decrease the probability of distress. The final impact of creditor rights on the RWA density depends therefore on which channel is stronger.

Moreover, national regulators themselves intervene in a discretional way to interact with the banks and induce them to set higher or lower weights, depending on their risk aversion and understanding of the general economic situations. Banks may determine their own internal model risk weights, but have first to obtain permission from their domestic regulator. Strict supervisory controls may determine prudent management behaviour and a higher RWA density. Basel II recognizes an important role to supervision in risk assessment, as approval and validation of IRB models is a key element of the new capital regime. The positive relation can also be due to the evidence that regulatory restrictions increase bank-taking incentives and thus the investment in risky assets (Gonzales, 2005).

[7]This represents the potential procyclicality caveat of the Basel Capital Accord.

Our hypothesis - *cost of equity capital* – has, to our knowledge, never been previously formulated. The cost of equity capital may be relevant because banks try to save on capital and therefore optimize its allocation to various activities, including regulatory capital. This optimization activity is not cost-free, as it may be achieved only by increasing the size and complexity of the risk department and being available to take more risk. The optimization that is carried out by each bank therefore results from a comparison of internal development costs and expected revenues associated with a reduction in the use of capital. This optimization has a bright side and a dark side. The bright side of RWA optimization is the possibility to better tune the capital needs to the actual risks run by the banks. The dark side is the selection of a level of capital that may be insufficient relatively to the actual risks. In theory, a bank that is short of regulatory capital may reduce risk weights and become compliant even without raising new capital. This should not be allowed to happen by alert regulators, that may permit RWA optimization to take place only if they believe that banks' internal models indeed offer a better assessment of risks than externally imposed risk weights. Overall, our central hypothesis is that a higher cost of equity capital and better growth opportunities[8] can induce banks to decrease risk weights.

3. **Data**

The empirical analysis uses an unbalanced panel data set of 548 banks from 45 countries over the period 2005-2011 (see the Appendix A for the list of countries and the number of banks per country). The availability of bank-specific and country-specific variables leads to a sample of around 1,000 bank-year observations. Our dependent variable is the ratio between risk weighted asset and total asset (RWTA)[9]. We acknowledge that this is a proxy of the variable we would like to examine, risk weights, but it is impossible to obtain data on weights for a large sample of

[8]For example, bank managers who foresee profitable lending opportunities may try to reduce RWA density in order to have a capital buffer that may support more lending.

[9] The European Banking Authority (2013) and Cannata et al. (2012) use the ratio between RWA and EAD as a proxy for the average risk weights. We have data on EAD only for a small sub-sample of mainly European banks.

international banks. The banks included in our sample have total assets larger than U.S. $1 billion as of 2010 and must have data on risk weighted assets for at least five years[10].

[Insert figure 1 around here]

Figure 1 displays the variability of the RWA density across countries, years and banks. Panel A shows the existence of substantial variations across countries and within each country. The country average can be as low as 0.2 and as high as 0.8. Dispersion within each country is also wide and heterogeneous. Panel B shows the RWTA for each bank across time and suggests that there has been a very relevant temporal variability. Panel C shows that, over time, the average RWTA is stable at approximately 60%. Figure 1 confirms that it is useful to study the RWA density through a large sample of international banks observed through time. The relevant sources of cross-bank, cross-country and cross-time variability should provide strong signals to uncover the factors determining the RWA density.

Table 1 shows the characteristics of the RWTA for the full sample and for the two subgroups of countries that adopt and do not adopt Basel II. Summary statistics show that banks located in countries not adopting Basel II have a RWTA of 70.29%, against 60.53% of banks belonging to countries adopting Basel II. The t-test of the mean difference for the two subsamples rejects the null of equality of means at any probability level. Basel II seems to be a relevant factor in driving RWTAs.

[Insert table 1 around here]

The main data source for bank's characteristics are Bureau van Dijk's Bankscope and bank's annual reports (Appendix B includes variables definition and data sources). All financial variables are converted into US dollars.

[Insert table 2 around here]

Bank-level variables summary statistics are reported in Table 2, panel A. All the variables have been winsorized at the 1% and 99% percentiles of their sample distribution to reduce the

[10]We remove observations regarding two banks (Comdirect and SCBT) where the RWTA were anomalous.

influence of outliers and potential data errors. Approximately half the banks in our sample adopt an IFRS accounting standard, and more than 60% follow the Basel II regulation. The average annual increase in the loan to asset ratio is only 0.4%, coherently with the slow-down in economic activity associated with the credit crisis. The average price-to-book ratio is 1.17 with a median close to 1. The average ratio between net interest income and total assets (net interest margin, taken as a proxy of the business model) is 3%. The median beta (measured from a market model regression for each bank with respect to the correspondent local equity index described in Appendix A) is close to 1 with a substantial standard deviation; such heterogeneity is welcome as our main hypothesis is about the relation between the cost of capital and the RWA density. The ratio between equity and total assets is 8.34% but goes down to 7.19% when tangible equity is considered. The average return on equity is 7.14% with a median of 10.17% and a large standard deviation due to observations with low or negative return on equity. Impaired loans are on average 4.37% of gross loans. The average tier one ratio is 12.22%. The natural logarithm of the z-score, which indicates the number of standard deviations that a bank's rate of return on asset has to fall before becoming insolvent, see Laeven and Levine (2009), is equal to 3.18 on average. Average total assets for the banks adopting the Basel 2 regime is equal to U.S. $176 billion.

Table 2, panel B, provides summary statistics for country level variables, that we gather from several databases: the legal origin of the country where the bank's headquarter is located and the degree of creditor rights come from Djankov et al. (2007); the World Bank ''Doing Business'' provides information regarding the recovery rate in case of insolvency and the strength of legal rights; the World Bank Survey on Bank Regulation and Surpervision 2008 and 2012 are used to construct the variable Official, measuring the power of the commercial bank supervisory agency; the index of financial freedom comes from the Heritage Foundation; finally, the Report to G20 leaders on Basel III implementation by the Bank of International Settlements (June 2012) and the answer 3.1 (part 3 on Capital) of the World Bank Bank Regulation and Surpervisory survey (December 2012) are used for constructing the dummy Basel II that provides information on whether the country applies the Basel II capital regime. We retrieve data on corporate income taxation from the OECD database.

Pairwise correlations between bank-level variables (Panel A of Table 3) and country variables (Panel B of Table 3) are generally small.

[Insert Table 3 around here]

4. **Empirical analysis**

In testing for the impact of betas and other variables on the density, a potential concern has to do with endogeneity. While we want to test for the possibility that banks use internal risk models to decrease the density as a reaction to the cost and benefit of holding equity capital, we recognize there are alternative possibilities. An alternative is that the density affects the beta rather than the other way around. Another alternative is that there is a third variable, leverage being the natural candidate, driving both the density and beta. The business model itself, affecting beta, might be jointly determined with density optimization.

To face such concerns we start with a static panel approach where we lag all independent variables, i.e. look at the impact of lagged betas (as well as lagged values of the control variables) on the current density, and control for several variables that in principle could drive beta. This makes it less likely that we find a spurious relation. We next move to a dynamic approach in a system GMM framework that includes the lagged level of the density in the specification and allows for endogeneity of the variables. We present both sets of results and look at their homogeneity.

Endogeneity would play *against* our hypothesis of a negative relation between the cost of equity capital and the density, as it would make the estimated coefficient more likely to be positive rather than negative. This is clearly true if beta is determined by the density, as higher risk weights should be associated with larger betas. The same happens if leverage determines both systematic risk and the density, as both would increase with the asset equity ratio. To explain a negative relation between density and beta, we would need an unobserved variable with a positive effect on systematic risk and a negative effect on the density.

4.1 ***A static approach***

In our static approach we explain the RWA density, RWTA, of bank *i* belonging to country *j* at time *t*, $RWA_{i,j,t}$, on the basis of variables determined at time *t-1*:

$$RWTA_{i,j,t} = \alpha_0 + \alpha_1 \beta_{i,t-1} + \alpha_2 \beta_{i,t-1} \times BAS_{j,t-1} + \alpha_3 PB_{i,t-1} + \alpha_4 NIM_{i,t-1} + \alpha_5 X_{i,t-1} + \alpha_6 CE_{j,t-1} + \varepsilon_{i,j,t} \qquad (1)$$

β is the cost of capital, that we proxy with the beta of the bank. In the absence of RWA optimization, we would expect beta to have a positive relation with the density, as a higher level of (operational and/or financial) risk should be associated with a higher ratio between RWA and total assets. The presence of RWA optimization however, possible for a bank belonging to a country signing the Basel Accord, for which the dummy variable *BAS* is equal to one, should change the sign of the coefficient, as riskier banks would try to reduce weights to save on equity capital. *PB* is the price-to-book ratio that proxies for the benefit of holding capital for exploiting future growth opportunities. We expect its impact to be negative, i.e. banks with better growth opportunities should try to reduce the density as much as possible. In our robustness analysis, we alternatively use the future growth rate of loans and the return on equity as proxies for the benefit of holding capital.

NIM is the net interest margin. It represents the business model of the bank, accounting for the difference between traditional relationship banking and transaction oriented activities, see also Demirguc-Kunt and Huizinga (2011). We expect this coefficient to be positive because regulation implies higher risk weights for commercial banking activities that cannot be completely unwind by the application of internal models.[11] In our robustness analysis, we alternatively use a dummy that distinguishes between commercial banks and investment banks and the ratio between loans and total assets.

[11] We also use the winsorized ratio between total loans and customer deposits, obtaining very similar result in terms of relevance of both the business model and the other explanatory variables.

X represents bank control variables, such as equity over total assets, size (proxied by log of total assets), the ratio between impaired loans and total loans, and the log of the Z-score. Importantly, equity over total assets is the inverse of the leverage ratio; we include it in order to avoid a spurious relation between beta and the density due to the association between leverage and the cost of capital. Controlling for leverage allows us to disentangle the marginal effect of RWA optimization. LTA is relevant because the implementation of Basel II may be achieved through the development of internal rating based models for a wide range of risks and counterparties, but requires investing substantial resources in a large and skilled risk management team. The bank's decision to move from a standardized to an IRB approach implies a relevant investment which is more easily undertaken by larger institutions, as discussed by Hakenes and Schnabel (2011). Controlling for the riskiness of the bank through LGZ, the log of the Z-score, allows us to interpret our findings as a result of the process of RWA optimization by the management rather than as a result of the reaction of bank management to regulators setting the risk weights.

CE represents country effects. There are two types of effects, one relevant at the static level when comparing banks located in different countries, and one relevant at the dynamic level within each country. At the static level, country heterogeneity may be due to institutions, laws, accounting standards and creditor's rights. At the dynamic level, risk may increase in a country because of a specific policy shock, forcing banks using internal models to update their PDs to account for an increased level of defaults. Moreover a country could have a more oscillating cycle (e.g. the USA) while another country (e.g. a European country) may have less volatility (compensated by lower average growth) due to differences in labour market flexibility, role of the State, degrees of protection of creditors and investors.

In terms of proxies for country effects, we alternatively[12] use fixed country effects and a number of proxy variables. We identify the following variables: the expected default frequency of the corporate sector (*EDF*), that may proxy for general riskiness of the lending environment; the

[12]Most of these variables do not move enough over time to be included together with fixed country effects.

index of official power (*OFFICIAL*) to measure the impact of regulation; a dummy that is equal to one when the country has adopted Basel II (*BAS*). *TAX* is the central government statutory corporate income tax rate. In principle, taxes might make equity more costly, so that accounting for different tax rates is a serious challenge for the cost of individual bank equity capital to show its impact on the density.

Finally, to measure the institutional environment we use the index of creditor rights (*CREDITOR RIGHTS)* from La Porta et al. (1998) that assembles information on reorganization and liquidation procedures. We alternatively use four other indexes. The first is a dummy equal to one when the legal origin is represented by the common law (*COMMON LAW*), that usually is associated with a higher loan to asset ratio and a higher degree of legal rights protection (Cole and Turk Ariss, 2011). La Porta et al. (1997), find that legal origin explains much of the cross-country variation in legal protection of investors. Djankov et al. (2007) establish that credit from financial intermediaries to the private sectors as a share of GDP is higher in countries of British legal origin. The second is the strength of legal rights (*LEGAL RIGHTS*), measuring the effectiveness of collateral and bankruptcy laws, obtained from the World Bank Doing Business Indicator. The third is the index of Financial Freedom (*FINANCIAL FREEDOM*), also used by Demirguc-Kunt and Huizinga (2011), that measures the openness of the financial system by looking mainly at the relevance of the public sector and its involvement in the allocation of credit.[13] The fourth is the recovery rate (*RECOVERY*) which is inversely related to the LGD. Recovery procedures, usually considered bank-specific, are strongly affected by national practices. These factors play a role in the risk management decisions as different recovery track records are associated with different risk weights and can affect bank officers' risk aversion.

Differences in accounting standard introduce a bias in the way total assets are computed. For example, the netting of derivatives positions is authorized under US GAAP but not allowed under IFRS. Thus off-balance sheet positions would appear "larger" on an IFRS basis.IFRS

[13]The index has been used to proxy for risk-taking on the part of banks, but Gonzales (2005) has shown that its relation with risk-taking is empirically ambiguous.

implementation is empirically associated to higher total adjusted assets and consequently to lower RWA density, see Le Leslé and Avramova (2012). *A* is a dummy variable whose value is 1 when the bank adopts the IFRS accounting standard and takes the value 0 otherwise

The results for panel regressions with fixed effects (year and country) and lagged bank-level variables are shown in table 4.

[Insert Table 4 around here]

Column 1 presents the basic specification; bank's control variables are added in the remaining columns. β is not significant, but the interaction between β and the Basle dummy is negative and significant in all specifications. A two standard deviation increase in the interaction $\beta \times BAS$ is associated with a reduction in the density of 5.4%, corresponding to a RWA saving of approximately U.S. $5 billion on average. The interpretation is that high-β banks in the Basle II framework have lower RWTAs, consistent with the hypothesis that stronger incentives to save capital lead to more optimization whenever this is allowed by regulation. Interestingly, the Basle II dummy variable by itself is not statistically significant. The price-to-book[14] has a negative coefficient: growth opportunities require banks to increase assets; in order to avoid raising capital, banks may decide to optimize risk weights more aggressively. The net income margin is positive, confirming that traditional banking activity is associated to higher risk weights[15].

The accounting dummy is negative, as expected. We also control for other bank level variables: the log of total assets, ratio between equity and total assets, the ratio of non-performing loans to gross loans, the log of the Z-score. The log of total assets is always significantly negative, as big banks use their risk departments to develop internal rating models. The adoption of the IRB approach requires the construction and maintenance of large internal databases, the acquisition of expertise necessary to build rating systems for each class of counterparts comparable to those

[14]We also try the interaction between the variable representing the benefit of capital and the dummy representing the jurisdictions adopting Basel II. Given the lack of statistical significance and the lack of space we do not report the correspondent specification in table 4 but results are available upon request to the authors.
[15]The dummy that distinguishes between commercial banks and investment banks was never significant in our specifications.

available from recognized external credit assessment institutions and several accurate validation procedures by the national supervisory body. The ratio of the book value of equity to total assets[16] is positive, as banks with low leverage may have less motivation to pursue RWA optimization policies. The ratio of non-performing loans to gross loans, in principle, should boost the stock of risk weighted assets as it worsens the risk profile of the loan portfolio. Finally, we control for idiosyncratic risk by including the log of the z-score. Interestingly, the last two control variables have no significant impact on the RWTA density.

An alternative way to account for country-specific effects is to introduce country level variables into equation (1).

[Insert Table 5 around here]

The basic results regarding bank characteristics are unaffected by the introduction of country specific variables, except for the significance of the accounting standard (A) and of the β coefficient that becomes significantly positive. As to the cost of capital, the overall effect (the sum of the coefficients of β and $\beta \times BAS$) is negative for banks belonging to jurisdictions adopting the Basle 2 framework. The positive relation between β and the density[17] for banks not belonging to Basle II may be due to the impact of systematic risk. Risky assets have a positive impact on the density, and the effect may be magnified by leverage. Actually, the presence of such a positive relation for non-Basel II banks reinforces our results on the peculiar negative relation between beta and density for Basel II banks.

Among country level variables, the average Expected Default Frequency (EDF) of the national corporate sector and the degree of official monitoring are significant with the expected sign, as higher environmental risk forces banks to maintain higher risk weights and more severe regulators prevent banks from over-optimizing. Creditor rights is positive and significant only when

[16]Alternatively we tried the ratio of tangible equity to total assets, with no difference in results. In the tables we kept the EQTA ratio simply to avoid the loss of observations due to a larger number of missing values associated to goodwill and other intangibles.
[17]The lack of such a relation in the previous specification may have been due to the presence of fixed country effects absorbing the impact of β.

the variable Legal rights is also included in the regression (it appears with a negative sign). We have already pointed out that their sign could be either negative or positive depending on the relative strength of demand and supply channels. As to other proxies of the institutional setting, the recovery rate is negative and significant while the index of Common Law and the index of Financial Freedom are not significantly different from zero.

4.2 ***The dynamic model: the system GMM approach***

In this section we consider a dynamic panel:

$$RWTA_{i,j,t} = \alpha_0 + \alpha_1 RWTA_{i,j,t-1} + \alpha_2 \beta_{i,t} + \alpha_3 \beta_{i,t} \times BAS_{j,t} + \alpha_4 PB_{i,t} + \alpha_5 NIM_{i,t} + \alpha_6 Z_{i,t} + \alpha_7 CE_{j,t} + \varepsilon_{i,j,t} \quad (2)$$

where $\varepsilon_{i,j,t}$ is the error term with $E(\varepsilon_{i,j,t}) = 0$ for all i, j and t. Equation (2) is estimated through a system GMM[18]. We go beyond the simple difference GMM estimator, originally proposed by Arellano and Bond (1991), due to its small sample bias when there are few time periods and the dependent variable is persistent, see Alonso–Borrego and Arellano (1999). Arellano and Bover (1995) and Blundell and Bond (1998) suggest the use of System Generalized Method of Moment (System GMM) that bypasses the finite sample bias if one assumes mild stationarity on the initial conditions of the underlying data generation process.

To test for mild stationarity, we cannot apply standard panel unit root tests due to the unbalanced nature of our dataset. We therefore use an indirect method to assess the appropriateness of system over difference GMM, that indirectly tests for the mild stationarity property of RWTA. We first estimate equation (2) using a simple OLS and a within panel estimator to obtain a range for the endogenous lagged coefficient term. This turns out to lie between 0.87 and 0.43. Second, we estimate (2) both using the difference GMM which gives a point estimate of 0.75 (associated with a standard error of 0.09) and the system GMM which gives an estimate of 0.65 (associated with a standard error of 0.07). Hence the system GMM estimate lies comfortably in the range above and this, together with the quality of the fit (see Table 7), indicates the appropriateness of choosing

[18]See Wintoki et al. (2012) for a recent application of system GMM in finance.

system GMM. This method seems appropriate also for a number of reasons: (i) it controls for the possible problem of reverse causality of many of the explicative variables used in the specification, (ii) it does not require a distributional assumption on the error term, (iii) it is suitable for a relatively large number of cross-section observations compared to time series observations.

In table 6 we follow Wooldridge (2002) and test for strict exogeneity by estimating a fixed-effects version of equation (1) that includes future values of some regressors. We alternatively consider specifications that include future values of the net interest margin, β, price-to-book, equity to total assets, and log of total assets, as well as a specification that includes them all. While net interest margin and log assets are not significant, β and price-to-book are significant. We therefore can reject strict exogeneity of such variables. In the system GMM therefore we consider β and price-to-book as endogenous[19], the other bank characteristics as predetermined and the country variables as exogenous.

[Insert Table 6 around here]

The number of instruments tends to increase exponentially altering the reliability of results. Thus we follow Roodman (2009) and implement his routine to collapse instrument matrix and use only one lag of the dependent variable[20]. The standards errors of panel data estimators also need to be adjusted because each additional time period of data is not independent of previous periods. We thus compute robust standard errors.

Table 7 reports one–step system GMM estimates of equation (2)[21]:

[Insert Table 7 around here]

We compute three main tests to determine the appropriateness of our dynamic GMM estimation. Firstly we run the Arellano-Bond test for autocorrelation of errors, with a null

[19]It is however interesting that we can reject the hypothesis that the density affects beta both in a system GMM with country and time fixed effects and in a panel OLS with lagged dependent variable.
[20] All GMM estimations are carried out using the xtabond2 package in Stata (see Roodman, 2009)
[21] Technically, the two-step estimator is asymptotically more efficient. However Monte Carlo studies have shown that the efficiency gain is typically small, and that the two-step GMM estimator has the disadvantage of converging to its asymptotic distribution relatively slowly. In finite samples, the asymptotic standard errors associated with the two-step GMM estimators can be seriously biased downwards, and thus form an unreliable guide for inference (Bond, Hoeffler, and Temple, 2001).

hypothesis represented by no autocorrelation in differenced residuals (more specifically, the second-order test in first differences for autocorrelation in levels). Secondly, we over-identify the system through the use of multiple lags, and carry out the Hansen *J* test which is distributed as a χ^2 under the null hypothesis of the validity of our instruments. Thirdly, we also show the results of the Diff-in-Hansen test for the validity of the additional moment restrictions necessary for system GMM. The system GMM estimator makes the additional exogeneity assumption that any correlation between our endogenous variables and the unobserved fixed effect is constant over time. This assumption allow us to include the levels equations in our GMM estimates and use lagged differences as instruments for the levels. The Diff-in-Hansen test also yields a *J*-statistic with a χ^2 distribution under the null hypothesis that the subset of instruments we use in the levels equations are exogenous.

In all cases the Arellano-Bond test for zero autocorrelation shows that there is no evidence of serial correlation at order two and the p-values of the Hansen *J* tests do not reject the null hypothesis. In summary our test statistics hint at a proper specification.

Table 7 reports seven regressions of the RWA density. In all regressions, the bank level variables enter with the expected sign when significant. Differently from the results in table 4 but in line with those of table 5, we find that the variable associated with the cost of capital is significant and positive. Again, the coefficient of β is smaller than the negative coefficient of the interaction between β and BAS. According to our results, use of internal models more than offsets the natural tendency of a positive association between β and the density. Similarly to results presented in table 5, the dummy variable BAS is usually not statistically significant. The net interest margin is positive and highly significant, confirming that more traditional banks have a higher density. The price-to-book is negative as expected. Leverage and total assets are usually not significant.

Finally, the estimates do not assign an important role to the selected country-level variables. Creditor rights shows a positive impact and Legal rights a negative impact on the RWA density.

However OFFICIAL is not significant anymore, contrary to what happened in the panel results. Heterogeneity of regulators' attitude towards monitoring banks' internal models does not seem to be a primary factor in explaining international differences. The corporate income tax is not significant, while β remains significant, and we interpret this as a sign that the impact of the cost of equity capital is a true element in the picture and not a consequence of the general impact of taxation on the relative costs of debt and equity.

5. Robustness and further insights

5.1 ***Robustness***

Table 8 Panel A presents the parameter estimates obtained substituting PB with two alternative measures of business opportunities, the return on average equity (ROAE) - column (1) and (2) - and the future growth of loans DLOTAF, in columns (3) and (4)[22].

[Insert Table 8 around here]

Ordinary panel data analysis cannot cope with the endogeneity problem due to the use of the future value of the percentage change of gross loans, thus we implement a panel IV GMM regression, where the instruments are the first two lags[23] of the same variable. Column (1) and (3) show specifications without LGZ as control variable which is instead accounted for in column (2) and (4). The statistical significance and sign of the relevant variables holds as in previous tables.

In Panel B, columns (5) and (6) repeat the GMM system analyses for the two subsamples of banks belonging to Basle II and not belonging to Basle II. For banks in Basle II there is a significant negative relation between beta and the density, but for banks out of Basle II the relation is significant and positive. In column (7) the system GMM estimation is repeated when all bank characteristics are treated as endogenous. The results about β remain the same. In column (8), we

[22]As pointed out by Dermine (2009), the price-book ratio may be a reflection of under-provisioning on the part of banks. Banks that are aware of such under-provisioning may minimize RWAs in order to prepare for a future reduction in equity capital taking place when credit losses materialize.
[23] Higher lags were not statistically significant.

use as a proxy for the business model the ratio between loans and assets rather than the net interest margin. The results continue to hold and the loan-to-asset ratio is positively related to the density.

In unreported analyses, available upon request, we show that our main results are moreover robust to the replacement of EQTA with the ratio between Tangible Equity and total assets, with the Tier one ratio, and to additional control variables such as Fragility. To account for macro cyclical conditions we also include in the regressions the GDP growth, and the ratio between public debt and GDP. Furthermore we run a number of additional regressions where we iteratively include a wide range of country-level variables representing regulatory, governance and financial structure variables that have been examined by other researchers as a proxy of the risk taking attitude of bankers.[24] Most of these variables are highly correlated and cannot be included in a single model. Among the regulatory variables[25] we consider Capital (an index of regulatory oversight of bank capital), Monitor (an index that measures the degree to which regulations empower, facilitate, and encourage the private sector to monitor banks) and an index of Deposit Insurance.

We also take into account additional governance variables including Rule of Law and Control of Corruption from the World Bank's Governance indicators, the Corruption Perception index from Transparency International along the line of Beck et al. (2006) who find a positive relation between bank officer's corruption and biased lending policies that can only partially be mitigated by supervisors. In addition we check for the relevance of financial market development by including the natural logarithm of the sum of Private Credit and Market Capitalization divided by GDP, the ratio between (Demand, Time and Saving) deposits and GDP and the banking sector's default risk (z-score), whose values are taken from Beck et al.(2009).[26] Finally we test for the significance of two measures of Bank Concentration - respectively the assets of the three and the five largest commercial banks as a share of total commercial banking assets[27]- as risk taking

[24]For parsimony results are not reported in the tables.
[25]Regulatory variables derive from Barth et al.(2008) and are constructed on data fromWorld Bank's Bank Regulation Survey 2008 and 2012
[26]Data are from the World Bank's Financial Structure database September 2012.
[27]Source the World Bank's Global Financial Development database 2012.

incentive for banks are usually higher as their markets become more concentrated (e.g. Boyd et al., 2005). None of these variables is significant when added to our model and our main results are not affected.

5.2 ***Internal Rating Models and RWA***

As part of the robustness analysis, in this section we study the relation between bank characteristics and internal risk models for a subset of banks in our sample. Here we focus on the percentage of credit EAD modelled by banks through internal models (we call such a variable IRBA). IRBA has two advantages: first it is a direct result of the efforts of banks to use internal models and second it is limited to credit risk and does not also include other sources of risk (e.g. market risk and operational risk) that may affect the density. We are able to measure IRBA from Pillar III reports of 86 international banks located in countries adopting Basle II.

[Insert Table 9 around here]

The results in panel A, with IRBA as the dependent variable, are consistent with our previous findings and confirm the importance of the bank-level variables. Signs are as expected and are reversed with respect to the ones reported in table 4, coherently with the definition of the new dependent variable.

In table 9, panel B, we show the panel estimation with fixed country and year effects explaining the RWTA for the subgroup of 86 banks on the basis of bank-level variables and the percentage of EAD weighted via internal rating models. Results are as expected. A larger share of EAD evaluated with internal rating models is associated with a lower RWA density. All the remaining variables keep the statistical significance and sign as in the previous analyses.

5.3 ***RWA optimization and banks' resilience***

Finally we ask whether a reduction of RWA via optimization has affected bank's resilience and performance during the recent crisis. The estimates of column 3 in table 4 are used to compute a measure of the reduction in RWTA due to bank's cost of capital, defined as the product of (0.0422) - see column 3 of Table 4 - times the average value of $\beta \times BAS$ (0.97) divided by average RWTA (0.64). The average (cross time and cross banks) amount of optimisation turns out to be around 6% of bank RWTA. In unreported results we compute our optimization proxy for banking systems of different countries. Top of the optimization list are banks from Switzerland, Belgium, France, the United Kingdom, Ireland and Germany with values above 10%; there are 10 countries, among which Hong Kong, Italy, Brazil, Austria, Norway and Mexico with values below 6%.

The same idea is used to derive a proxy for each bank-year observation (BOPT) which represents the reduction of RWTA due to optimization (high degrees of optimization corresponding to large positive values).

[Insert Table 10 around here]

Panel A in Table 10 shows the estimates of a panel OLS where the dependent variable (ROAE) is regressed against BOPT and other control variables. In all cases, over the full sample and during times of crisis, the RWA optimization produces a negative effect on bank's performance. This result could be due to a biased valuation of risks that alters the profitability prospects and is robust to the introduction of bank's level control variables, including the cost of capital β (see equation 3 in Table 10). This finding is preliminary, also due to potential measurement error in our proxy for weights optimization, but holds true also when we consider as dependent variable the ratio between net income and total assets[28]. Despite the need for further analyses, this suggests that risk weight optimization have a null short run impact of profitability.

In Panel B, a Probit model - over the sample period 2007-2009, corresponding to the credit crisis - provides estimates of the effect of BOPT and other bank-control variables on the likelihood of an increase of equity capital. The dependent variable is a dummy named CAPIN that is equal to 1 when the number of shares in the year changes at least by 10%. The proxy BOPT affects the capital increase outcome with a positive sign. This means that the higher the level of RWA optimization

[28] Estimates are not reported here for parsimony but are available upon request to the authors.

the higher the likelihood of capital increases during time of distress. IMPLGL is always significant with a positive sign, which can be reasonably associated to a worsening of bank's resilience to shocks due to a deterioration of the loan portfolio. The relevance of the proxy of RWA optimization and of the share of impaired loans is also detected by the margins[29] computed at the mean level, respectively equal to 23% and 22%. All the remaining control variables do not display any statistical significance.

6. **Conclusions**

We show that the cost of equity is a relevant factor in risk weights optimization. This holds under several econometric specifications, and controlling for bank and country characteristics that represent objective sources of heterogeneity in the choice of risk weights. A higher cost of equity capital and better growth opportunities have a negative relation with the ratio between risk-weighted assets and total assets and with the share of credit risk evaluated though internal models. We also find that banks that are more aggressive in terms of such optimization have a subsequent lower return on equity and are more likely to have raised capital during the credit crisis.

Our findings are relevant for regulators, investors, board members and researchers. From the point of view of international competition, our results suggest that an unequal international playing field may be an unintended consequence of the flexibility allowed by regulators to determine risks using the large information sets locally available to banks. Moreover, our analysis also raises the question of whether stock market investors understand the result of this optimization process under the current disclosure arrangements. If investors do understand this process, then stock prices may incorporate the possibility that in some cases equity capital is not large enough to allow the bank to resist adverse shocks. Similarly, researchers would better use a measure of tangible equity rather than the tier one ratio in order to measure resilience to shocks. Finally, it is unclear whether board members have an understanding of the true level of risk incurred by a bank. Negotiations about

[29] The margins are the estimates of the marginal probability effects of the explanatory variables.

RWAs take place between managers and regulators, and board members may not have perfect information about the details and the outcome of the negotiation. They may believe that equity capital is larger than it really is to cover the risks run by the bank.

Our results have nothing to say about the optimal level of bank capital and cannot be interpreted as proof of ‘manipulation’ on the part of banks. Economic theory does predict that banks should set their risk weights on the basis of the cost and benefit of holding equity capital, and regulators may have already accounted for this behaviour when approving and monitoring risk weights. Regulators impose minimum ‘floors’ on banks’ RWAs and this may prevent the selection of inappropriately low weights. What is important is that the resulting level of equity capital is large enough to allow banks to face losses. We do not study this question, except for an analysis of the relation between risk-weight optimization and the likelihood of a capital increase during the crisis.

The ultimate impact of the risk weighting system on banks and the economy at large is a fascinating topic. The risk weighting system may affect business choices of banks, for example by inducing them to over-invest in low-risk weight assets like real estate and government debt. If there are macroeconomic crises associated with the emergence of unforeseen risks in the assets the banks have over-invested into, then indicators of risk that are set by the regulators may have unintended consequences. This could be due to errors in determining risk weights, e.g. regulators suffering from behavioural biases and not looking at the long run experience revealed by the data, and/or new risks exogenously appearing in ways that are unrelated to historical experience, and/or to an endogenous mechanism by which low risk weights allow excess capital to flow into a sector and as a consequence relax discipline among agents in that sector and finally build up risks. In this paper we do not consider such links and limit ourselves to understanding whether the cost and benefit of holding capital do play a role in the current system. We raise the possibility that RWA optimization may be bad for profits and may induce banks both to work with too little capital in normal times and to raise capital in bad times. However, these results should be backed up by further studies that see RWA optimization as part of a broader picture which also includes macroeconomic instability.

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Appendix A: Distribution of banks by country and correspondent local equity index

This table reports the number of banks per countries, the list of countries and the local equity index used for the computation of the variable BETA.

Country	n. of banks	Local Equity Index	Country	n. of banks	Local Equity Index
ARGENTINA	2	ARGENTINA BURCAP	KOREA REP. OF	7	KOREA SE COMPOSITE (KOSPI)
AUSTRALIA	9	ASX ALL ORDINARIES	LUXEMBOURG	1	LUXEMBOURG SE LUXX
AUSTRIA	7	WIENER BOERSE INDEX (WBI)	MALAYSIA	10	FTSE BURSA MALAYSIA KLCI
BELGIUM	2	BEL 20	MALTA	2	MALTA SE MSE
BRAZIL	13	BRAZIL BOVESPA	MEXICO	4	MEXICO IPC (BOLSA)
CANADA	8	S&P/TSX COMPOSITE INDEX	NETHERLANDS	4	AEX INDEX (AEX)
CHILE	4	CHILE SANTIAGO SE GENERAL (IGPA)	NORWAY	17	OSLO SE OBX
CHINA-PEOPLE'S REP.	11	SHANGHAI SE A SHARE	PHILIPPINES	11	PHILIPPINE SE I(PSEi)
COLOMBIA	3	COLOMBIA IGBC INDEX	POLAND	9	WARSAW GENERAL INDEX 20
CYPRUS	2	CYPRUS GENERAL	PORTUGAL	5	PORTUGAL PSI-20
CZECH REPUBLIC	1	PRAGUE SE PX	ROMANIA	3	ROMANIA BET (L)
DENMARK	19	OMX COPENHAGEN BMARK (OMXCB)	RUSSIAN FEDERATION	14	RUSSIAN MICEX INDEX
FINLAND	2	OMX HELSINKI (OMXH)	SINGAPORE	2	STRAITS TIMES INDEX L
FRANCE	7	SBF 120	SOUTH AFRICA	4	FTSE/JSE ALL SHARE
GERMANY	10	DAX 30 PERFORMANCE	SPAIN	11	IBEX 35
GREECE	9	ATHEX COMPOSITE	SWEDEN	4	OMX AFFARSVARLDENS GENERAL
HONG KONG	4	HANG SENG	SWITZERLAND	4	SWISS MARKET (SMI)
INDIA	15	INDIA BSE (100) NATIONAL	THAILAND	4	BANGKOK S.E.T.
INDONESIA	5	IDX COMPOSITE	TURKEY	9	ISTANBUL SE NATIONAL 100
IRELAND	4	IRELAND SE OVERALL (ISEQ)	UNITED ARAB EMIRATES	17	ADX GENERAL
ISRAEL	6	ISRAEL TA 100	UNITED KINGDOM	7	FTSE ALL SHARE
ITALY	18	FTSE ITALIA ALL SHARE	USA	231	S&P 500 COMPOSITE
JAPAN	7	TOPIX			
n. of countries	45		n. of banks	548	

Appendix B: Variables definition and data sources

This table provides the definition of the variables used in this study and their data source. Panel A describes the bank-level variables and Panel B the country-level variables.

Acronym	Description	Source
PANEL A: bank-level variables		
RWTA	Bank's total risk weighted assets on bank's total assets	Our computation on Bankscope raw data
A	Dummy variable whose value is 1 when the bank adopts the IFRS accounting standard and takes the value 0 otherwise	Bankscope
β	Beta estimated at bank-level by a daily CAPM regression with respect to the local equity index described in Appendix A	Our computation on Datastream data
$\beta \times BAS$	Product between Beta and Dummy Basel 2	Our computation On Bloomberg database and Datastream
BOPT	Proxy of RWA optimization according to estimates in table 4 (see section 5.3)	Our computation
BAS	Dummy variable whose value is 1 when the bank's headquarter is located in a country that adopts the Basel2 supervisory regime and takes the value 0 otherwise	BIS an 2012 World Bank survey on Bank regulation
CAPIN	Dummy variable equal to 1 when the number of shares in the year changes at least by 10% and takes the value of 0 otherwise	Our computation on Datastream raw data /Thompson Reuters
DLOTAF	First difference of the ratio of bank's total loans to bank's total assets one period ahead	Our computation on Bankscope raw data
EQTA	Ratio of total equity to total assets (in percentage)	Our computation on Bankscope raw data
FRAGILITY	Deposits from other banks, other deposits and short-term borrowing to total deposits plus money market and short-term funding, as in Beltratti Stulz (2012)	Our computation on Bankscope raw data
IMPLGL	Ratio impaired loans to gross loans (in percentage)	Our computation on Bankscope raw data
IRBA	Percentage of credit EAD modeled by banks through internal models	Banks Annual Reports
LGZ	Z-score, computed as the average bank return on asset plus bank equity to assets ratio scaled by the standard deviation of return on assets over a five-year rolling window. Higher z score indicate lower bank risk. We use the natural logarithm of Z-score because its distribution is highly skewed (in percentage)	Our computation on Bankscope raw data
LTA	Natural log of total assets	Our computation on Bankscope raw data
LOTA	Total bank's loans to bank's total assets	Our computation on Bankscope raw data
NIM	Net interest margin. It is the ratio of the difference between the total interest income and cost of –interest expenses related to - the funds used for making loans and investments on the average interest bearing assets	Our computation on Bankscope raw data
PB	Bank's price to book value	Bankscope
ROAE	Return on average equity (in percentage)	Bankscope
TEQTA	Tangible equity (total equity-goodwill) to total assets	Our computation on Bankscope raw data
T1RATIO	Bank's core capital to total risk weighted assets	Bankscope

PANEL B: country-level variables		
COMMON LAW	Dummy variable that takes value 1 when the country has common law as legal origin	Djankov, McLiesh, and Shleifer(2007)
CREDITOR RIGHTS	An index aggregating creditor rights. It ranges between 0 and 4 over the period of 1978– 2003. It is the sum of the four indexes that follow**:** restrictions on reorganization that equals 1 if the reorganization procedure imposes restrictions and 0 otherwise; no automatic stay that equals 1 if there is no imposition of an automatic stay on the assets upon filing the petition and creditors are able to seize their collateral after the petition is approved and 0 otherwise; secured creditor paid first that equals 1 if secured creditors are ranked first in the distribution of the proceeds of a bankruptcy as opposed to other creditors 0 otherwise; no management stay that equals 1 if an official appointed by the court or by the creditors, is responsible for the operation of the business during reorganization and 0 otherwise	La Porta, Lopez-de-Silanes, Shleifer, and Vishny(1998), Djankov, McLiesh, and Shleifer(2007)
EDF	Average expected default frequency of the domestic corporate sector (not financial)	KMV Moody's Database
FINANCIAL FREEDOM	An indicator of relative openness of banking and financial systems. The index ranges from 0 (very low) to 100 (very high). It reflects the government ownership of financial institutions, restrictions on the ability of foreign banks to open branches and subsidiaries, government influence over the allocation of credit; government regulations	Heritage Foundation's Index of Economic Freedom
LEGAL RIGHTS	The index measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and thus facilitate the lending .The index ranges from 0 to 10. Higher values indicate that laws are better designed to expand access to credit	World bank Doing Business Indicators 2005-2012
OFFICIAL	Index of the power of the commercial bank supervisory agency, including the rights of the supervisor to meet with and demand information from auditors, to force a bank to change the internal organizational structure, to supersede the rights of shareholders, and to intervene in a bank	World Bank Survey on Bank Regulation and Surpervisory 2008 and 2012
RECOVERY	Cents on the dollar recovered by creditors through reorganization, liquidation or debt enforcement (foreclosure) proceedings. It is a present value based on end-of period lending rates from the International Monetary Fund	World bank Doing Business Indicators 2005-2012
TAX	Basic central government statutory corporate income tax rate (inclusive of surtax (if any)), adjusted (if applicable) to show the net rate where the central government provides a deduction in respect of sub-central income tax.	OECD Tax Database

Table 1.
Descriptive statistics RWTA.
This table presents summary statistics for the ratio of RWA to total assets, for the full sample of banks and for both banks located in countries adopting the Basle 2 framework and banks located in countries that do not adopt the Basle 2 framework. The number of observation indicates the total number of firm-year observations.

RWTA	**observations**	**mean**	**Standard deviation**
Full sample	2,420	0.6458	0.1714
Subgroup Basle2	1,416	0.6053	0.1820
Subgroup no Basle2	1,004	0.7029	0.1361
	t value		
t test of different mean in subgroups	-15.09		

Table 2

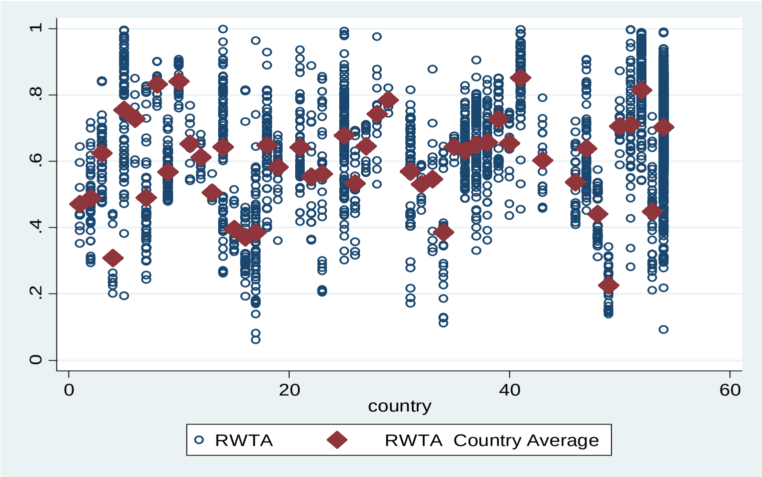
Descriptive Statistics.

This table reports the descriptive statistics of all the explanatory variables. See Appendix B for a detailed description of each variable. Panel A reports summary statistics for bank-level variables. Panel B reports summary statistics for country-level variables.

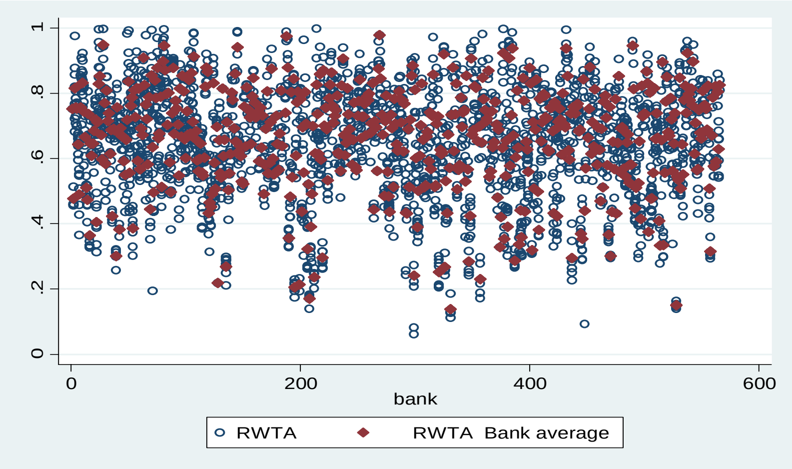
Panel A	***Bank- Level Variables***			
Variable	**Obs**	**Mean**	**Median**	**Std. Dev.**
A	2420	0.5525	1	0.4973
β	1701	0.9598	0.9767	0.4902
BAS	2420	0.6079	1	0.4883
DLOTA	2086	0.0038	-0.0033	0.1232
EQTA	2350	8.3437	7.6331	4.4124
FRAGILITY	2279	17.1413	11.5194	17.4806
IMPL/GL	2202	4.3697	3.0115	4.3534
LGZ	2332	3.1812	3.2128	0.9775
LOTA	2346	0.6066	0.6342	0.1601
LTA	2350	16.6580	16.3648	2.1750
NIM	2350	3.0010	2.8869	1.6823
PB	1957	1.1748	0.9870	0.8489
ROAE	2342	7.1423	10.1750	17.5909
TEQTA	1995	7.1997	6.5788	3.8864
T1RATIO	2305	12.2182	11.2000	5.2447
Panel B	***Country-level Variables***			
Variable	**Obs**	**Mean**	**Median**	**Std. Dev.**
COMMON LAW	2420	0.4793	0	0.4997
CREDITOR RIGHTS	2000	1.6930	1	1.0988
EDF	1937	0.8083	0.3700	1.7201
FINANCIAL FREEDOM	2391	64.2283	70.0000	16.8844
LEGAL RIGHTS	2413	6.9453	8	2.4167
OFFICIAL	2369	9.5129	10	1.8924
RECOVERY	2408	60.5555	75.4000	25.4056
TAX	3045	29.3084	32.7	5.3492

Fig. 1 Dispersion of risk weighted asset density.
(A) dispersion across countries; (B) dispersion across banks; (C) dispersion across time.

(A)



(B)



(C)

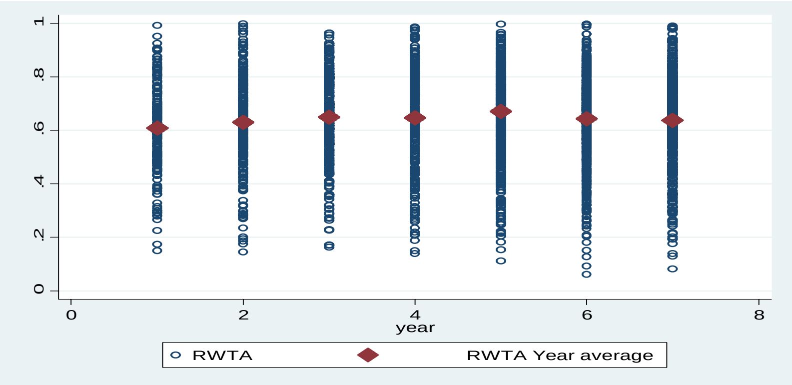


Table 3

Correlations.

The table presents pairwise correlations of the variables. The sample consists of banks located in 45 countries in 2005-2011. All variables are defined in Appendix B. Panel A refers to bank variables. Panel B refers to country variables. * represents significance at 5% level.

Panel A	A	β	β x BAS	BAS	DLOTA	EQTA	FRAGILITY	IMPLGL	LGZ	LTA	LOTA	NIM	PB	ROAE	TEQTA	T1RATIO
A	1															
β	0.0250	1														
β x BAS	0.5654*	0.3262*	1													
BAS	0.6014*	0.0737*	0.8228*	1												
DLOTA	0.1061*	0.0655*	0.1510*	0.1308*	1											
EQTA	-0.1369*	-0.1338*	-0.2328*	-0.1480*	0.1267*	1										
FRAGILITY	0.3225*	0.0824*	0.3381*	0.3123*	0.0336	-0.1266*	1									
IMPLGL	0.0554*	0.1096*	0.1263*	0.0765*	-0.0583*	0.1057*	0.0338	1								
LGZ	0.0631*	-0.3284*	-0.0163	0.0851*	0.0064	0.0954*	-0.0784*	-0.3462*	1							
LTA	0.3753*	0.3508*	0.5146*	0.3398*	0.0363	-0.3610*	0.3081*	-0.1870*	0.0573*	1						
LOTA	-0.0183	-0.1064*	-0.1160*	-0.0855*	0.0252	-0.0126	-0.1759*	-0.0254	0.0765*	-0.2728*	1					
NIM	-0.3255*	-0.0829*	-0.4051*	-0.3667*	0.0522*	0.5151*	-0.2622*	0.2059*	-0.0492*	-0.4447*	0.1910*	1				
PB	0.1525*	-0.1305*	0.0484	0.1231*	0.1119*	0.1115*	0.0385	-0.2420*	0.2587*	0.0979*	-0.1078*	0.0433	1			
ROAE	0.1566*	-0.1632*	0.0784*	0.1297*	0.1327*	0.2290*	-0.0506*	-0.3831*	0.4358*	0.1524*	-0.0784*	0.1082*	0.3795*	1		
TEQTA	-0.1832*	-0.1268*	-0.2082*	-0.1349*	0.1413*	0.9515*	-0.1351*	0.1035*	0.0918*	-0.4216*	-0.0392	0.5390*	0.1126*	0.2359*	1	
T1RATIO	-0.1956*	-0.0509*	-0.1849*	-0.1325*	0.0643*	0.7117*	-0.0344	0.1128*	-0.0293	-0.3221*	-0.2547*	0.3340*	0.0433	0.1153*	0.7009*	1

Panel B	COMMON LAW	TAX	CREDITOR RIGHTS	EDF	FINANCIAL FREEDOM	LEGAL RIGHTS	LT GOV RATE	OFFICIAL	RECOVERY
COMMON LAW	1								
TAX	0.5737*	1							
CREDITOR RIGHTS	-0.1524*	-0.4292*	1						
EDF	-0.2178*	-0.2972*	0.2594*	1					
FINANCIAL FREEDOM	0.4130*	0.3074*	-0.3363*	-0.2445*	1				
LEGAL RIGHTS	0.6721*	0.3469*	0.0157	-0.2084*	0.6342*	1			
LT GOV RATE	-0.1727*	0.0961*	-0.1058*	0.1507*	-0.2218*	-0.3387*	1		
OFFICIAL	0.2887*	0.3305*	-0.2766*	-0.2070*	0.2977*	0.2198*	0.2162*	1	
RECOVERY	0.3652*	0.3699*	-0.1696*	-0.2669*	0.6879*	0.6200*	-0.4978*	0.0728*	1

Table 4

RWTA panel OLS estimations with fixed country effects.

This table presents estimates of $RWTA_{i,j,t} = \alpha_0 + \alpha_1\beta_{i,t-1} + \alpha_2\beta_{i,t-1} \times BAS_{j,t-1} + \alpha_3 PB_{i,t-1} + \alpha_4 NIM_{i,t-1} + \alpha_5 X_{i,t-1} + \alpha_6 CE_j + \varepsilon_{i,j,t}$ where $RWTA_{i,j,t}$ is the RWA density, *i* indexes the bank, *j* indexes the country and *t* denotes the year. β is the cost of capital, *PB* is the price-to-book, *NIM* is the net interest margin, *X* are bank characteristics, and *CE* are country effects, here assumed to be fixed. See Appendix B for variable definitions. Robust standard errors are used to compute the Student-*t*. ***** , ****and* represent statistical significance at the 1%, 5% and 10% level respectively.

	1		2		3		4		5	
	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t
NIM $_{t-1}$	0.0392	8.44 ***	0.0347	7.18 ***	0.0312	6.45 ***	0.0306	6.27 ***	0.0237	4.55 ***
β $_{t-1}$	0.0002	0.02	0.0014	0.15	0.0116	1.15	0.0078	0.75	0.0107	1.01
β x BAS $_{t-1}$	-0.0475	-2.92 ***	-0.0440	-2.70 ***	-0.0422	-2.62 ***	-0.0385	-2.40 **	-0.0288	*-1.70* *
PB $_{t-1}$	-0.0132	-2.48 **	-0.0145	-2.70 ***	-0.0125	-2.28 **	-0.0130	-2.28 **	-0.0098	*-1.69* *
A $_{t-1}$	-0.0876	-2.63 ***	-0.0840	-2.51 **	-0.0803	-2.55 **	-0.0967	-2.91 ***	-0.0575	-1.21
BAS $_{t-1}$	-0.0164	-0.92	-0.0187	-1.11	-0.0109	-0.70	-0.0117	-0.74	0.0812	1.40
EQTA $_{t-1}$			0.0057	3.51 ***	0.0054	3.33 ***	0.0056	3.37 ***	0.0057	3.33 ***
LTA $_{t-1}$					-0.0081	-3.26 ***	-0.0074	-2.91 ***	-0.0064	-2.37 **
LGZ $_{t-1}$							-0.0059	-1.21	-0.0038	-0.75
IMPLGL $_{t-1}$									0.0006	0.43
CONSTANT	0.8522	20.10 ***	0.7890	17.13 ***	0.9126	16.08 ***	0.9318	16.02 ***	0.7787	12.86 ***
Year fixed effects		YES		YES		YES		YES		YES
Country fixed effects		YES		YES		YES		YES		YES
n. of obs		1326		1326		1326		1283		1207
Adjusted R2		0.508		0.516		0.521		0.521		0.521

Table 5

RWTA panel OLS estimations with country-level variables.

This table presents estimates of $RWTA_{i,j,t} = \alpha_0 + \alpha_1\beta_{i,t-1} + \alpha_2\beta_{i,t-1} \times BAS_{j,t-1} + \alpha_3 PB_{i,t-1} + \alpha_4 NIM_{i,t-1} + \alpha_5 X_{i,t-1} + \alpha_6 CE_{j,t-1} + \varepsilon_{i,j,t}$ where $RWTA_{i,j,t}$ is the RWA density, i indexes the bank, j indexes the country and t denotes the year. β is the cost of capital, *PB* is the price-to-book, *NIM* is the net interest margin, *X* are bank characteristics, and *CE* are country-level variables. See Appendix B for variable definitions. Robust standard errors are used to compute the Student-*t*. ***** , ****and* represent statistical significance at the 1%, 5% and 10% level respectively.

	1		2		3		4		5		6		7		8	
	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t
NIM $_{t-1}$	0.0410	7.73 ***	0.0405	7.46 ***	0.0428	7.24 ***	0.0384	6.74 ***	0.0406	7.35 ***	0.0364	6.45 ***	0.0405	7.42 ***	0.0612	7.72 ***
β $_{t-1}$	0.0217	2.09 **	0.0206	1.98 **	0.0206	1.98 **	0.0191	1.81 *	0.0206	1.98 **	0.0190	1.83 *	0.0208	1.99 **	0.0177	2.83 **
β xBAS $_{t-1}$	-0.0614	-3.27 ***	-0.0749	-3.95 ***	-0.0761	-3.98 ***	-0.0745	-3.91 ***	-0.0751	-3.92 ***	-0.0716	-3.82 ***	-0.0799	-4.15 ***	-0.0990	-3.81 ***
PB $_{t-1}$	-0.0274	-3.99 ***	-0.0290	-4.08 ***	-0.0293	-4.04 ***	-0.0303	-4.27 ***	-0.0291	-4.06 ***	-0.0273	-3.87 ***	-0.0294	-4.10 ***	-0.0268	-2.01 ***
A $_{t-1}$	0.0182	1.33	-0.0002	-0.01	-0.0042	-0.26	0.0029	0.19	0.0008	0.05	-0.0186	-1.22	0.0087	0.51	-0.0127	-0.27
BAS $_{t-1}$	0.0202	0.86	0.0308	1.18	0.0384	1.43	0.0197	0.74	0.0318	1.16	0.0065	0.24	0.0257	0.93	0.0551	1.09
EQTA $_{t-1}$	0.0068	3.65 ***	0.0053	2.79 ***	0.0053	2.75 ***	0.0048	2.50 **	0.0054	2.81 ***	0.0040	2.06 ***	0.0052	2.75 ***	0.0070	1.22 ***
LTA $_{t-1}$	-0.0123	-4.80 ***	-0.0122	-4.61 ***	-0.0118	-4.28 ***	-0.0122	-4.59 ***	-0.0122	-4.57 ***	-0.0135	-5.05 ***	-0.0123	-4.61 ***	-0.0105	-2.02 ***
EDF $_{t-1}$	0.0093	2.27 **	0.0144	3.99 ***	0.0152	4.16 ***	0.0122	3.25 ***	0.0145	4.01 ***	0.0092	2.46 **	0.0162	4.33 ***	0.0403	3.99 ***
OFFICIAL $_{t-1}$	0.0097	3.25 ***	0.0105	3.45 ***	0.0106	3.49 ***	0.0103	3.36 ***	0.0106	3.42 ***	0.0075	2.36 **	0.0104	3.34 ***	0.0075	1.56 ***
CREDITOR RIGHTS $_{t-1}$			0.0009	0.19	-0.0003	-0.06	0.0024	0.48	0.0008	0.15	0.0097	1.81 *	0.0007	0.15	0.0117	0.65
LT GOV RATE $_{t-1}$					-0.0010	-0.76										
RECOVERY $_{t-1}$							-0.0004	-1.72 *								
COMMON LAW $_{t-1}$									0.0020	0.16						
LEGAL RIGHTS $_{t-1}$											-0.0122	-4.24 ***				
FINANCIAL FREEDOM $_{t-1}$													0.0000	0.09		
TAX $_{t-1}$															0.0011	0.33
CONSTANT	0.5851	11.22 ***	0.5877	10.75 ***	0.5769	10.05 ***	0.6336	10.74 ***	0.5844	9.74 ***	0.7598	10.48 ***	0.5886	8.73 ***	0.4514	3.09 ***
Year fixed effects		YES		YES		YES		YES		YES		YES		YES		YES
n.of banks		340		314		310		314		314		314		310		258
n. of obs		1069		999		984		999		999		999		984		892
Adjusted R2		0.35		0.38		0.37		0.39		0.38		0.39		0.38		0.48
n .of countries		43		36		36		36		36		36		35		25

Table 6

Tests of strict exogeneity.

In this table we presents results estimation of the regression $RWTA_{i,j,t} = \alpha_0 + \alpha_1\beta_{i,t} + \alpha_2\beta_{i,t}\times BAS_{j,t} + \alpha_3 PB_{i,t} + \alpha_4 NIM_{i,t} + \alpha_5 X_{i,t} + \alpha_6 CE_{j,t} + \alpha_7 NIM_{i,t+1} + \alpha_8\beta_{i,t+1} + \alpha_9 PB_{i,t+1} + \alpha_{10} EQTA_{i,t+1} + \alpha_{11} LTA_{i,t+1} + \varepsilon_{i,j,t}$ where *RWTA* is the RWA density, *i* indexes the bank, *j* indexes the country and *t* denotes the year. β is the cost of capital, *PB* is price-to-book, *NIM* is the net interest margin, *X* are bank characteristics, *CE* are country-level variables, and $\varepsilon_{i,j,t}$ is the error term. See Appendix B for variables details. Robust standard errors are used to compute the Student-*t*. ***** , ****and* represent statistical significance at the 1%, 5% and 10% level respectively.

	1		2		3		4		5	
	coef	t	coef	t	coef	t	coef	t	coef	t
NIM $_t$	0.0271	2.50 **	0.0333	2.41 **	0.0338	2.50 **	0.0333	2.38 **	0.0290	2.82 ***
β_t	0.0073	1.20	-0.0293	-6.30 ***	0.0077	1.31	0.0086	1.45	-0.0285	-6.28 ***
β x BAS $_t$	-0.0485	-1.98 **	0.0457	1.81 *	-0.0502	-2.03 **	-0.0492	-2.00 **	0.0426	1.73 *
PB $_t$	-0.0193	-1.99 **	-0.0208	-2.18 **	-0.0092	-1.08	-0.0188	-1.95 *	-0.0109	-1.18
A $_t$	-0.0812	-1.12	-0.0702	-1.07	-0.0808	-1.15	-0.0805	-1.14	-0.0743	-1.11
BAS $_t$	-0.0117	-0.65	-0.0090	-0.57	-0.0052	-0.29	-0.0091	-0.55	-0.0049	-0.27
EQTA $_t$	0.0057	1.50	0.0055	1.47	0.0058	1.52	0.0086	2.70 ***	0.0083	2.83 ***
LTA $_t$	-0.0068	-1.14	-0.0068	-1.25	-0.0069	-1.19	-0.0069	-1.16	0.0011	0.04
NIM $_{t+1}$	0.0069	0.86							0.0063	0.80
β_{t+1}			0.0415	5.29 ***					0.0414	4.69 ***
β x BAS $_{t+1}$			-0.1132	-5.82 ***					-0.1137	-6.23 ***
PB $_{t+1}$					-0.0165	-2.31 **			-0.0148	-1.85 *
EQTA $_{t+1}$							-0.0034	-1.57	-0.0032	-1.45
LTA $_{t+1}$									-0.0075	-0.26
CONSTANT	0.7349	7.31 ***	0.7400	7.89 ***	0.7408	7.47 ***	0.7382	7.42 ***	0.7367	7.61 ***
Year fixed effects		YES		YES		YES		YES		YES
Country fixed effects		YES		YES		YES		YES		YES
Adjusted R2		0.28		0.29		0.28		0.28		0.29
Prob>F		0.40		0.00		0.0253		0.12		0.00

Table 7

RWTA dynamic system GMM estimation.

This table presents estimates from the regression $RWTA_{i,j,t} = \alpha_0 + \alpha_1 RWTA_{i,j,t-1} + \alpha_2 \beta_{i,t} + \alpha_3 \beta_{i,t} \times BAS_{j,t} + \alpha_4 PB_{i,t} + \alpha_5 NIM_{i,t} + \alpha_6 X_{i,t} + \alpha_7 CE_{j,t} + \varepsilon_{i,j,t}$ where *RWTA* is the RWA density, *i* indexes the bank, *j* indexes the country and *t* denotes the year. β is the cost of capital, *PB* is price-to-book, *NIM* is the net interest margin, *X* are bank characteristics, *CE* are country variables, and $\varepsilon_{i,j,t}$ is the error term. All instruments are collapsed; β, *PB*, *EQTA* are treated as endogenous, all other bank-level variables are treated as predetermined; all country-level variables are treated as strictly exogenous. AB test AR1 is the Arellano-Bond test with an auto-regressive model of order one for the error, AB test AR2 is the Arellano-Bond test with an auto-regressive model of order two for the error, Hansen *J* is the test of over-identification and Diff-in-Hansen *J* is the test for the exogeneity of a subset of instruments. See Appendix B for variables details. One step robust standard errors are used to compute the Student-*t*. ***** , ****and* represent statistical significance at the 1%, 5% and 10% level respectively.

	1		2		3		4		5		6		7	
	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t
RWTA $_{t-1}$	0.6466	10.05 ***	0.6471	8.40 ***	0.6203	8.44 ***	0.6985	9.65 ***	0.6106	8.01 ***	0.6639	8.58 ***	0.6677	8.86 ***
NIM $_t$	0.0293	3.23 ***	0.0279	2.54 ***	0.0260	2.40 **	0.0276	3.10 ***	0.0255	2.33 **	0.0275	2.42 **	0.0301	2.28 **
β $_t$	0.0314	1.89 *	0.0303	2.65 ***	0.0282	2.41 **	0.0241	3.76 ***	0.0291	2.60 **	0.0288	2.77 ***	0.0321	3.11 ***
β x BAS $_t$	-0.0430	-2.08 **	-0.0394	-1.82 *	-0.0432	-2.08 **	-0.0293	-1.76 *	-0.0438	-2.14 **	-0.0450	-2.22 **	-0.0397	-2.09 **
PB $_t$	-0.0388	-2.54 **	-0.0512	-3.03 ***	-0.0528	-3.14 ***	-0.0424	-2.50 **	-0.0468	-2.83 ***	-0.0500	-2.85 ***		
A $_t$	-0.0179	-1.58	0.0317	1.38	0.0297	1.40	0.0359	1.80 *	0.0192	1.00	0.0266	1.28	0.0264	0.87
BAS $_t$	0.0121	1.05	0.0428	1.64	0.0323	1.05	0.0387	1.65 *	0.0314	1.21	0.0450	1.75 *	0.0567	1.62
EQTA $_t$	-0.0008	-0.28	0.0068	1.40	0.0052	1.08	0.0061	1.98 *	0.0043	1.07	0.0052	1.37	0.0030	1.12
LTA $_t$	-0.0087	-1.00	-0.0133	-1.57	-0.0118	-1.36	-0.0121	-1.80 *	-0.0125	-1.45	-0.0117	-1.39	-0.0180	-1.72 *
EDF $_t$			0.0018	0.75	0.0011	0.49	0.0017	0.84	0.0008	0.40	0.0019	0.79	0.0004	0.12
OFFICIAL $_t$			0.0014	0.52	0.0018	0.65	0.0010	0.48	0.0010	0.38	0.0012	0.50	-0.0016	-0.50
CREDITOR RIGHTS $_t$			0.0090	1.87 *	0.0099	2.01 **	0.0073	1.58	0.0119	2.69 **	0.0085	1.79 *	-0.0052	-0.63
RECOVERY $_t$					-0.0004	-1.09								
COMMON LAW $_t$							0.0096	0.72						
LEGAL RIGHTS $_t$									-0.0051	-1.93 *				
FINANCIAL FREEDOM $_t$											0.0000	0.05		
TAX $_t$													-0.0016	-1.37
CONSTANT	0.3985	2.34 **	0.2732	1.67 *	0.3149	1.92 *	0.2195	1.55	0.3575	2.02 **	0.2522	1.45 *	0.4386	2.32 **
Year fixed effects	YES		YES		YES		YES		YES		YES		YES	
Country fixed effects	YES		NO		NO		NO		NO		NO		NO	
SE clustered at country level	NO		YES		YES		YES		YES		YES		YES	
n. of obs	1172		964		964		964		964		949		764	
n. of instruments	96		54		55		55		55		55		55	
n. of groups	348		318		318		318		318		314		252	
ratio groups/instruments	3.63		5.89		5.78		5.78		5.78		5.71		4.58	
AB test AR1	0.00		0.00		0.00		0.00		0.00		0.00		0.00	
AB test AR2	0.30		0.65		0.63		0.61		0.62		0.47		0.76	
Hansen J p-value	0.96		0.98		0.99		0.98		0.98		0.99		0.99	
Diff in Hansen test of exogeneity p-value	0.99		0.96		0.86		0.78		0.61		0.79		0.99	
n. of countries	45		36		36		36		36		35		25	

Table 8

Robustness check.

Panel A presents baseline RWTA panel OLS estimation with fixed country effects. The benefit of holding capital is alternatively proxied by the return on average equity (columns one and two) and by the forward percentage change of the ratio of loan to total assets (DLOTAF) (columns three and four). Panel B presents System GMM for two subsamples of countries adopting and not adopting the Basel II regulation (columns five and six). System GMM for the whole sample where all bank variables are treated as endogenous (column seven) and where the business model is proxied by the loan-to-asset ratio (column eight).AB test AR1 is the Arellano-Bond test with an auto-regressive model of order one for the error, AB test AR2 is the Arellano-Bond test with an auto-regressive model of order two for the error, Hansen *J* is thetest of over-identification and Diff-in-Hansen *J* is the test for the exogeneity of a subset of instrument. See Appendix B for variables details. One step robust standard errors are used to compute the Student-*t*. ***** , ****and* represent statistical significance at the 1%, 5% and 10% level respectively

Panel A: Alternative proxies for the benefit of holding capital

	PANEL OLS						PANEL IV GMM to account for endogeneity of DLOTAF					
	1			2			3			4		
	Coef.	t		Coef.	t		Coef.	t		Coef.	t	
NIM $_{t-1}$	0.0277	6.83	***	0.0266	6.57	***	0.0263	5.88	***	0.0262	5.85	***
β_{t-1}	0.0093	0.94		0.0110	1.09		0.0274	2.34	**	0.0255	2.05	**
β x BAS $_{t-1}$	-0.0307	-1.99	**	-0.0298	-1.95	*	-0.0471	-2.29	**	-0.0455	-2.24	**
ROAE $_{t-1}$	-0.0005	-1.97	**	-0.0005	*-1.78*	*						
DLOTAF $_{t-1}$							-0.4700	-2.53	**	-0.4584	-2.44	**
A $_{t-1}$	-0.0744	-2.88	***	-0.0827	-2.99	***	-0.1016	-2.63	***	-0.1018	-2.68	***
BAS $_{t-1}$	-0.0112	-0.82		-0.0095	-0.70		0.0083	0.49		0.0071	0.41	
EQTA $_{t-1}$	0.0050	3.67	***	0.0049	3.58	***	0.0061	3.69	***	0.0062	3.77	***
LTA $_{t-1}$	-0.0074	-3.08	***	-0.0075	-3.07	***	-0.0069	-2.42	**	-0.0068	-2.39	**
LGZ $_{t-1}$				0.0021	0.43					-0.0023	-0.43	
CONSTANT	-0.5229	-15.56	***	0.8934	16.37	***	0.9249	13.76	***	0.9318	13.7	***
Year fixed effects		YES			YES			YES			YES	
Country fixed effects		YES			YES			YES			YES	
n.of obs		1488			1435			969			968	
Adjusted R2		0.545			0.544			0.556			0.559	

Panel B: Alternative System GMM representations

	SYSTEM GMM subsample Basle 2			SYSTEM GMM subsample no Basle2			SYSTEM GMM esplicative bank variables treated as endogeneous			SYSTEM GMM Business model proxied by LOTA		
	5			6			7			8		
	Coef.	t		Coef.	t		Coef.	t		Coef.	t	
RWTA $_{t-1}$							0.7009	8.99	***	0.4648	6.13	***
LOTA $_t$										0.3901	4.93	***
NIM $_t$	-0.0047	-0.22		0.0218	1.13		-0.0036	-0.27				
β_t	-0.0775	-3.08	***	0.0237	2.15	**	0.0321	4.92	***	0.0359	2.39	**
β x BAS$_t$							-0.0400	-3.81	***	-0.0468	-2.67	**
PB$_t$	0.0147	1.24		-0.0503	-1.80	*	-0.0013	-0.07		-0.0398	-3.08	***
A $_t$	-0.1851	-3.81	***	-0.0017	-0.04		-0.0141	-0.61		-0.0299	-1.31	
BAS$_t$							0.0271	2.50	**	0.0295	2.84	***
EQTA $_t$	-0.0012	-0.14		-0.0009	-0.19		0.0037	0.79		0.0022	0.65	
LTA $_t$	-0.0024	-0.11		-0.0150	-1.99	**	-0.0087	-1.20		-0.0146	-1.21	
CONSTANT	1.13087	3.38	***	0.8600	11.31	***						
Year fixed effects		YES			YES			YES			YES	
Country fixed effects		YES			YES			YES			YES	
n.of obs		963			597			1172			1169	
n. of instruments		79			71			76			95	
n. of groups		190			199			348			347	
ratio groups/instruments		2.41			2.80			4.58			3.65	
AB test AR1		0.12			0.72			0.00			0.00	
AB test AR2		0.25			0.87			0.42			0.83	
Hansen J p-value		0.99			0.99			0.99			0.99	
Diff in Hansen test of exogeneity p-value		0.99			0.99			0.99			0.99	
n. of countries		36			9			45			45	

Table 9

Relevance of the internal rating models.

Panel A presents the Tobit estimates for the percentage of EAD evaluated with internal rating models. Panel B reproduces the regressions in table 4 for the sample of 86 banks, adding as explanatory variable the percentage of EAD modeled through internal models. All variable definitions are in Appendix B. Standard errors are robust and clustered by years. ***** , **** and* represent statistical significance at the 1%, 5% and 10% level respectively.

Panel A : Tobit regression, dependent variable IRBA

	1			2			3		
	Coef.	t		Coef.	t		Coef.	t	
β_{t-1}	0.1979	18.72	***	0.2061	4.18	***	0.1914	7.09	***
PB $_{t-1}$				0.1224	2.45	**	0.1700	3.54	***
NIM $_{t-1}$							-0.0927	-6.58	***
EQTA $_{t-1}$							-0.0578	-3.45	***
LTA $_{t-1}$							-0.0124	-0.59	
CONSTANT	5.5E+06	11.76	***	4.0E+06	2.82	***	1.0276	2.04	**
Country fixed effects		YES			YES			YES	
n. of countries		27			27			26	
n. of obs		263			237			233	
Pseudo R2		0.46			0.55			0.60	

Panel B: Panel OLS , dependent variable RWTA

	1			2		
	Coef.	t		Coef.	t	
IRBA $_{t-1}$	-0.0806	-4.78	***	-0.0472	-5.36	***
β_{t-1}				-0.0499	-4.26	***
PB $_{t-1}$				0.0219	1.58	
NIM $_{t-1}$				0.0502	4.76	***
EQTA $_{t-1}$				0.0127	2.70	***
LTA $_{t-1}$				-0.0482	-7.73	***
CONSTANT	0.5539	11.76	***	1.0276	2.04	**
Country fixed effects		YES			YES	
n. of countries		27			24	
n. of obs		225			160	
Adjusted R2		0.72			0.87	

Table 10

The impact of RWA optimization on profitability and the likelihood of a capital increase during the crisis.

This table studies the impact of our RWA optimization proxy (BETA OPT) on the return on average equityboth over the full sample and in the crisis period (panel A) and on the likelihood of a capital increase during the crisis (panel B).Standard errors are robust and clustered at country level.In panel B *margins*are the estimates of the marginal probability effects of each explanatory variable and are computed at the mean level. Probit regression coefficients give the change in the z-score for a one unit change in the predictor.z-test is normal distributed under the null. All the variables are defined in Appendix B. ***** , **** and* represent statistical significance at the 1%, 5% and 10% level respectively.

Panel A: Panel OLS, dependent variable is return on average equity (ROAE)

	1				2				3				4				5			
	Full sample		2007-2009		Full sample		2007-2009		Full sample		2007-2009		Full sample		2007-2009		Full sample		2007-2009	
	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef	t	Coef.	t
BOPT $_{t-1}$	-36.13	-2.35 **	-96.04	-2.38 **	-55.80	-3.71 ***	-107.25	-2.57 ***	-25.08	-0.87	-122.27	-5.46 ***	-41.99	-2.51 **	-113.67	-2.61 ***	-27.40	-1.36	-107.63	-2.63 ***
IMPLGL $_{t-1}$					-1.77	-1.42	-0.53	-1.96 **	-1.73	-1.45	-0.53	-2.09 **	-1.90	-1.45	-0.47	-1.83 *	-1.96	-1.52	-0.50	-1.89 *
β_{t-1}									-9.19	-1.11	3.92	1.06								
LTA $_{t-1}$													-1.11	-1.27	0.43	0.80	0.52	0.71	1.10	1.47
EQTA $_{t-1}$																	1.71	1.52	0.65	1.43
CONSTANT	-1.44	0.13	12.35	4.94 ***	9.57	2.24 **	15.76	6.63 ***	16.76	4.37 ***	13.24	4.84 ***	28.36	2.22 **	8.35	0.88	-14.65	-0.64	-8.07	-0.54
Year fixed effects		YES		YES		YES		YES		YES		YES		YES		YES		YES		YES
SE clustered at country level		YES		YES		YES		YES		YES		YES		YES		YES		YES		YES
n. of countries		37		32		37		32		37		32		37		32		37		32
n. of obs		844		394		771		367		771		367		771		367		771		367
Adjusted R2		0.03		0.12		0.05		0.14		0.05		0.14		0.05		0.13		0.06		0.14

Panel B: Probit regression, the dependent variable is the capital increase event during the crisis (CAPIN, sample period 2007-2009)

	1			2			3			4			5			6		
	Coef.	z		Coef.	z		Coef.	z		Coef.	z		Coef.	z		Coef.	z	
$BOPT_t$	3.78	2.35	**	5.01	2.92	***	4.59	2.46	**	4.58	2.45	**	4.58	2.43	**	4.43	2.23	**
margin	0.22	11.87	***	0.23	11.53	***	0.23	11.46	***	0.23	11.46	***	0.23	11.47	***	0.23	11.41	***
$IMPLGL_t$				0.04	1.82	*	0.04	1.89	*	0.04	1.86	*	0.04	1.75	*	0.04	1.86	*
margin				0.22	11.33	***	0.22	11.33	***	0.22	11.33	***	0.22	11.34	***	0.22	11.33	***
LTA_t							0.03	0.60		0.03	0.57		0.02	0.29		0.03	0.56	
NIM_t										-0.01	-0.13		0.01	0.10		-0.01	-0.11	
$EQTA_{t-1}$													-0.01	-0.52				
$RWTA_t$																-0.11	-0.15	
CONSTANT	-1.07	-3.17	***	-1.18	-3.31	***	-1.77	-1.59		-1.73	-1.47		-1.42	-1.11		-1.66	-1.26	
Year fixed effects		YES			YES			YES			YES			YES			YES	
Country fixed effects		YES			YES			YES			YES			YES			YES	
n. of countries		37			36			36			36			36			36	
n.of obs		464			412			412			412			409			412	
Prob> $\chi 2$		0.00			0.00			0.00			0.00			0.00			0.00	
Pseudo R2		0.11			0.12			0.12			0.12			0.12			0.12	