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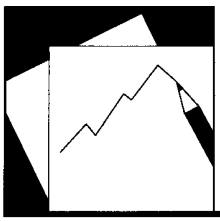

IMF Working Paper

How Risky Are Banks' Risk Weighted Assets? Evidence from the Financial Crisis

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How Risky Are Banks' Risk Weighted Assets? Evidence from the Financial Crisis

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Abstract

We study how investors account for the riskiness of banks' risk-weighted assets (RWA) by examining the determinants of stock returns and market measures of risk. We find that banks with lower RWA performed better during the US and European crises. This relationship is weaker in Europe where banks can use Basel II internal risk models. For large banks, investors paid less attention to RWA and rewarded instead lower wholesale funding and better asset quality. RWA do not, in general, predict market measures of risk although there is evidence of a positive relationship before the US crisis which becomes negative afterwards.

JEL Classification Numbers: G20, G21, G28

Keywords: Banks, capital, crisis, liquidity, regulation, risk weighted assets, Basel III

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[1] Cornell University and International Monetary Fund, respectively. We are grateful for comments from Bertrand Candelon, Vanessa Le Leslé, Ceyla Pazarbasioglu, Aditya Narain, Noel Sacasa, and participants at an IMF seminar.

Contents Page

I. INTRODUCTION

"The leverage ratio - a simple ratio of capital to balance sheet assets - and the more complex risk-based requirements work well together. The leverage requirement provides a baseline level of capital to protect the safety net, while the risk-based requirement can capture additional risks that are not covered by the leverage framework. The more advanced and complex the models become, the greater the need for such a baseline. The leverage ratio ensures that a capital backstop remains even if model errors or other miscalculations impair the reliability of risk-based capital. This is a crucial consideration - particularly as we work through the implementation of Basel II standard. By restraining balance sheet growth, the leverage ratio promotes stability and resilience during difficult economic periods."– Remarks by Sheila Bair, Chairman, Federal Deposit Insurance Corporation before the Basel Committee on Banking Supervision, Merida, Mexico, October 4, 2006.

The financial crisis that began in 2007 has exposed a number of important weaknesses in banking regulation. A key challenge is how to appropriately determine the riskiness of banks' assets. The principle that regulatory capital requirements should be tied to the risks taken by banks was accepted internationally and formalized with the Basel I accord in 1988, and the definition of capital and measurement of risks have undergone several revisions since that time. The second Basel accord, published in 2004, recommended banks hold total regulatory capital equal to at least 8 percent of their risk-weighted assets (RWA). The recently updated Basel III guidelines emphasize higher quality forms of capital, but makes limited strides in the measurement of risks. Instead, Basel III proposes as a complementary measure, a non-risk-weighted leverage ratio.[2]

Risk weighted assets are an important element of risk-based capital ratios. Indeed, banks can increase their capital adequacy ratios in two ways: (i) by increasing the amount of regulatory capital held, which boosts the numerator of the ratio, or (ii) by decreasing risk-weighted assets, which is the denominator of the regulatory ratio. A key concern about current methods of determining risk-weighted assets is that they leave room for individual banks to "optimize" capital requirements by underestimating their risks and thus being permitted to hold lower capital. Jones (2000) discusses techniques banks can use to engage in regulatory capital arbitrage and provides evidence on the magnitude of these activities in the Unites States. Even under the Basel I system, in which particular classes of assets are assigned fixed risk-weights, the capital ratio denominator can be circumvented. Merton (1995) provides an example in which, in place of a portfolio of mortgages, a bank can hold the economic equivalent of that portfolio at a risk-weight one-eighth as large. Innovations in financial products since the first Basel accord have also likely made it easier for financial institutions to manipulate their regulatory risk measure. Acharya, Schnabl, and Suarez (2010) analyze asset-backed commercial paper and find results suggesting that banks used this form of securitization to concentrate, rather than disperse, financial risks in the banking sector while reducing bank capital requirements.

In addition to concerns about underestimating the riskiness of assets, there are differences in calculation of risk weighted assets across countries that may have unintended effects on financial

[2] The specific definition and enforcement of the leverage ratio under Basel III is pending.

stability. Lord Adair Turner, chairman of the UK Financial Services Authority, warned in June that international differences in the calculation of risk-weighted assets could undermine Basel III[3] and Sheila Bair, former chairman of the US Federal Deposit Insurance Corporation, added her concern that Europe and the US may be diverging in their calculation of RWA: "The risk weightings are highly variable in Europe and have led to continuing declines in capital levels, even in the recession. There's pretty strong evidence that the RWA calculation isn't working as it's supposed to."[4]

In this paper, we study whether equity investors find banks' reported risk-weighted assets to be a credible measure of risk. First, did banks with lower risk-weighted assets have higher stock returns during the recent financial crisis? And second, do measures of risk based on equity market information correspond to risk-weighted assets? Demirgüç-Kunt, Detragiache, and Merrouche (2010) and Beltratti and Stulz (2010) study banks' stock return performance during the financial crisis as well, focusing primarily on the effect of different measures of capital and bank governance, respectively. Our paper studies whether markets price bank risk as measured by RWA, to inform the debate on how best to measure the risks embedded in banks' portfolios.

Addressing the first question, we find that banks with higher RWA performed worse during the severe phase of the crisis, from July 2007 to September 2008, suggesting that equity investors did look at RWA as a determinant of banks' stock returns in this period. This relationship is weaker in Europe where banks can use Basel II internal risk models. For large banks, investors paid less attention to RWA and rewarded instead lower wholesale funding and better asset quality.

We find as in Demirguc-Kunt, Detragiache, and Merrouche (2010) that markets do not respond to all measures of capital, but respond positively to higher quality measures – that is, capital with greater loss-absorbing potential. We also investigate the possibility of a capital-liquidity trade-off in the market assessment of banks. Our results indicate that there is indeed a capital-liquidity trade-off: (i) banks with more stable sources of short-term funding are not rewarded as highly for having higher capital, and (ii) banks with liquid assets are not rewarded as highly for having higher capital.

Regarding the relationship between RWA and stock market measures of bank risk, we find that RWA do not, in general, predict market measures of banks' riskiness. There is evidence, however, of a positive relationship between RWA and market risk in the three years prior to the crisis, from 2004 to 2006, and this relationship becomes negative after the crisis. This could result from the large increase in market measures of risk, which reflect the volatility of a bank's stock price, since the crisis, while banks have not adjusted their RWA to account for increased risk.

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[3] Risk Magazine June 24, 2011, "FSA's Turner: RWA divergence would undermine Basel III" www.risk.net/risk-magazine/news/2081533/fsas-turner-rwa-divergence-undermine-basel-iii

[4] Risk Magazine June 24, 2011, "Europe lax on RWA calculations, says Bair" www.risk.net/risk-magazine/news/2081139/europe-lax-rwa-calculations-bair

II. STYLIZED FACTS

The past decade has seen a decrease in the measured risk-weighted assets of banks and a decrease in the quality of capital held by banks. Figure 1 shows the downward trend in RWA at U.S. bank holding companies (BHC) since the late 1990s and Figure 2 the downwards trend in the amount of capital held as a percentage of RWA at BHCs in the United States in the years preceding the crisis. This decline is sharpest in tangible common equity, which has the greatest loss-absorbing capacity, and less pronounced in total regulatory capital.

Figure 1. Decrease in risk-weighted assets at US BHCs

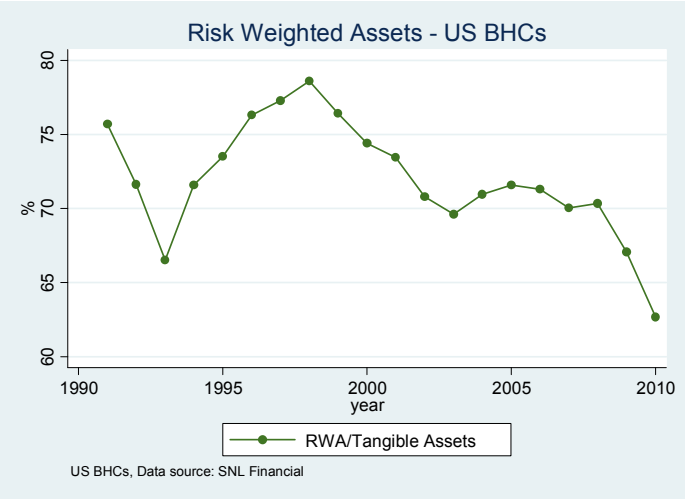
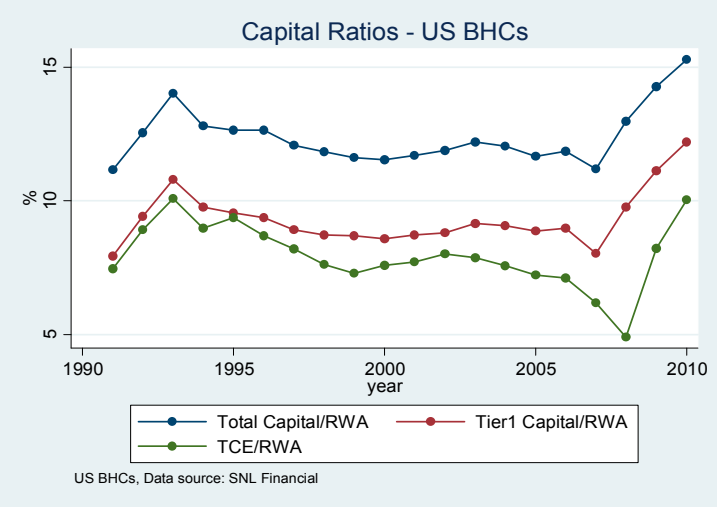


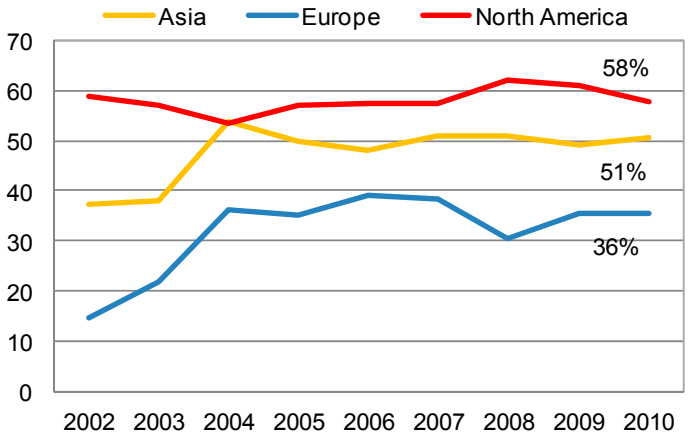
Figure 2. Quality of regulatory capital at US BHCs



Total regulatory capital is the sum of Tier 1 capital and Tier 2 capital. Tier 2 capital includes subordinated debt, hybrid instruments, such as perpetual preferred stock, revaluation reserves, general provisions, and undisclosed reserved are also permitted by regulators in certain countries. Tier 1 capital includes shareholders equity, both common equity and non-cumulative preferred stock, and retained earnings. Tangible common equity is equal to common equity minus intangibles and goodwill.

There are also differences in RWA between geographical regions with European banks having on average much lower RWA as a share of their total assets than banks in North America or Asia (Figure 3)[5].

Figure 3: RWA over Total Assets in Asia, Europe and North America (2002-2010)



Source: Bloomberg, SNL Financial.

III. RISK WEIGHTED ASSETS: BASEL II AND STANDARDIZED AND IRB APPROACHES

The 1998 Basel I accords proposed a simple framework based on a few risk buckets, for four broad categories of claims: sovereigns, banks, mortgages, and corporates. In contrast, Basel II aimed at improving the risk sensitivity of capital requirements. A prelude to the Basel II internal ratings-based (IRB) approach was the adoption by the Basel Committee in 1996 of the value-at-risk (VaR) approach to determine capital requirements for market risk (which was subsequently integrated into the Basel II framework). The 2004 Basel II accord extended a similar approach to credit risk. It opened the way for banks to determine risk weights using external credit rating agencies or their own internal ratings systems based on historical default data, after supervisory validation, to calculate the parameters of a uniform regulatory formula.

For banks not (yet) deemed by supervisors to be able to implement model-based approaches, Basel II contemplated simplified approaches for each of the risk categories it covered. In particular, the Standardized Approach (SA) for credit risk provided a much more differentiated treatment of exposures than Basel I, while allowing risk weights for each exposure to vary according to ratings issued by external credit rating agencies (CRAs). However, although external ratings could drive risk weights significantly higher than Basel I's highest of 100

[5] Data are for a sample of the largest banks in each region.

percent, they could also drive them much lower. Moreover, in the important case of home mortgages, the risk weight was reduced from 50 to 35 percent.

Basel III improves risk weights on exposures to market risk but leaves Basel II standardized approach (SA) risk weights on credit risk exposures unchanged. However, banks are now expected to use higher than external-ratings-based risk weights if their own risk assessment so warrants.

The Basel II IRB approach is built on three risk parameters: (i) the probability of default (PD) which describes the likelihood that an obligor will default, (ii) the exposure at default (EAD), and (iii) the loss given default (LGD), which describes the loss rate on the exposure in the event of default.[6] Indeed, the level of regulatory capital that a bank should hold depends on the amount of loss it is expected to exceed with a small, pre-defined probability. Capital is set according to the bank's unexpected loss (UL) which is the gap between the bank's expected loss (EL) and Value-at-Risk (VaR) at a certain confidence level, over a one-year horizon.

$$EL = PD \times EAD \times LGD \text{ or in percentage of EAD, } EL = PD \times LGD$$

The capital requirement (K) is set using a Merton model which depends on PD and LGD. Risk weighted assets (RWA) are then expressed as a function of the capital requirement and the minimum capital ratio of 8 percent (or its reciprocal 12.5).

$$RWA = 12.5 \times K \times EAD$$

It is important to note that under the Basel II IRB approach, banks have considerable discretion in reporting their own average PD, and EAD and LGD (under the advanced IRB).

IV. REVIEW OF LITERATURE

This paper builds on two main strands of literature. First, our paper is related to studies of bank resilience during the recent financial crisis. Demirgüç-Kunt, Detragiache, and Merrouche (2010) find that capital was positively related to banks' stock returns during the crisis[7] and Beltratti and Stulz (2010) find that large banks with more capital[8] and higher reliance on deposits for short-term funding in 2006 had higher stock returns during the crisis, but these factors did not have a robust impact on bank risk, as measured by the bank's idiosyncratic volatility and distance-to-default. Kato, Kobayashi and Saita (2010) find indications that, for systemically important banks,

[6] The Basel II IRB formula is based on an asymptotic single-risk factor (ASRF) model.

[7] Specifically, they find that during the crisis, a stronger capital position was associated with better stock market performance, most markedly for larger banks, and the relationship between stock returns and capital is stronger when capital is measured by the leverage ratio (capital to total assets) rather than the risk-adjusted capital ratio.

[8] They test both the ratio of Tier1 capital to RWA and tangible equity to total assets. The regulatory ratio is found to be statistically significant in most regression specifications.

stock returns from 2007 to 2008 were not correlated to the Tier1 capital ratio but were positively correlated to the deposit-to-liability ratio.

Second, we build on the empirical literature that studies bank risk-taking and regulatory risk in the United States. Avery and Berger (1991b) and Bradley et al (1991) find that RWA for banks and for thrifts, respectively, are positively related to the bank or thrift's probability of failure and accounting measures of risk, but that these relationships are fairly weak. Cordell and King (1995) compare stock market measures of risk to regulatory risk-based capital measures for banks and thrifts in the United States in 1990. Their results suggest that market and risk-based capital standards agree to some extent on the adequacy of institutions' current capital, but the measures of asset risk are not positively correlated.

Most importantly, we shed light on the credibility of RWA as currently measured. The debate on the appropriate capital requirements for banks has reached consensus on higher capital requirements, but the discussion of appropriate measurement of asset-risk has come to the forefront only recently. Acharya (2011) notes that the importance of residential housing as an asset class increased endogenously in response to the low risk weights on residential mortgage backed securities in capital requirements and, although the crisis showed banks were clearly not holding enough capital against these assets, the relatively low risk weight on this asset class has continued. The significance of the problem is clear in the current Eurozone debt crisis. The zero risk-weights on European banks' holdings of the debt of their sovereigns are clearly not in line with current assessments of their riskiness.

In studying the effects of government bailouts, Duchin and Ross (2011) find evidence that bailed out banks approve riskier loans and shift investment portfolios toward riskier securities. This shift in risk occurs mostly within the same asset class and therefore has little effect on the closely monitored capitalization levels. Consequently, bailed-out banks appear safer according to the capitalization requirements, but show a significant increase in market-based measures of risk. They conclude that those banks' responses to capital requirements may erode their efficacy in risk regulation.

To what extent are differences between regulatory and market assessments of risk problematic? Market discipline requires investors to both (i) monitor the condition of banks and incorporate those assessments into their stock prices, and (ii) influence the managers of banks through these changes in stock prices (Bliss and Flannery 2001). Our study does not delve into whether market participants are able to influence banks managers but instead focuses on the first, necessary, component of discipline. That is, how does the market assess the riskiness of banks based on their regulatory reports, balance-sheet, and income statements? Even if markets are not able to influence manager's actions[9], an understanding of their assessments is important in that bank regulators and supervisors can incorporate this information into their assessments and actions.

[9] There is some support for market influence in banking. Flannery and Rangan (2002) document a build-up of regulatory and market equity capital in large U.S. bank holding companies from 1986 and 2000, beyond levels necessary to meet regulatory standards, and attribute this increase in capital to enhanced market incentives to monitor and price large banks' default risk. Barrios and Blanco (2003) argue that Spanish banks' capital ratios over the period 1985–1991 were primarily driven by the pressure of market forces rather than regulatory constraints.

V. DATA AND METHODOLOGY

The sample consists of 808 publicly-listed deposit-taking institutions in 35 countries, spanning North America, Europe, Asia, and Australia.[10] The balance-sheet and income statement data are from the Bankscope database, which has good coverage from 2004 onwards, and the stock return data is from Datastream. We discard obvious mistakes in the data as well as outliers at the 1 percent and 99 percent levels.

The average bank stock return from June 30, 2007 to September 30, 2008, the phase of the financial crisis before the beginning of government capital purchase programs, was a poor -31 percent with a large standard deviation of 27 percent. The stock return during the recent Eurozone debt crisis is also low, at -13 percent, with a similarly large standard deviation of 20 percent (see Table 1).

Our first hypothesis is that banks with higher risk-weighted assets will perform worse during a period of crisis. This would be an indication that markets do give credence to the regulatory measure of asset-risk. In other words, investors expect banks with higher RWA to have larger LGDs during the financial crisis. We separate banks' regulatory capital ratios into simple leverage ratios and RWA scaled by tangible assets, to determine the effects of RWA on stock returns while controlling for the capital of the bank.[11]

(H1) Banks with lower RWA will perform better during the crisis.

Second, we expect a positive relationship between capital and stock returns, since capital functions as a buffer against adverse shocks by providing loss absorbency beyond provisions and other expected-loss buffers. A higher share of customer deposits in funding decreases the susceptibility of banks to runs, so we expect banks with more stable funding to perform better during periods of crisis. There may also be a trade-off between these two factors, in that banks with higher capital are better able to withstand liquidity problems.

(H2) Banks with higher capital ratios will have higher stock returns during the crisis and banks with more stable funding will have higher stock returns during the crisis.

(H2-A) Banks with more stable funding will not receive as high a reward for higher capital, compared to banks with less stable funding.

Third, if RWA are a good measure of asset-risk, we expect they will be positively related to market-based measures of risk. The relationship between the two, if found, could change in

[10] Institutions with a deposit/asset ratio above 20 percent and a loan/asset ratio above 10 percent, as in Beltratti and Stulz (2010)

[11] For example: $\frac{Tier1Capital}{RWA} = \frac{Tier1Capital}{TangibleAssets} \times \frac{TangibleAssets}{RWA}$. Previous studies include either the regulatory capital ratio or the simple leverage ratio, which does not allow for a direct test of the effect of RWA on performance.

either direction after the crisis. The onset of the crisis could render RWA less credible to investors, or the increase in risk-aversion associated with crisis could result in increased sensitivity to any available information on asset-risk.

(H3) Market measures of bank risk will be positively correlated with RWA.
(H3-A) This relationship may change after the financial crisis.

To test these hypotheses we estimate two models. In the first, we study the effects of risk-weighted assets and capital adequacy on the cross-section of banks' stock returns, while controlling for other balance-sheet measures of risk exposure. We perform least squares dummy variable (LSDV) estimation, with country fixed effects, on the model:

$$r_i = \theta_0 + \theta_1 (RWA/TA)_{it-1} + \theta_2 (Capital/TA)_{it-1} + X_{i,t-1}\gamma_1 + \eta_i \quad (1)$$

where the dependent variable r_i is the real stock return in US dollars from June 30, 2007 to September 30, 2008 for bank *i*. The end date is chosen to precede the beginning of the Troubled Assets Relief Program, established in October 2008, in which the U.S. Department of the Treasury, infused capital into qualifying financial institutions. We also study stock returns over the three-month period from June 30, 2011 to September 30, 2011 to contrast market reactions in the recent European sovereign debt crisis to the first phase of the global financial crisis. In both cases, all of the explanatory variables are lagged by one year. Table 3 reports descriptive statistics for the explanatory variables in 2006 and 2010.

The main explanatory variables of interest are the ratio of risk-weighted assets to tangible assets and the capital ratio. After comparing three different measures of capital[12] in our first specification, and finding results consistent with Demirgüç-Kunt, Detragiache, and Merrouche (2010), we proceed to use tangible common equity (TCE) as our measure of bank capital in the rest of the paper.[13] One can expect holders of non-TCE capital instruments to have weaker incentives to monitor bank risk-taking than common equity shareholders.

The other explanatory variables, in $X_{i,t-1}$, are:

(i) Stability of funding, measured as the share of customer deposits in total deposits and short-term funding[14]

[12] These are (i) tangible common equity, (ii) Tier 1 regulatory capital, and (iii) Total regulatory capital. Total regulatory capital is equal to the sum of Tier 1 capital and Tier 2 capital. Tier 1 capital consists of shareholder's funds, perpetual non-cumulative preference share, and retained earnings. Tier 2 capital includes hybrid capital, subordinated debt, loan loss reserves, and valuation reserves.

[13] This is calculated by subtracting preferred shares, intangibles, and goodwill from total equity, where data is available.

[14] This is equal to 100 – x where x is the funding fragility measure of Demirgüç-Kunt and Huizinga (2009): deposits from other banks, other deposits, and short-term borrowing as a fraction of total deposits plus money market funding.

(ii) The ratio of securities to assets, as a proxy for the liquidity of assets
(iii) The share of non-performing loans
(iv) Return on average assets, a measure of the bank profitability
(v) The log of assets, to proxy for bank size
(vi) Country dummies, to control for differences in the institutional and regulatory environments across countries
(vii) Dummy variables to control for the specialization of the bank[15]

The share of customer deposits in total deposits and short-term funding is expected to increase a bank's stability since these deposits are less likely to be withdrawn in a bank run, due to deposit insurance. Gorton (2010) and others have described the recent crisis as a run in non-retail funding markets. Our measure is equal to 100 – x where x is the funding fragility measure of Demirgüç-Kunt and Huizinga (2009). We expect a positive relationship between the stability of funding and banks' stock returns.

A second specification of this model includes interaction terms between (i) the capital ratio and funding stability, and then (ii) the capital ratio and the proxy for asset liquidity, the ratio of securities to assets. This is to test the notion that there is a trade-off in the capital adequacy and liquidity required to satisfy markets' of a bank's health. A negative coefficient on the interaction term between funding stability and the capital ratio suggests that banks with more stable funding are not required to hold as much capital in order to receive the same stock return, compared to a banks with fragile funding. Similarly, a negative coefficient on the interaction term between capital and the ratio of liquid assets indicates that banks with more liquid assets can have lower capital and receive the same assessment from the market.

The second model is a panel estimation of how the explanatory variables described above are related to three market measures of risk: the volatility of the bank's stock return, its co-movement with a market index – the CAPM beta – and idiosyncratic volatility from the CAPM model.

$$Risk_i = \mu_j + \delta_1 (RWA/TA)_{i,t-1} + \delta_{21} (Capital/TA)_{i,t-1} + \delta_{21} (Capital/TA)^2_{i,t-1} + X_{i,t-1}\gamma_2 + \eta_{it} \quad (2)$$

where the dependent variable $Risk_{it}$ is one of:

(1) Stock return volatility: the standard deviation of the monthly stock returns of bank i in year *t*
(2) Systematic risk: beta from a CAPM estimated over the previous 60 months,
(3) Idiosyncratic volatility: the standard deviation of residual from the estimated CAPM

[15] Bank holding companies, commercial banks, cooperative banks, investment banks, real estate and mortgage banks, and savings banks

Table 2 shows descriptive statistics for the market measures of risk. The explanatory variable are as in model (1) except we now include the squared capital ratio, $(Capital/TA)^2$, to test the hypothesis of a U-shaped effect of capital on bank risk-taking. Calem and Rob (1999) model a situation in which, when banks are severely undercapitalized, they take maximum risk to exploit the benefits of deposit insurance and, at high levels of capital, increased risk-taking occurs because the probability of insolvency is low. Model (2) is estimated over the period 2004 to 2010 and year effects to control for macroeconomic shocks that may affect bank stock returns are included.

Market measures of risk

Prior to estimating model (2), we first estimate the systematic and idiosyncratic risk for each bank, by estimating a simple CAPM:

$$R_{it} - R_{ft} = \alpha_i + \beta_1(R_{mt} - R_{ft}) + \beta_2(R_{Wt} - R_{ft}) + \varepsilon_{it}$$

where nominal stock prices in US dollars are deflated by the CPI to obtain real returns, R_{ft} is the 3-month US Treasury bill rate, adjusted to a one month risk-free rate, R_{mt} is the MSCI national market index for the country *m* in which the bank is headquartered, and R_{Wt} is the MSCI World index.[16] Systematic risk in model (2) is the estimate of β_1 from the above CAPM, and idiosyncratic volatility is the standard deviation of ε_i over each 60 month period. That is, for each bank-year observation in model (2), beta and idiosyncratic volatility are calculated using monthly, US-dollar, real excess returns over the last 5 years.

VI. ESTIMATION RESULTS

Determinants of stock returns

Market perceptions of risk-weighted assets

Table 4a presents the results of our benchmark estimation of model (1), the determinants of stock returns over 2007-2008 crisis period. As expected, we find that stock returns are lower for banks with higher risk-weighted assets. The relationship is statistically quite significant and the effect is such that banks with a one percentage point higher RWA to tangible assets (TA) ratio have a stock return that is 0.06 percentage points lower. The estimated coefficients on the three different capital ratios confirm the finding of Demirgüç-Kunt, Detragiache, and Merrouche (2010) that not all types of capital matter in explaining stock returns. The tangible common equity to TA ratio is positively related to stock returns in the cross-section, but the two broader measures of capital

[16] In these estimations, the coefficient on the excess return of the world index is statistically insignificant for most emerging markets.

adequacy are not. The signs of the coefficients on the additional explanatory variables are as expected. Higher stock returns are associated with more stable funding, more liquid assets, a lower share of non-performing loans, and a higher accounting return on assets. However, only the liquidity of the assets, measured as the share of securities to assets, and the accounting return on assets have a strong statistical relationship with the stock returns.

Table 4b shows the same estimation on the sample restricted to larger banks, with assets greater than 10 billion US$ in 2006. While the coefficient on RWA is still negative, it is not statistically significant in this sample. Similarly, the coefficients on the capital measures are not significant. The effect of funding stability is now statistically significant and larger in magnitude. A one percentage point increase in the share of stable funding at a large bank is associated with a stock return that is 0.25 percentage points higher, on average. The magnitudes of the coefficients on the share of securities in assets and the share of non-performing loans are similar to the estimation with the full sample, and the share of non-performing loans is now statistically significant. Higher net income, as indicated by a higher ROAA, is rewarded with a higher stock return.

Overall, large banks appear to be different from the rest of the sample on four dimensions. Their returns were not affected by (i) the relative size of their RWA or (ii) their capital adequacy ratio. In contrast to the other banks, the returns of large banks benefited from (iii) higher customer deposits and (iv) lower levels of non-performing loans. These results suggest that for large banks, investors paid less attention to the quality of capital and RWAs during the crisis and rewarded instead lower reliance on wholesale funding and better asset quality as measured by the relative size of customer deposit and non-performing loans, respectively.

Is there a capital-liquidity trade-off?

We find a trade-off between capital and liquidity in terms of their positive effects on bank stock returns. Table 5 presents the results of the estimation of model (1) in which an interaction term between capital and funding stability and, subsequently, an interaction term between capital and the liquidity of assets, are included. The negative coefficient on the interaction term in column (2) shows that the more stable a bank's funding, the less positive the effect of higher capital on its stock return. Similarly, column (3) indicates that the more liquid a bank's assets, the less an increase in capital will increase its stock return.

Differences across regions

Identifying the extent to which banks may be artificially lowering their risk-weighted assets in order to post less capital is a difficult task. Comparing the relationship between RWA and stock returns in regions with different regulatory requirements, however, can help shed light on the credibility of RWA being reported. Specifically, countries in Asia with large financial sectors followed Basel II while smaller jurisdictions were still following Basel I guidelines during the financial crisis, which requires banks to assign specific risk-weights to assets in particular categories and leaves less room for manipulation. On the other hand, EU Capital Requirements Directive (CRD) required that countries in Europe implement the Basel II guidelines by the time of the crisis, allowing banks to use their own internal models to determine risk-weights. In

contrast, US banks continue to report under Basel I and only the largest internationally active US banks are required to move under Basel II by 2012. Because of these regulatory differences, we expect RWA to be higher for US and Asian banks and lower for European banks. Differences in default history and other PD assumptions can also influence reported RWAs. For instance, Le Leslé and Avramova (2011) note that historical default rates in Europe over the last 15 years have been consistently below those in Asia and in the US, which together with the use of IRB approaches in Europe explain lower RWA reported by European banks. Using a sample of the largest banks, Le Leslé and Avramova (2011) find that European banks have lower RWA as a share of total assets than US and Asian banks, even after controlling for differences in business model and regulatory regime.[17]

We find some evidence consistent with this hypothesis in Table 6. The estimated coefficient on the interaction term between the indicator for banks in Asia and RWA/TA in column (2) is negative, at -0.103, indicating that banks in Asia with higher RWA have lower stock returns as a result, compared to the banks in other regions. In column (4), the positive coefficient of 0.169 on the interaction coefficient, indicates a positive relationship between RWA/TA and stock returns for banks in Europe, unlike for the rest of the banks in the sample. This indicates that markets are not rewarding European banks for lower RWA, which may suggest a lack of credibility of their RWA. Finally, the relationship between RWA and returns for American banks, in column (3) is in between those for Asia and Europe, as expected. The magnitudes of the estimated interaction coefficients are consistent with the hypothesis that markets do not use RWA in their assessment of banks in regions where banks are more able to "game" the measure, however the differences in the samples are not statistically significant.

Other differences in which balance-sheet measures are rewarded with higher stock returns across regions are also apparent. American banks receive a higher reward for holding more securities, and European banks with higher securities are actually penalized with a lower stock return. Market reactions to American banks are also different in that American banks are more heavily penalized for having a higher share of non-performing loans. Column (3) indicates that American banks with a one percentage point higher share of non-performing loans in 2006 had stock returns that were approximately 5.6 percentage points lower over the crisis.

Recent performance during the European debt crisis

We next estimate model (1) for the stock-returns of banks from June 30, 2011 to September 30, 2011 to compare market reactions during the 2007-2008 phase of the financial crisis with the recent sovereign debt crisis in Europe. Table 7 shows the results. The signs of the coefficients are the same as for model (1) estimated over 2007-2008 crisis period, however only RWA/TA, the

[17]For a sample of large banks, Le Leslé and Avramova (2011) find that that retail banks tend to have the highest RWA as a share of total assets and investment banks the lowest, with universal banks in-between. Investment banks are expected to have relatively lower RWA to total assets because of their larger trading books, which until recently required lower risk weights than banking book assets. Changes to the Basel II market risk framework (Basel 2.5) will require higher levels of capital for some activities such as securitization, proprietary trading, and mark-to-market losses (credit value adjustment).

share of securities in assets, and ROAA have had statistically measurable effects on the stock return in this crisis so far.

Market Measures of Risk and Balance-Sheet Measures of Risk Exposure

Table 8 presents the estimation results of model (2) for the period from 2004 to 2010, studying the effects of capital and RWA/TA on three market measures of risk. This specification includes a square term for the capital ratio to investigate the existence of a U-shaped relationship between risk and capital. Looking first at the coefficients on the control variables, we see that they have the expected signs. Factors that are positively related to stock return performance, estimated in model (1), are negatively related to the market measures of risk.

Turning to the main variables of interest, no significant relationship is found between RWA and the three market measures of risk. For both the stock return volatility and idiosyncratic volatility, we find a negative relationship between capital and risk up to a certain point. Figure 3 plots the predicted relationship between TCE/TA and the stock return volatility measure of risk. This result suggests that the benefits of lower leverage—in terms of lower stock return volatility during the financial crisis—increase rapidly but only up to a point. Given the limited number of observations, we cannot conclude that these benefits become negative beyond a certain threshold.

Figure 3. Nonlinear relationship between market risk and the capital ratio

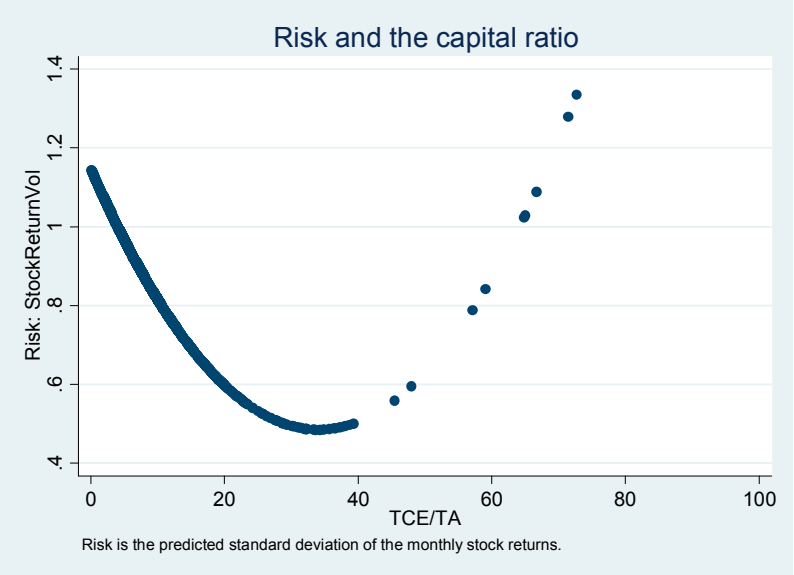


Table 10 splits the sample into three years prior to the start of the crisis, from 2004 to 2006, and three years since, from 2008 to 2010, to investigate whether there is a change in the relationship between RWA and the market measures of risk. In the pre-crisis period, seen in Panel A, nothing affects idiosyncratic volatility, which is what we would expect in good times. There is a positive relationship between RWA and systematic risk, beta. In the years since the onset of the crisis, the relationship between RWA and systematic risk turns negative, and the relationship between

RWA and stock return volatility is negative as well. This could result from the large increase in market measures of risk, which reflect the volatility of a bank's stock price, since the crisis, while banks have not adjusted their RWA to reflect increased risk.

VII. CONCLUSIONS

There has been a steady decline in the measure of asset-risk that banks report to regulators—risk-weighted assets (RWA)—over the last decade. In light of this trend and other indications that banks can "optimize" their capital by under-reporting RWA in an attempt to minimize regulatory burdens, we study how equity market investors account for the riskiness of RWA by examining the determinants of stock returns and stock-market measures of risk of an international panel of banks.

Regarding banking stock returns, we find a negative relationship between RWA and stock returns over periods of financial crisis, suggesting that investors use RWA as an indicator of bank portfolio risk. Indeed, banks with higher risk-weighted assets performed worse during the severe phase of the crisis, from July 2007 to September 2008. We find a similar result when we focus on the ongoing crisis in the Europe.

Comparing regions with different regulatory structures, we find, however, that the relationship between stock returns and RWA is weaker in countries where banks have more discretion in the calculation of RWA. Specifically, in countries that had implemented Basel II before the onset of the recent financial crisis, allowing banks to use their own internal models to assess credit risks, investors look to other balance-sheet measures of risk exposure but not RWA. Our results also suggest that for large banks, investors paid less attention to the quality of capital and RWAs during the crisis and rewarded instead lower reliance on wholesale funding and better asset quality as measured by the relative size of customer deposit and non-performing loans, respectively.

We confirm results from previous studies that only capital with the greatest loss-absorbing potential matters for stock returns. In addition, we find a trade-off between capital and liquidity in terms of their positive effects on bank stock returns. The more stable a bank's funding, the less positive the effect of higher capital on its stock return; the more liquid a bank's assets, the less an increase in capital will increase its stock return

When it comes to stock-market measures of risk, we find that RWA do not, in general, predict market measures of bank risk. There is evidence, however, of a break in the relationship between stock market measures of risk and RWA since the start of the crisis. Indeed, we find a positive relationship between RWA and market risk in the three years prior to the crisis, from 2004 to 2006, and this relationship becomes negative after the crisis. This could result from the large increase in market measures of risk, which reflect the volatility of a bank's stock price, since the crisis, while banks have not adjusted their RWA to reflect increased risk.

In light of increasing risk-aversion in markets during times of crisis, the question of how market assessments of risk should be incorporated into banking regulation and supervision remains. Indeed, the asymmetry of information between banks, supervisors, and market participants

regarding how risky RWA are can lead to increased uncertainty about the adequacy of bank capital, which during a financial crisis, can have damaging effects for financial stability.

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TABLES

Table 1. Descriptive statistics – stock returns over periods of crisis

	June 2007 to Sep 2008 (770 obs)	June 2011 to Sep 2011 (808 obs)
Mean	-31.37	-13.10
Std. Dev.	26.55	19.60
Min	-99.97	-75.28
Max	78.49	192.36

Table 2. Descriptive statistics – market measures of risk

2004-2010 (4229 obs)	Vol of monthly stock return	Beta	Idiosyncratic Vol
Mean	9.15	0.63	-1.52E-09
Std. Dev.	7.87	1.27	7.12E-08
Min	0.16	-4.08	-1.75E-06
Max	184.84	5.45	1.12E-06

Table 3. Descriptive statistics – explanatory variables

	2006 (770 obs)		2010 (808 obs)	
	Mean	Std. Dev.	Mean	Std. Dev.
TCE/RWA	11.26	8.37	10.73	6.00
Tier 1/RWA	12.73	7.61	13.06	5.03
Total Capital/RWA	14.47	7.37	14.96	4.87
RWA/Assets	42.40	31.47	66.60	14.86
CustDeposits	90.56	11.85	91.20	11.22
Securities/Assets	19.92	11.57	22.14	11.88
NPL/Loans	1.66	2.72	4.45	4.83
ROAA	0.87	0.90	0.38	1.18
log(Assets)	14.92	2.28	15.29	2.34
Beta	0.24	1.07	1.00	1.33

Table 4a. Determinants of returns: Do risk-weighted assets affect stock returns?

All banks

Dependent variable: Stock return from June 2007 to Sep 2008

	(1)	(2)	(3)
RWA/TangibleAssets	-0.065***	-0.059***	-0.064***
	(0.013)	(0.013)	(0.011)
TCE/TangibleAssets	0.292***		
	(0.074)		
Tier1capital/TangibleAssets		-0.011	
		(0.085)	
TotalCapital/TangibleAssets			0.026
			(0.089)
CustDeposits	0.045	0.056	0.054
	(0.069)	(0.072)	(0.070)
Securities/Assets	0.673***	0.688***	0.682***
	(0.107)	(0.103)	(0.102)
NPL/Loans	-0.279	-0.293	-0.302
	(0.183)	(0.194)	(0.196)
ROAA	5.101***	4.706***	4.755***
	(0.502)	(0.679)	(0.600)
Observations	766	760	766
R-squared	0.181	0.178	0.179

The table presents regressions for banks in 33 countries. The dependent variable is the bank's stock return over the period from June 30, 2007 to September 30, 2008. The independent variables, all values for 2006, are the ratio of risk-weighted assets to tangible assets, capital ratios (Tangible Common Equity (TCE), Tier1 Capital, and Total regulatory capital, all divided by tangible assets), the share of stable deposits, the share of securities in the bank's assets, the share of non-performing loans, the return on assets, the log of assets, and the stock's beta with a national market index. Country fixed effects and dummy variables representing the bank's specialization are included. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the country level using the Huber (1967) correction. *** indicates significance at the 1 percent level; ** indicates significance at the 5percent level; * indicates significance at the 10percent level.

Table 4b. Determinants of returns: Do risk-weighted assets affect stock returns of large banks?

Large banks: Assets>10 Billion US$

Dependent variable: Stock return from June 2007 to Sep 2008

	(1)	(2)	(3)
RWA/TangibleAssets	-0.086	-0.102	-0.059
	(0.079)	(0.071)	(0.227)
TCE/TangibleAssets	0.784		
	(0.860)		
Tier1capital/TangibleAssets		1.447	
		(1.292)	
TotalCapital/TangibleAssets			-0.222
			(2.049)
CustomerDeposits	0.226*	0.265***	0.277***
	(0.113)	(0.077)	(0.085)
Securities/Assets	0.431***	0.428***	0.457***
	(0.106)	(0.096)	(0.088)
NPL/Loans	-0.990*	-0.986*	-1.088**
	(0.579)	(0.555)	(0.522)
ROAA	8.161**	7.922**	9.495**
	(3.461)	(3.758)	(3.892)
Observations	226	226	226
R-squared	0.369	0.370	0.366

The table presents regressions for banks in 33 countries. The dependent variable is the bank's stock return over the period from June 30, 2007 to September 30, 2008. The independent variables, all values for 2006, are the ratio of risk-weighted assets to tangible assets, capital ratios (Tangible Common Equity (TCE), Tier1 Capital, and Total regulatory capital, all divided by tangible assets), the share of stable deposits, the share of securities in the bank's assets, the share of non-performing loans, the return on assets, the log of assets, and the stock's beta with a national market index. Country fixed effects and dummy variables representing the bank's specialization are included. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the country level using the Huber (1967) correction. *** indicates significance at the 1 percent level; ** indicates significance at the 5percent level; * indicates significance at the 10percent level.

Table 5. Determinants of returns: Is there a capital and liquidity trade-off?

All banks

Dependent variable: Stock return from June 2007 to Sep 2008

	(1)	(2)	(3)
TCE/TangibleAssets	0.292***	4.196***	5.604**
	(0.074)	(1.493)	(2.197)
CustDeposits	0.045	0.319***	0.396***
	(0.069)	(0.085)	(0.121)
(TCE/TangibleAssets)*CustDeposits		-0.041***	-0.048**
		(0.015)	(0.019)
Securities/Assets	0.673***	0.666***	0.983***
	(0.107)	(0.103)	(0.314)
(TCE/TangibleAssets)*(Securities/Assets)			-0.034*
			(0.019)
RWA/TangibleAssets	-0.065***	-0.064***	-0.074***
	(0.013)	(0.012)	(0.011)
NPL/Loans	-0.279	-0.262	-0.248*
	(0.183)	(0.160)	(0.134)
ROAA	5.101***	4.158***	4.517***
	(0.502)	(0.547)	(0.469)
Observations	766	766	766
R-squared	0.181	0.186	0.193

The table presents regressions for banks in 33 countries. The dependent variable is the bank's stock return over the period from June 30, 2007 to September 30, 2008. The independent variables, all values for 2006, are the ratio of tangible common equity (TCE) to tangible assets, the share of stable deposits, the share of securities in the bank's assets, an interaction term between the capital ratio (TCE/tangible assets) and stable deposits, an interaction term between the capital ratio and the share of securities, the ratio of risk-weighted assets to tangible assets, the share of non-performing loans, the return on assets, the log of assets, and the stock's beta with a national market index. Country fixed effects and dummy variables representing the bank's specialization are included. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the country level using the Huber (1967) correction. *** indicates significance at the 1 percent level; ** indicates significance at the 5percent level; * indicates significance at the 10percent level.

Table 6. Determinants of returns: Are the effects of RWA different in the United States, Europe, and Asia?

All banks

Dependent variable: Stock return from June 2007 to Sep 2008

	(1)	(2)	(3)	(4)
	No interactions	X=Asia	X=US	X=Europe
TCE/TangibleAssets	0.292***	0.298***	0.895**	0.306***
	(0.074)	(0.078)	(0.424)	(0.067)
X*TCE/TangibleAssets		0.263	-0.654	1.009
		(0.426)	(0.417)	(1.661)
RWA/TangibleAssets	-0.065***	-0.053***	-0.144	-0.076***
	(0.013)	(0.012)	(0.103)	(0.014)
X*RWA/TangibleAssets		-0.103	0.074	0.169
		(0.136)	(0.102)	(0.255)
CustDeposits	0.045	-0.008	0.082	0.075
	(0.069)	(0.066)	(0.093)	(0.060)
X*CustDeposits		0.204	-0.108	0.026
		(0.161)	(0.092)	(0.148)
Securities/Assets	0.673***	0.699***	0.282	0.737***
	(0.107)	(0.101)	(0.169)	(0.066)
X*Securities/Assets		-0.103	0.554***	-0.774**
		(0.121)	(0.170)	(0.343)
NPL/Loans	-0.279	-0.306	-0.199	-0.267
	(0.183)	(0.224)	(0.130)	(0.208)
X*NPL/Loans		-0.447	-5.411***	-0.567
		(0.828)	(0.153)	(0.722)
ROAA	5.101***	4.828***	3.762	4.943***
	(0.502)	(0.366)	(2.426)	(0.452)
X*ROAA		1.820	0.589	-6.771
		(2.846)	(2.429)	(5.210)
Observations	766	766	766	766
R-squared	0.181	0.190	0.213	0.190

The table presents regressions for banks in 33 countries. The dependent variable is the bank's stock return over the period June 30, 2007 to September 30, 2008. The independent variables, all values for 2006, are the ratio of tangible common equity (TCE) to tangible assets, the share of stable deposits, the share of securities in the bank's assets, an interaction term between the capital ratio (TCE/tangible assets) and stable deposits, an interaction term between the capital ratio and the share of securities, the ratio of risk-weighted assets to tangible assets, the share of non-performing loans, the return on assets, the log of assets, and the stock's beta with a national market index. X is a dummy variable equal to 1 for banks in the United States in column (2), for banks in Europe in column (3), and for banks in Asia in column (4). Country fixed effects and dummy variables representing the bank's specialization are included. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the country level using the Huber (1967) correction. *** indicates significance at the 1 percent level; ** indicates significance at the 5percent level; * indicates significance at the 10percent level.

Table 7. Determinants of returns: Recent performance during the European sovereign debt crisis

All banks

Dependent variable: Stock return from June 2011 to Sep 2011

	(1)	(2)	(3)
	No interactions	X=US	X=Europe
TCE/TangibleAssets	-0.035	0.358	0.009
	(0.066)	(0.330)	(0.070)
X*TCE/TangibleAssets		-0.379	-0.002
		(0.335)	(0.364)
RWA/TangibleAssets	-0.096*	-0.239***	-0.061
	(0.058)	(0.064)	(0.048)
X*RWA/TangibleAssets		0.230***	-0.171
		(0.062)	(0.126)
CustDeposits	0.042	0.030	0.096**
	(0.044)	(0.067)	(0.040)
X*CustDeposits		0.075	-0.137*
		(0.067)	(0.075)
Securities/Assets	0.055*	-0.021	0.082***
	(0.033)	(0.067)	(0.022)
X*Securities/Assets		0.116*	-0.152
		(0.065)	(0.104)
NPL/Loans	-0.244	-0.038	-0.529***
	(0.188)	(0.172)	(0.088)
X*NPL/Loans		-0.458**	0.621***
		(0.171)	(0.149)
ROAA	2.580***	1.047	2.248***
	(0.280)	(0.903)	(0.295)
X*ROAA		1.456	-0.681
		(0.908)	(0.840)
Observations	808	808	808
R-squared	0.401	0.409	0.409

The table presents regressions for banks in 35 countries. The dependent variable is the bank's stock return over the period from June 30, 2011 to September 30, 2011. The independent variables, all values for 2010, are the ratio of tangible common equity (TCE) to tangible assets, the share of stable deposits, the share of securities in the bank's assets, an interaction term between the capital ratio (TCE/tangible assets) and stable deposits, an interaction term between the capital ratio and the share of securities, the ratio of risk-weighted assets to tangible assets, the share of non-performing loans, the return on assets, the log of assets, and the stock's beta with a national market index. X is a dummy variable equal to 1 for banks in the United States in column (2), and for banks in Europe in column (3). Country fixed effects and dummy variables representing the bank's specialization are included. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the country level using the Huber (1967) correction. *** indicates

significance at the 1 percent level; ** indicates significance at the 5percent level; * indicates significance at the 11percent level.

Table 8. Market measures of risk and balance-sheet measures of risk exposure

All banks, 2004-2010
Dependent variable: Market risk
Standardized beta coefficients are reported in parentheses

	(1)	(2)	(3)
Risk Measure:	StockReturnVol	Beta	IdiosyncraticVol
TCE/TA (t-1)	-34.832***	0.460	-1.425***
	(-0.252)	(0.018)	(-0.136)
TCE/TA squared (t-1)	0.349***	0.007	0.026***
	(0.107)	(0.012)	(0.104)
RWA/TA (t-1)	0.339	-0.017	0.004
	(0.015)	(-0.004)	(0.002)
CustDeposits (t-1)	-3.826***	-0.079	-0.107
	(-0.063)	(-0.007)	(-0.023)
Securities/Assets (t-1)	-5.784***	-0.887***	0.112**
	(-0.096)	(-0.082)	(0.025)
NPL/Loans (t-1)	59.964**	2.619***	-0.315
	(0.265)	(0.064)	(-0.018)
ROAA (t-1)	-143.081***	-8.973***	1.348**
	(-0.234)	(-0.081)	(0.029)
log(Assets) (t-1)	0.177	27.959***	-0.840**
	(0.001)	(0.510)	(-0.037)
Observations	4229	4229	4229
R-squared	0.459	0.225	0.023

The table presents panel regressions for banks in 35 countries from 2004 to 2010. The dependent variable is the standard deviation of the bank's monthly stock return over the previous year in column (1), the stock's beta with a national market index estimated from a CAPM model in column (2), the idiosyncratic volatility from this model in column (3). The independent variables, all lagged by one year, are the ratio of tangible common equity (TCE) to tangible assets, the ratio of risk-weighted assets (RWA) to tangible assets, the share of stable deposits, the share of securities in the bank's assets, the share of non-performing loans, the return on assets, and the log of assets. Country fixed effects, dummy variables representing the bank's specialization, and year dummies are included. Standard errors are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the country level using the Huber (1967) correction. *** indicates significance at the 1 percent level; ** indicates significance at the 5percent level; * indicates significance at the 10percent level. Standardized beta coefficients are reported in parentheses.

Table 9. Descriptive statistics – market measures of risk

Panel A: pre-crisis (2004-2006)

(1403 obs)

	Vol of monthly stock return	Beta	Idiosyncratic Vol
Mean	5.65	0.25	-1.72E-09
Std. Dev.	3.24	1.02	8.56E-08
Min	0.28	-4.04	-1.75E-06
Max	38.84	5.44	4.77E-07

Panel B: post-crisis (2008-2010)

(1680 obs)

	Vol of monthly stock return	Beta	Idiosyncratic Vol
Mean	12.84	1.00	-1.15E-09
Std. Dev.	8.07	1.41	5.57E-08
Min	0.16	-3.87	-3.75E-07
Max	124.26	5.45	2.33E-07

Table 10. Market measures of risk and balance-sheet measures of risk exposure - have the relationships changed since the crisis?

All banks

Dependent variable: Risk, Standardized beta coefficients in parentheses

	2004-2006			2008-2010		
	(1)	(2)	(3)	(1)	(2)	(3)
Risk Measure:	StockReturnVol	Beta	IdiosyncraticVol	StockReturnVol	Beta	IdiosyncraticVol
TCE/TA (t-1)	-17.641***	-0.179	-0.688	-90.861***	2.744	-2.047***
	(-0.336)	(-0.011)	(-0.084)	(-0.405)	(0.074)	(-0.143)
TCE/TA squared (t-1)	0.249***	0.025**	0.009	2.522***	-0.038	0.062***
	(0.239)	(0.077)	(0.056)	(0.256)	(-0.023)	(0.098)
RWA/TA (t-1)	0.401	0.322**	0.009	-0.784*	-0.557***	-0.020
	(0.037)	(0.098)	(0.006)	(-0.026)	(-0.112)	(-0.011)
CustDeposits (t-1)	-3.920***	-0.082	0.124	-8.526***	-0.115	-0.164
	(-0.135)	(-0.009)	(0.028)	(-0.113)	(-0.009)	(-0.034)
Securities/Assets (t-1)	-1.763***	-0.062	0.036	-10.636***	-1.784***	0.039
	(-0.065)	(-0.008)	(0.009)	(-0.142)	(-0.143)	(0.008)
NPL/Loans (t-1)	19.655**	0.144	0.471	69.952***	0.386	-0.315
	(0.191)	(0.005)	(0.029)	(0.261)	(0.009)	(-0.018)
ROAA (t-1)	-15.736***	1.489*	-0.529	-186.742***	-12.876***	0.216
	(-0.052)	(0.016)	(-0.011)	(-0.278)	(-0.115)	(0.005)
log(Assets) (t-1)	-30.354***	11.793***	0.008	-10.578	39.730***	-1.125*
	(-0.216)	(0.275)	(0.000)	(-0.029)	(0.660)	(-0.049)
Observations	1403	1403	1403	1680	1680	1680
R-squared	0.227	0.214	0.054	0.381	0.252	0.027

The table presents panel regressions for banks in 33 countries from 2004-2006 in Panel A and 2008-2010 in Panel B. The dependent variable is the standard deviation of the bank's monthly stock return over the previous year in column (1), the stock's beta with a national market index estimated from a CAPM model in column (2), the idiosyncratic volatility from this model in column (3). The independent variables, all lagged by one year, are the ratio of tangible common equity (TCE) to tangible assets, the ratio of risk-weighted assets (RWA) to tangible assets, the share of stable deposits, the share of securities in the bank's assets, the share of non-performing loans, the return on assets, and the log of assets. Post is an indicator equal to one for the years 2008-2010. Country fixed effects, dummy variables representing the bank's specialization, and year dummies are included. Standard errors are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the country level using the Huber (1967) correction. *** indicates significance at the 1 percent level; ** indicates significance at the 5percent level; * indicates significance at the 10percent level. Standardized beta coefficients are reported in parentheses.

Table 11a. How does the capital mix affect stock returns?

All banks

Dependent variable: Stock return from June 2007 to Sep 2008

	(1)	(2)
(Tier1 - TCE)/Tier1	-0.163**	
	(0.078)	
(TotalCapital-Tier1)/TotalCapital		-0.520**
		(0.190)
CustomerDeposits	0.042	0.149**
	(0.105)	(0.069)
Securities/Assets	0.724***	0.714***
	(0.068)	(0.045)
NPL/Loans	-0.263	-1.787
	(0.196)	(1.259)
ROAA	4.112***	3.921***
	(0.775)	(0.374)
Observations	676	666
R-squared	0.186	0.197

The table presents regressions for banks in 30 countries. The dependent variable is the bank's stock return over the period from June 30, 2007 to September 30, 2008. The independent variables, all values for 2006, are the share of Tier1 capital that is not common shareholder's equity, the share of total regulatory capital that is not Tier 1 capital, the share of stable deposits, the share of securities in the bank's assets, the share of non-performing loans, the return on assets, the log of assets, and the stock's beta with a national market index. Country fixed effects and dummy variables representing the bank's specialization are included. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the country level using the Huber (1967) correction. *** indicates significance at the 1 percent level; ** indicates significance at the 5percent level; * indicates significance at the 10percent level.

Table 11b. How does the capital mix affect stock returns? Recent performance during the European sovereign debt crisis

All banks
Dependent variable: Stock return from June 2011 to Sep 2011

	(1)	(2)
(Tier1 - TCE)/Tier1	-0.017**	
	(0.007)	
(TotalCapital-Tier1)/TotalCapital		-0.031
		(0.047)
CustomerDeposits	0.075	0.066
	(0.070)	(0.066)
Securities/Assets	0.138***	0.136***
	(0.027)	(0.021)
NPL/Loans	-0.147	-0.193
	(0.182)	(0.200)
ROAA	2.122***	2.182***
	(0.300)	(0.294)
Observations	666	658
R-squared	0.385	0.384

The table presents regressions for banks in 32 countries. The dependent variable is the bank's stock return over the period from June 30, 2011 to September 30, 2011. The independent variables, all values for 2006, are the share of Tier1 capital that is not common shareholder's equity, the share of total regulatory capital that is not Tier 1 capital, the share of stable deposits, the share of securities in the bank's assets, the share of non-performing loans, the return on assets, the log of assets, and the stock's beta with a national market index. Country fixed effects and dummy variables representing the bank's specialization are included. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the country level using the Huber (1967) correction. *** indicates significance at the 1 percent level; ** indicates significance at the 5percent level; * indicates significance at the 10percent level.

Table 12a. Determinants of banks' stock returns over the crisis
Comparing regulatory capital ratios

Dependent variable: Stock Return from June 30, 2007 to Sep 30, 2008

	(1)	(2)	(3)
TCE/RWA (t-1)	0.361		
	(0.557)		
Tier1capital/RWA (t-1)		0.392	
		(0.782)	
TotalCapital/RWA (t-1)			0.141
			(0.746)
CustDeposits (t-1)	0.252**	0.274***	0.283***
	(0.122)	(0.088)	(0.086)
Securities/Assets (t-1)	0.456***	0.458***	0.496***
	(0.103)	(0.099)	(0.082)
NPL/Loans (t-1)	-0.788*	-0.810**	-0.823**
	(0.386)	(0.366)	(0.370)
ROAA (t-1)	8.916***	9.176***	9.556***
	(2.372)	(2.543)	(2.667)
Observations	234	234	234
R-squared	0.380	0.379	0.378

The table presents regressions for banks in 33 countries. The dependent variable is the bank's stock return over the period from June 30, 2007 to September 30, 2008. The independent variables, all values for 2006, are capital ratios (Tangible Common Equity (TCE), Tier1 Capital, and Total regulatory capital, all divided by Risk-weighted assets (RWA)), the share of stable deposits, the share of securities in the bank's assets, the share of non-performing loans, the return on assets, the log of assets, and the stock's beta with a national market index. Country fixed effects and dummy variables representing the bank's specialization are included. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the country level using the Huber (1967) correction. *** indicates significance at the 1 percent level; ** indicates significance at the 5percent level; * indicates significance at the 10percent level.

Table 12b. Determinants of banks' stock returns over the crisis
Comparing regulatory capital ratios – large banks

Large banks: Assets > 10 billion $US

Dependent variable: Stock return from June 2007 to Sep 2008

	(1)	(2)	(3)
TCE/RWA	0.361		
	(0.557)		
Tier1capital/RWA		0.392	
		(0.782)	
TotalCapital/RWA			0.141
			(0.746)
CustDeposits	0.252**	0.274***	0.283***
	(0.122)	(0.088)	(0.086)
Securities/Assets	0.456***	0.458***	0.496***
	(0.103)	(0.099)	(0.082)
NPL/Loans	-0.788*	-0.810**	-0.823**
	(0.386)	(0.366)	(0.370)
ROAA	8.916***	9.176***	9.556***
	(2.372)	(2.543)	(2.667)
Observations	234	234	234
R-squared	0.380	0.379	0.378

The table presents regressions for banks with assets greater than 10 billion US dollars in 2006, in 31 countries. The dependent variable is the bank's stock return over the period from June 30, 2007 to September 30, 2008. The independent variables, all values for 2006, are capital ratios (Tangible Common Equity (TCE), Tier1 Capital, and Total regulatory capital, all divided by Risk-weighted assets (RWA)), the share of stable deposits, the share of securities in the bank's assets, the share of non-performing loans, the return on assets, the log of assets, and the stock's beta with a national market index. Country fixed effects and dummy variables representing the bank's specialization are included. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the country level using the Huber (1967) correction. *** indicates significance at the 1 percent level; ** indicates significance at the 5percent level; * indicates significance at the 10percent level.

Table 13a. Determinants of banks' stock returns over the crisis – when capital ratios have a floor of 50 percent of assets

All banks

Dependent variable: Stock return from June 2007 to Sep 2008

	(1)	(2)	(3)
TCE/RWAfloor	0.163***		
	(0.036)		
Tier1capital/RWAfloor		-0.024	
		(0.054)	
TotalCapital/RWAfloor			-0.147***
			(0.046)
CustomerDeposits	0.036	0.047	0.050
	(0.070)	(0.073)	(0.071)
Securities/Assets	0.689***	0.715***	0.722***
	(0.105)	(0.104)	(0.104)
NPL/Loans	-0.302	-0.318	-0.338
	(0.199)	(0.208)	(0.208)
ROAA	5.091***	4.793***	4.368***
	(0.553)	(0.701)	(0.709)
Observations	766	766	766
R-squared	0.178	0.175	0.178

Robust standard errors clustered at country level in parentheses, ***p<0.01, **p<0.05, *p<0.10.

The table presents regressions for banks in 33 countries. The dependent variable is the bank's stock return over the period from June 30, 2007 to September 30, 2008. The independent variables, all values for 2006, are the ratio of risk-weighted assets to tangible assets, capital ratios (Tangible Common Equity (TCE), Tier1 Capital, and Total regulatory capital, all divided by max[0.5*Assets, RWA]), the share of stable deposits, the share of securities in the bank's assets, the share of non-performing loans, the return on assets, the log of assets, and the stock's beta with a national market index. Country fixed effects and dummy variables representing the bank's specialization are included. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the country level using the Huber (1967) correction. *** indicates significance at the 1 percent level; ** indicates significance at the 5percent level; * indicates significance at the 10percent level.

Table 13b. Determinants of banks' stock returns over the crisis – when capital ratios have a floor of 50 percent of assets – large banks

Large banks: Assets>10 Billion US$

Dependent variable: Stock return from June 2007 to Sep 2008

	(1)	(2)	(3)
TCE/RWAfloor	0.527		
	(0.580)		
Tier1capital/RWAfloor		0.651	
		(0.652)	
TotalCapital/RWAfloor			-0.556
			(0.815)
CustDeposits	0.213*	0.262***	0.278***
	(0.120)	(0.078)	(0.086)
Securities/Assets	0.461***	0.459***	0.508***
	(0.095)	(0.083)	(0.097)
NPL/Loans	-1.036*	-1.074**	-1.085*
	(0.543)	(0.513)	(0.530)
ROAA	7.769***	8.114***	9.662**
	(2.558)	(2.894)	(3.590)
Observations	226	226	226
R-squared	0.367	0.366	0.367

The table presents regressions for banks in 33 countries. The dependent variable is the bank's stock return over the period from June 30, 2007 to September 30, 2008. The independent variables, all values for 2006, are the ratio of risk-weighted assets to tangible assets, capital ratios (Tangible Common Equity (TCE), Tier1 Capital, and Total regulatory capital, all divided by max[0.5*Assets, RWA]), the share of stable deposits, the share of securities in the bank's assets, the share of non-performing loans, the return on assets, the log of assets, and the stock's beta with a national market index. Country fixed effects and dummy variables representing the bank's specialization are included. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the country level using the Huber (1967) correction. *** indicates significance at the 1 percent level; ** indicates significance at the 5percent level; * indicates significance at the 10percent level.

Table 14. Determinants of returns: Do risk-weighted assets affect stock returns? Reduced sample – maximum of 17 banks per country

Reduced sample

Dependent variable: Stock return from June 2007 to Sep 2008

	(1)	(2)	(3)
RWA/TangibleAssets	-0.246*	-0.348***	-0.301*
	(0.126)	(0.129)	(0.153)
TCE/TangibleAssets	0.011		
	(0.668)		
Tier1capital/TangibleAssets		1.368	
		(0.950)	
TotalCapital/TangibleAssets			0.547
			(0.956)
CustDeposits	0.248*	0.265*	0.255*
	(0.132)	(0.135)	(0.130)
Securities/Assets	0.265	0.199	0.252
	(0.161)	(0.161)	(0.159)
NPL/Loans	-0.175	-0.163	-0.163
	(0.156)	(0.162)	(0.160)
ROAA	8.232***	5.977*	7.579***
	(2.803)	(3.188)	(2.777)
Observations	189	185	189
R-squared	0.506	0.515	0.507

The table presents regressions for a reduced sample of banks in 32 countries, with 17 or fewer banks per country. See Table A2 for the list of countries. The dependent variable is the bank's stock return over the period from June 30, 2007 to September 30, 2008. The independent variables, all values for 2006, are the ratio of risk-weighted assets to tangible assets, capital ratios (Tangible Common Equity (TCE), Tier1 Capital, and Total regulatory capital, all divided by tangible assets), the share of stable deposits, the share of securities in the bank's assets, the share of non-performing loans, the return on assets, the log of assets, and the stock's beta with a national market index. Country fixed effects and dummy variables representing the bank's specialization are included. Standard errors (in parentheses below the coefficient estimates) are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the country level using the Huber (1967) correction. *** indicates significance at the 1 percent level; ** indicates significance at the 5percent level; * indicates significance at the 10percent level.

Table 15. Market measures of risk and balance-sheet measures of risk exposure
Cross-section for 2007

All banks, 2007
Dependent variable: Risk

	(1)	(2)	(3)
Risk Measure:	SDofStockRet	Beta	IdiosyncraticVol
TCE/TangibleAssets (t-1)	-10.334***	-0.722	-1.960***
	(-0.189)	(-0.036)	(-0.211)
TCE/TA squared (t-1)	0.070	0.020	0.053***
	(0.056)	(0.044)	(0.251)
RWA/TangibleAssets (t-1)	0.288	-0.099	0.105***
	(0.030)	(-0.028)	(0.065)
CustDeposits (t-1)	-1.103	0.347	-0.357*
	(-0.042)	(0.036)	(-0.080)
Securities/Assets (t-1)	-4.166***	-0.833***	0.411***
	(-0.160)	(-0.088)	(0.093)
NPL/Loans (t-1)	14.215	0.197	0.261
	(0.124)	(0.005)	(0.013)
ROAA (t-1)	-50.156***	6.788***	4.132*
	(-0.151)	(0.056)	(0.073)
log(Assets) (t-1)	5.125	25.275***	-1.010
	(0.039)	(0.529)	(-0.045)
Observations	758	758	758
R-squared	0.278	0.189	0.117

The table presents regressions for banks in 33 countries for 2007. The dependent variable is the standard deviation of the bank's monthly stock return over the previous year in column (1), the stock's beta with a national market index estimated from a CAPM model in column (2), the idiosyncratic volatility from this model in column (3). The independent variables, all lagged by one year, are the ratio of tangible common equity (TCE) to tangible assets, the ratio of risk-weighted assets (RWA) to tangible assets, the share of stable deposits, the share of securities in the bank's assets, the share of non-performing loans, the return on assets, and the log of assets. Country fixed effects, dummy variables representing the bank's specialization. Standard errors are adjusted for heteroskedasticity using the Huber (1967) and White (1980) correction, as well as for clustering at the country level using the Huber (1967) correction. *** indicates significance at the 1 percent level; ** indicates significance at the 5percent level; * indicates significance at the 10percent level. Standardized beta coefficients are reported in parentheses.

APPENDIX TABLES

Table A1. List of countries – full sample

Country	# banks	% Sample
Australia	6	0.74
Austria	4	0.5
Bangladesh	5	0.62
Belgium	2	0.25
Canada	9	1.11
China	11	1.36
Denmark	11	1.36
Finland	2	0.25
France	4	0.5
Germany	5	0.62
Greece	9	1.11
Hong Kong	6	0.74
India	12	1.49
Indonesia	8	0.99
Italy	20	2.48
Japan	81	10.02
Korea	4	0.5
Malaysia	9	1.11
Netherlands	1	0.12
Norway	13	1.61
Philippines	11	1.36
Poland	9	1.11
Russian Federation	7	0.87
Serbia	1	0.12
Singapore	3	0.37
Spain	8	0.99
Sri Lanka	6	0.74
Sweden	4	0.5
Switzerland	3	0.37
Taiwan	8	0.99
Thailand	6	0.74
Turkey	10	1.24
Ukraine	2	0.25
UK	7	0.87
USA	501	62

Table A2. List of countries – reduced sample used in several robustness checks

Country	# banks	% Sample
Australia	6	3.17
Austria	2	1.06
Belgium	1	0.53
Canada	11	5.82
China	7	3.7
Denmark	7	3.7
Finland	1	0.53
France	1	0.53
Germany	5	2.65
Greece	5	2.65
Hong Kong	6	3.17
India	1	0.53
Indonesia	3	1.59
Italy	17	8.99
Japan	17	8.99
Korea	3	1.59
Malaysia	8	4.23
Norway	9	4.76
Philippines	9	4.76
Poland	6	3.17
Russian Federation	4	2.12
Singapore	3	1.59
Spain	8	4.23
Sri Lanka	3	1.59
Sweden	4	2.12
Switzerland	3	1.59
Taiwan	2	1.06
Thailand	8	4.23
Turkey	8	4.23
Ukraine	2	1.06
UK	6	3.17
USA	13	6.88

Table A3. Descriptive statistics – correlations of explanatory variables in 2006

All banks: 766 observations

	TCE/TA	TCE/RWA	RWA/TA	CustDeps	Sec/Assets	NPL/Loans	ROAA	log(Assets)	Beta
TCE/TangibleAssets	1								
TCE/RWA	0.927								
RWA/TangibleAssets	0.149	0.124	1						
CustDeposits	0.274	0.203	-0.074	1					
Securities/Assets	-0.144	0.082	-0.083	-0.209	1				
NPL/Loans	-0.116	-0.132	0.197	-0.055	0.083	1			
ROAA	-0.297	-0.313	-0.137	-0.107	-0.052	0.014	1		
log(Assets)	-0.586	-0.453	0.133	-0.505	0.339	0.153	0.157	1	
Beta	-0.169	-0.104	0.169	-0.208	0.104	0.227	0.022	0.389	1