ROE and Risk-Taking in Banks

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Christophe Moussu[1]
ESCP Europe, Labex Refi

Arthur Petit-Romec[2]
ESCP Europe, Labex Refi

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[1]Corresponding author: ESCP Europe, 79 avenue de la République 75543 Paris Cedex 11, France. Tel: +33 1 49 23 22 69; Fax: +33 1 49 23 20 80; E-mail: moussu@escpeurope.eu

[2] ESCP Europe, 79 avenue de la République 75543 Paris Cedex 11, France. Tel: +33 1 49 23 20 33; Fax: +33 1 49 23 20 80; E-mail: arthur.romec@edu.escpeurope.eu

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ROE and Risk-Taking in Banks

Abstract:

Return on equity (ROE) is a central measure of performance in the banking industry. Empirical evidence that bank managers' pay is linked to ROE exists. We investigate the implications of ROE targeting on bank risk-taking. Using the 2007-2008 financial crisis, we reveal that pre-crisis ROE has a strong and very robust positive impact on both individual and systemic risk in the crisis. Our results are unchanged for the 1998 crisis but are totally reversed when samples of non-banking firms are considered. ROE also explains the persistence of poor performance across crises and appears as a key component of bank risk culture and vulnerability to crises. Overall, our results strongly suggest that reliance on ROE as a performance measure is a major incentive to take excessive risk in banks.

J. Dimon (CEO JP Morgan): "We feel good about the 17% ROE of the investment bank," Financial Times, *January 16th, 2013*

H. Schwartz (CFO Goldman Sachs): "There is a lot of value to having the best ROE in the industry," Financial Times, *April 17th, 2013*

1. Introduction

A great deal of anecdotal evidence suggests that return on equity (ROE) is a central measure of performance in banks. Target ROEs are not only set at the bank level, but they are also used to drive resource allocation across and even inside divisions. In a recent paper, Bennett, Gopalan and Thakor (2015) document empirically that bank CEOs and executives have a larger portion of their compensation linked to ROE than CEOs and executives of other industries. In this paper, we analyze the implications of ROE targeting on bank risk-taking. Our main hypothesis is that ROE is associated with higher risk and therefore carries strong risk-taking incentives in banks.

The reliance on ROE in banks has emerged from the risk management approach that inspired bank capital regulation. In this approach, a specific "capital charge" is determined, depending on the risk of each asset, in order to cover losses. This capital charge is either imposed by the regulator or estimated through internal risk models. Therefore, looking for the highest return for a given capital charge becomes the target, both inside divisions and at bank level. In this business model of banks, bank capital is adjusted to risk and excess capital inefficient. This perspective is hard to reconcile with a more traditional corporate finance approach, where risk is taken into account through specific discount rates and "excess" capital does not matter, as it reduces both the return and the risk for shareholders (Modigliani and Miller, 1958). Addressing the issue of

convergence of those approaches is not the purpose of this paper. However, given the prevalence of ROE everywhere in banks, it is very important to provide an assessment of the incentives ROE conveys in banks.

As Rajan (2006) argues, evaluating the true nature of bank performance is a very complicated task, and risk-taking may seem value-enhancing, albeit as long as risk has not materialized. We use the financial crisis as the materialization of the real risks taken by banks.

In order to test our main hypothesis, we first examine whether bank pre-crisis ROE is associated with the realization of bank risk in the crisis. We use two measures of bank risk: bank stock performance, as a proxy of bank individual risk, and the marginal expected shortfall (MES), computed following Acharya et al. (2010), as a proxy of systemic risk. Our results reveal that ROE is strongly associated with individual and systemic risk, based on a sample of 273 large banks from 28 countries. Our results are very robust to the introduction of numerous variables, controlling for risk, both on the asset and the liability sides of bank balance sheets, as well as market measures of risk and country variables. In particular, our results hold when we introduce control variables for bank capital or funding strategies, thereby indicating that ROE captures risk-taking above and beyond funding issues. The results also hold when we restrict the sample to deposit-taking banks. Interestingly, and contrarily to other control variables, ROE always appears as a main determinant of both bank individual risk and systemic risk.

We analyze further the relationship between ROE and bank individual risk during the crisis, by using dummy variables based on ROE quartiles. When tested against the lowest quartile, the dummies for the other three quartiles are highly significant, which reveals that the association between ROE and risk is not limited to banks with the highest ROE, but also holds for banks with intermediate ROE. We also run similar tests for the 1998 crisis on a subsample of 181 banks and

uncover a similar relationship between bank pre-crisis ROE and individual risk in the 1998 crisis, which suggests that the effect of ROE was not limited to the 2007-2008 crisis.

Three main reasons may explain our results, the more direct of which is a contingent explanation. As argued previously, ROE emerged as the natural performance measure of a bank business model grounded on risk management. With risk correctly assessed and capital exactly adjusted to risk, expected ROE does not increase with bank risk. However, in good states of nature, when losses are below their expected level, realized ROE increases with the level of risk. From this perspective, a contingent effect may explain our results, in that a higher ROE before the crisis resulted in higher risk that materialized during the crisis. One could argue that this argument is trivial. A higher level of performance is achieved through higher risk and results in higher losses when conditions worsen.

If the contingent effect is trivial, it should apply to firms outside the banking industry. Consequently, we test whether our results apply to non-financial firms as well, running two different out-of-sample tests. First, using the same empirical design and period, we test the impact of pre-crisis performance measures on stock returns in the crisis for a sample of 449 non-financial firms. Shareholder losses are comparable to those incurred by bank shareholders. In sharp contrast with our results for banks, firms with higher pre-crisis ROCE (return on capital employed), ROA (return on assets) or ROE performed better during the crisis. One reason for this difference is that the 2007-2008 crisis is a banking crisis. In order to address this concern, we propose a second out-of-sample test, in which we use the same empirical design for a shock specific to another industry. We focus on the stock performance of oil companies after the recent collapse of oil prices, which began in June 2014. We find no effect of pre-crisis performance measure on stock returns when controlling for capital structure, asset structure, size, risk and

institutional variables. Our two out-of-sample tests suggest that the contingent effect does not apply outside the banking industry. Therefore, the explanation is not trivial. The results reveal a specificity of banks: stronger performance makes them more vulnerable in crisis.

Two other explanations complement or substitute for the contingent explanation, namely mistakes and incentives. Concerning mistakes, our paper is related to Krüger, Landier and Thesmar (2014), who reveal how the use of a unique company-wide discount rate led to overinvestment in the riskiest activities of diversified firms. They attribute this mistake to a poor command of financial principles. In banks, inadequate capital charges are equivalent to using wrong discount rates. If capital charges are underestimated, ROE is artificially inflated and associated with higher risk for shareholders. The opposite is true as well, in that the overestimation of capital charges leads to lower ROE and lower risk. The complexity of bank activities, the imperfection of regulation (e.g., Vallascas and Hagendorff, 2013; Mariathasan and Merrouche, 2014), the existence of tail risk and heterogeneity in risk management practices (e.g., Aebi, Sabato, and Schmid, 2012; Ellul and Yerramilli, 2013) are possible reasons why banks make mistakes. Bank capital regulation accentuates these potential errors; indeed, the system of regulatory risk-weights does not provide a continuous adjustment of bank capital to risk, for instance the same capital charge can be required for a class of assets with risk heterogeneity (e.g., sovereign bonds). When regulation relies on internal models, we are back to the issue of heterogeneous risk management practices.

Our previous explanations apply even when mistakes in capital charges do not distort the bank capital allocation process. However, as a central performance measure, ROE is intrinsically tied to the resource allocation process in banks. Our third explanation is based on incentives. When ROE is targeted, managers are inclined to distort the capital allocation process along two lines.

First, ROE targeting creates an incentive for managers to engage strategically in regulatory arbitrage activities. Investing in the riskiest assets of a given class, favoring asset classes with undervalued capital charges and underestimating the real risks are examples of such activities. Empirical evidence highlights the existence of such regulatory arbitrage activities (Acharya, Schnabl, and Suarez, 2013; Acharya and Steffen, 2015; Mariathasan and Merrouche, 2014). Second, the use of ROE in banks is prone to a time-inconsistency problem. Asset allocation in banks is supposed to be based on expected ROE, but the performance of bank managers is assessed on observable realized ROE. Consequently, if ROE increases with risk in good times, in line with a contingent effect, managers have clear incentives to inflate this measure taking higher risk. Third, managers may be inclined to develop tail risk strategies, not taken into account in capital charges. The positive association between ROE and systemic risk may flow from this hypothesis. Also, when banks overcome regulatory constraints, by choosing the same assets with underestimated capital charges, regulatory arbitrage leads to systemic risk.

Anecdotal evidence indicates that ROE is a main target in the design of the compensation structure of bank managers. As mentioned previously, Bennett, Gopalan and Thakor (2015) confirm empirically that bank CEOs and executives have monetary incentives to maximize ROE on a sample of U.S. banks over the period 2006-2012. We check the existence of pay sensitivity to ROE for a portion of our sample of international banks, for which CEO compensation is available on Boardex. We find a strong sensitivity of CEO compensation to ROE, suggesting that monetary incentives to maximize ROE existed in the years leading up to the crisis. The effect of ROE is robust to the introduction of risk and size control variables, which are documented as being important determinants of bank CEO compensation (Cheng, Hong, and Scheinkman,

2014). This adds to the empirical evidence of Bennett, Gopalan and Thakor (2015), as it provides first evidence that CEO pay is also linked to ROE for non U.S. banks.

One interesting question is whether ROE is responsible for explaining the persistence of poor bank performance across crises, documented by Fahlenbrach, Prilmeier, and Stulz (2012) for U.S. banks. Following their methodology, we first show that the persistence of poor performance across crises also holds for our international sample. Second, we reveal that banks with high ROE, either in 1997 or in 2006, were more likely to perform poorly in both crises, which suggests that ROE targeting is an important component of what Fahlenbrach et al. (2012) describe as a 'risk culture'.

Our paper adds to the prolific literature investigating the determinants of bank performance during the crisis (Beltratti and Stulz, 2012; Berger and Bouwman, 2013; Demirgüç-Kunt, Detragiache, and Merrouche, 2013; Erkens, Hung, and Matos, 2012; Fahlenbrach and Stulz, 2011; Minton, Taillard, and Williamson, 2014). Beltratti and Stulz (2012) in particular provide a comprehensive study of the influence of both firm-level and country-level pre-crisis characteristics on bank performance during the crisis. Our paper complements these previous studies by revealing the role played by pre-crisis performance measures in explaining the vulnerability of banks in crises. In particular, the effect of ROE is robust to the introduction of bank capital structure variables, which are important determinant of an institution's ability to withstand shocks.

Our paper is also related to the literature investigating the role of incentives in banks. Motivated by the fact that executive incentives were publicly blamed for the near-collapse of

banks in the financial crisis[3], a prolific body of literature has investigated the relationship between compensation and risk-taking. Numerous studies have examined this question, and overall, the consensus is that compensation and risk in banks are strongly associated (Chesney et al., 2011; De Young et al., 2013; Cheng, Hong, and Scheinkman, 2014; Balachandran et al., 2011; Fahlenbrach and Stulz, 2011; Mehran and Rosenberg, 2007; Bolton, Mehran, and Shapiro, 2010). Our results complement this literature and indicate that one channel through which the design of CEO compensation induced risk-taking is sensitivity to ROE.

Finally, our paper illustrates perfectly the existence of perverse effects associated with the design of performance measures in firms. In particular, the fascination with an "objective" criterion is viewed as the main cause of distorted incentives in organizations (e.g. Kerr, 1975; Gibbons, 1998). Baker (1992) and Baker, Jensen, and Murphy (1988) discuss how the focalization on a wrong or inadequate performance measure is likely to induce counterproductive effects or agency conflicts if employees overreact to or game the performance measure. In particular, Baker, Jensen, and Murphy (1988) explain that one important criticism of a pay-for-performance system is that it can be too effective and motivate people to focus only on the output used in the measure. In line with this idea, our results are consistent with the fact that managers achieve higher ROE taking excessive risk.

The rest of the paper is organized as follows. The next section describes the sample, empirical methodology and the variables. In section 3 we present and interpret the empirical results, while in section 4 we propose two out-of-sample checks based on non-financial firms. In section 5 we focus on the sensitivity of CEO compensation to ROE and in section 6 we investigate the existence of an "ROE culture" in banks. Section 7 concludes.

[3] See *Wall Street Journal*, "Crazy Compensation and the crisis," by A. Blinder

2. Sample construction, description of variables and summary statistics

This section provides information on the construction of the sample and presents the main variables used in the empirical analysis and some descriptive statistics.

2.1 Sample construction

We obtain accounting data on balance sheets and income statements from Bankscope, stock and index returns from Datastream and CEO compensation information from BoardEx. The starting point for the construction of the sample comprises all banks that existed in Bankscope and Datastream databases for the year 2006[4]. We first exclude banks which are not listed, because our main dependent variable is the buy-and-hold stock return of banks during the crisis. Second, we reduce the sample to banks from those countries for which Djankov, La Porta, Lopez-de-Silanes, and Shleifer (2008) provided revised data on anti-director rights and for which regulation indices based on Barth, Caprio, and Levine (2008) are available. Finally, we focus our analysis on the largest banks, with assets over $10 billion just before the crisis at the end of 2006. To enter our sample, we require that a bank have a full set of data for our key variables.

We obtain a final sample of 273 banks from 28 countries (see Appendix A). In some empirical tests, we also focus on a subsample restricted to deposit-taking banks. Following

[4] Similar to previous studies (e.g. Fahlenbrach and Stulz, 2011; Beltratti and Stulz, 2012; Erkens et al., 2012), we choose the year 2006 to construct our sample, because this was the last complete year before the crisis for which data on balance sheets and income statements are available.

Beltratti and Stulz (2012), we impose a threshold of 20% for the ratio of customer-deposits to total assets. This subsample is composed of 245 banks.

2.2 Empirical Methodology

The main model we test is a simple OLS model, in which the main dependent variable is the buy-and-hold stock return of a bank in the crisis and the main independent variable is pre-crisis ROE. We control for various characteristics at the bank level. Most control variables are measured as for 2006, and we also control for several country-level variables. A definition of each variable is provided in Appendix B.

- *Dependent variable:*

We investigate the determinants of individual bank risk during the crisis, by using buy-and-hold returns, computed with weekly stock returns over a period of 18 months from July 2007 to the end of 2008. Of course, bank stocks continued to suffer in 2009 as a result of the crisis. However, consistent with the existing literature (Aebi, Sabato, Schmid, 2012; Beltratti and Stulz, 2012; Erkens, Hung, and Matos, 2012; Fahlenbrach and Stulz, 2011), we restrict the period to 2007-2008 in order to avoid bias in our dependent variable, since stock returns in 2009 were affected to a certain extent by government interventions and uncertainty about the possible nationalizations of banks.

In alternative specifications, we use the systemic risk contribution of a bank, using the marginal expected shortfall (MES) as a dependent variable. Following Acharya et al. (2010), we compute the MES as the average stock return of a bank over the worst 5% of days for the MSCI

world index during the period July 2007-December 2008. The MES corresponds to the drop in bank market capitalization when the market experiences extreme downward movements, and represents a measure of systemic risk.

- *Main independent variable*:

Our main independent variable is ROE, defined as the ratio of pre-tax profit to equity. We choose to use pre-tax ROE in order to smooth tax differences across countries.

- *Control variables at the bank level:*

We focus on control variables at the bank level which have been highlighted previously in the literature as important determinants of bank stock performance during the crisis[5].

We employ two measures of bank capital. The first measure is the Tier 1 ratio, which corresponds to the main regulatory capital ratio and is defined as the ratio of Tier 1 capital to total risk-weighted assets. Our second measure is the tangible equity ratio, defined as tangible common equity divided by total assets less intangible assets. The tangible equity ratio thus offers a more conservative approach to bank capital than the standard ratio of equity to assets[6].

We also use two other measures related to the capital structure of banks. The first measure is the ratio of total customer deposits to total assets. Contrary to funding received from financial markets or intermediaries, which can rapidly become expensive or unavailable, deposits are less subject to runs because they are insured and therefore represent a stable source of funding. Empirically, Beltratti and Stulz (2012) and Demirgüç-Kunt, Detragiache, and Merrouche (2013)

[5] See, for example, Beltratti and Stulz (2012), Demirgüç-Kunt, Detragiache and Merrouche (2013), Erkens, Hung and Matos (2012).
[6] In unreported tests, we find that our results are unchanged if we consider the equity ratio.

confirm the positive impact of deposits on bank performance during the crisis. Our second measure is the funding fragility ratio, proposed by Demirgüç-Kunt and Huizinga (2010), which is defined as the ratio of the sum of deposits and short-term borrowing, excluding customer deposits, to total deposits and short-term borrowing[7].

Concerning the nature of activities, we focus on the importance of non-traditional activities, by using the ratio of non-interest income to total operating income. Non-interest income includes net fee income, net commission income and net trading income. Previous studies have documented an impact of the share of non-traditional activities on bank risk, notably Baele, De Jonghe, and Vander Vennet (2007) for the beta of the stock and Stiroh (2004) for the Z-score. Furthermore, Demirgüç-Kunt and Huizinga (2010) show that expanding the share of non-interest activities can offer some risk diversification at very low levels, though this approach quickly becomes very risky.

We also control for the pre-crisis stock return over the year 2006, which can be considered as a proxy for certain risks rewarded by the market prior to the crisis but which eventually turned out badly during the crisis. In other words, stock performance during the crisis could represent a reversal of pre-crisis performance. Empirically, Beltratti and Stulz (2012) and Fahlenbrach et al. (2012) find that banks that performed well in 2006 suffered poor returns in the crisis.

In additional tests, we also use the ratio of risk-weighted assets to total assets, often called "density", as a risk measure of bank assets. Alternatively, density can be considered as a proxy for the regulatory arbitrage strategies pursued by banks in order to economize equity (Beltratti

[7] It is therefore inversely related to the importance of customer deposits in the short-term funding of banks, which is the most stable source of short-term funding.

and Paladino, 2013). In this case, lower density would indicate a more aggressive optimization of risk weights in order to "save" capital.

Finally, we control throughout our analysis for the size and beta. Size is defined as the natural logarithm of total assets, and we compute the beta by estimating a market model of weekly returns from 2004 to 2006. We use the MSCI World Index as the market portfolio and the three-month T-bill as the risk-free rate.

- *Control variables at the country level:*

On top of our previous control variables, we also control for six institutional variables at the country level which may influence risk-taking behavior and stock performance in the crisis. Two variables, namely the anti-director right index from Djankov et al. (2008) and the average of the voice, political stability, government effectiveness, regulatory quality, rule of law and corruption indicators from Kaufmann, Kraay, and Mastruzzi (2008), are general governance variables. The other four are specific to the banking industry and correspond to the regulation variables set out by Caprio, Laeven, and Levine (2007). Appendix B provides a precise description of these variables. All country variables are included at the same time in the regressions, and the main results are unchanged when entering them separately.

2.3. Summary statistics

Table 1 provides summary statistics for our bank sample. The median and mean buy-and-hold stock returns for the sample, respectively, are minus 40.7% and minus 36.4% from July 2007 to December 2008. In line with previous studies (e.g. Beltratti and Stulz, 2012; Fahlenbrach

et al., 2012), the standard deviation of these returns, 32%, is rather high. The median and mean MES are minus 3.27% and minus 3.69%. Pre-crisis ROEs were high, with a median and a mean of 18.49% and 20.12% respectively, and some heterogeneity exists across banks, since the standard deviation of ROE is 11% and the highest ROE reaches more than 50%. By contrast, the mean and median ROA, 1.41% and 1.24%, were much smaller. This discrepancy in the levels of ROE and ROA is related to the leverage of banks. Tangible equity ratios are relatively low, with a median and a mean of 5.76% and 6.25%, respectively, while the median and mean Tier 1 ratios are 8.57% and 9.08%, respectively. All banks are above the regulatory minimum of 4%. The portion of deposits in the financial structure is important, with an average deposit ratio of 57.2%. However, the standard deviation, 27%, is high, as our sample includes both commercial and investment banks. Similarly, the average funding fragility ratio is 24.4%, with a standard deviation of almost 27%. The average ratio of risk-weighted assets to total assets, 0.6, is equivalent to that reported by Beltratti and Paladino (2013). The median bank in our sample has $38 billion in assets in 2006, and the median and mean equity betas are 0.98 and 1.02, respectively.

3. Presentation and discussion of the results

3.1 ROE and individual risk in the 2007-2008 crisis

Table 2 presents ten regressions in which the dependent variable is the bank buy-and-hold stock return (BHR) during the crisis. The results indicate strongly that higher pre-crisis ROE is associated with more value destruction for bank shareholders during the crisis. The negative

impact of ROE on bank stock returns appears to be highly significant, both statistically and economically. According to regression 1, a one standard deviation increase in pre-crisis ROE is associated with an 11.45% (-1.035*11.06%) lower BHR, which corresponds to 35.4% of its standard deviation. This finding confirms that while in risk management models expected ROE amounts to a risk-adjusted measure, realized ROE is in contrast inflated through higher risk in good states of nature.

The impact of pre-crisis ROE on individual risk during the crisis remains very strong, even after taking into account our different control variables. In all the specifications, ROE has a strong and economically significant impact on the losses borne by bank shareholders during the crisis, with rather strong stability in the coefficients. For example, according to regression 7, where we control for the tangible equity ratio, the deposit ratio, the stock return in 2006, the size, the beta and our country variables, a one-standard deviation increase in pre-crisis ROE remains associated with a 6.48% lower BHR, which corresponds to 20% of its standard-deviation.

The impact of pre-crisis ROE on value destruction is robust and even increases when we replace the tangible equity ratio with the Tier 1 ratio (regressions 6 and 8). Consistent with Beltratti and Stulz (2012) and Demirgüç-Kunt, Detragiache, and Merrouche (2013), we find that banks with more capital, more deposits and less funding fragility performed better during the crisis, while results on our other control variables indicate that large banks and those with a higher involvement in non-interest activities experienced worse stock returns during the crisis. The negative impact of size is in line with the idea that large banks are more complex and had more opaque asset and funding structures which were uncovered during the crisis. Alternatively, the negative impact of size could also partly result from the existence of a ‘too big to save’ effect (Demirgüç-Kunt and Huizinga, 2013). The negative impact of non-interest income is consistent with Stiroh (2004) and Demirgüç-Kunt and Huizinga (2010), showing that the share of non-

interest income-generating activities is associated with higher risk. Banks with higher stock returns in 2006 tend to have lower stock returns in the crisis, although the effect is not strongly significant. Finally, banks with a higher ratio of risk-weighted assets experienced worse stock returns during the crisis, which indicates that although probably imperfect, the pre-crisis regulatory assessment of bank risk had some predictive power to explain individual risk. In contrast, the beta appears to have no predictive power.

In regressions 9 and 10, we restrict the sample to deposit-taking banks (for which customer deposits amount to at least 20% of total assets). Coefficients on ROE are similar and even of slightly higher economic significance in the case of ROE, thereby indicating that our results are not driven by investment banks.

Overall, the results from Table 2 indicate that ROE is associated with higher risk for bank shareholders. Of course, if we could observe all the ex-ante strategies aiming at increasing risk, we would expect to have no impact of ROE; however, the robustness and strength of the predictive power of ROE indicate that it is a good proxy for those strategies.

In Table 3, we analyze whether there are asymmetries in the relation between ROE and bank individual risk during the crisis. We split banks into quartiles, based on their pre-crisis ROE, and then create dummy variables for each group. ROE is replaced by the quartile indicator variables, and the omitted group is the quartile 1 corresponding to the group of banks with the lowest pre-crisis ROE. The results for our control variables remain the same except for Tier 1 ratio, which is still positive but no longer significant. In the six specifications, all the quartile dummies are highly significant and the coefficient becomes more and more negative as we move from the lowest ROE quartile to the highest ROE quartile. For example, according to regression 1, being in the 2^{nd}, 3^{rd} and 4^{th} quartiles is associated with a decrease in BHR of 16.6%, 22.8% and 24.7%, respectively. Remarkably, the BHR difference between the first and second quartiles is

already very important. These results go against the idea that the relation between ROE and individual risk is driven by banks with extreme ROE only.

3.2 ROE and systemic risk in the 2007-2008 crisis

In order to better gauge the nature of the risk associated with reliance on ROE, we replace the BHR with the MES, which in turn provides a measure of systemic risk. The results, which are reported in Table 4, strongly indicate that banks with higher pre-crisis ROE had more systemic risk during the crisis. Indeed, pre-crisis ROE has a strong and negative impact on the MES in all specifications, and this effect appears to be highly significant both statistically and economically. For example, according to regression 1, a one-standard-deviation increase in ROE is associated with a decline of 0.56% (-5.069*11.06%) in the MES, which represents 24.5% of its standard deviation.

Results for the control variables indicate that bank capital and deposits, which were important determinants of bank stock returns during the crisis, have no predictive power for systemic risk. Similarly, regressions 3 to 6 reveal that funding fragility and non-interest income have no impact on MES. The results for our control variables are consistent with Laeven, Ratnovski, and Tong (2014) and Weiß, Bostandzic, and Neumann (2014), in that they show that the determinants of individual risk and systemic risk tend to be different for the recent financial crisis. On the contrary, size is an important determinant of systemic risk, and interestingly, the beta becomes significant to some extent in explaining MES whereas it had no impact on individual risk.

3.3 The crisis of 1998

In this subsection we are interested in whether our results on ROE are specific to the recent financial crisis. We check whether our results hold for another crisis, namely that of 1998, which was marked by Russia's default and the collapse of long-term capital management (LTCM) and was at that time considered the worst financial crisis since the Great Depression.

Table 5 presents regressions for which the dependent variable is the buy-and-hold stock return of a bank during the crisis of 1998, while the ROE and control variables are computed for the year 1997. We follow Fahlenbrach, Prilmeier, and Stulz (2012) and use daily return data to compute buy-and-hold returns from August 3, 1998 (the first trading day of August 1998) to the day on which the bank attains its lowest stock price across the rest of the year 1998. Table 5 indicates that the results on ROE are unchanged for this specific crisis and robust to the introduction of several control variables. The effect appears to be highly significant, both statistically and economically. The results for the control variables indicate that, as in 2007-2008, large banks and banks with higher non-interest income experienced worse stock returns during the 1998 crisis. Conversely, the deposit ratio and funding fragility have no predictive power in the case of the 1998 crisis.

3.4. Discussion of the results

Our results indicate that ROE is associated with higher risk that materialized during the recent crisis, and in particular systemic risk. Moreover, the results hold when we consider the 1998 crisis. Different reasons may explain this association between pre-crisis ROE and the materialization of risk during crises, the most direct of which is a contingent explanation. As

argued previously, the risk management and regulatory approaches to banking activities have fostered ROE as a main performance measure. With risk correctly assessed and capital exactly adjusted to risk, expected ROE does not increase with bank risk. However, higher risk imply higher realized ROE in good states of nature but results in higher losses in bad states of nature. This contingent effect may explain our results and would apply even if risk was perfectly assessed. In the next section, we intend to check whether the simple story whereby highly performing firms end up doing worse in shocks applies to non-financial firms as well.

In the contingent explanation, possible mistakes in the assessment of risk and the incentives associated with ROE as a central performance measure are not taken into account. Our second explanation is based on mistakes. If banks fail to adequately adjust capital charges to the risk of their assets, the contingent effect is accentuated further. Flaws in regulation and diversity in risk management practices can explain these mistakes. Finally, as a central performance measure, ROE provides incentives. As a target, ROE potentially creates distortions in the capital allocation process of banks in favor of riskier assets or assets with underestimated capital charges. This explanation may reinforce the contingent effect or constitute per se an alternative explanation for our results. Section 5 studies the existence of incentives attached to ROE.

4. Out-of-sample tests: are banks special?

In this section we analyze the relevance of the contingent explanation for two out-of-sample tests based non-financial firms.

4.1 Non-financial firms and the 2007-2008 crisis

As a first out-of-sample test, we use the same empirical design and assess the impact of pre-crisis performance measures on the stock performance for a sample of non-financial firms with the same size (at least $10 billion in 2006) and from the same countries. The losses suffered by shareholders of non-financial firms were substantial, since the median firm in our sample had a stock return of minus 41% during the crisis (compared to minus 40.7% for banks). In this shock of comparable importance for the shareholders of banks and non-financial firms, we focus on three different pre-crisis measures of performance (return on capital employed, return on equity and return on assets) and test their impact on the BHR of non-financial firms during the crisis.

The results reported in regressions 1 to 3 of Table 6 indicate that ROCE, ROA and ROE are all positively associated with the stock performance of a firm during the crisis. The results are robust to the introduction of control variables, including beta, size, cash ratio, equity ratio, fixed assets, short-term debt and industry dummies (two-digit SIC codes). Interestingly, and in contrast with our results for banks, the pre-crisis beta has a strong negative impact on the stock performance of non-financial firms during the crisis. On the contrary, investors experienced more difficulties in properly assessing bank risk, which is consistent with the fact that banks are relatively more opaque than other firms (Morgan, 2002).

The results from this first out-of-sample test highlight that, at odds with our results on banks, non-financial firms with higher accounting-based performance measures before the crisis did much better during the crisis, thereby suggesting that the contingent explanation we propose for banks is not trivial.

4.2 The case of the oil industry and the 2014 oil shock

One reason for the difference between banks and non-financial firms is that the 2007-2008 crisis was a banking crisis that reflected the bad state of nature for the industry. To address this concern, we propose a second out-of-sample test in which we use the same empirical design for a shock that is specific to another industry. We focus on the stock performance of oil companies after the recent collapse of crude oil prices which began in June 2014. Specifically, we test the impact of 2013 performance measures for oil-related companies (oil extraction, petroleum refining, etc.) on the BHR from June 20, 2014, to the end of March, 2015[8]. We restrict the sample to oil companies from the same countries as the banks and with total assets totalling more than $100 million at the end of 2013[9]. This shock is of significant importance for oil companies, since the median firm in our sample had a stock return of minus 33% over the period. The results, which are reported in regressions 4 to 6 of Table 6, indicate that ROCE, ROA and ROE have no impact on the stock performance of oil companies during the oil shock when we control for capital and asset structures, size, risk and industry (four-digit SIC code) variables. The correlation between pre-crisis performance measures and the stock performance of oil companies in the crisis is statistically significant, but the effect disappears once we introduce our control variables. The results for the control variables indicate that larger firms and firms with lower beta enjoyed higher stock performance during the oil crisis.

Overall, out-of-sample tests indicate that higher performance in good times does not result in higher losses outside the banking industry when conditions worsen. The results suggest that the effect we observe for banks is not trivial. Of course, they cannot rule out a contingent explanation

[8] The results are unchanged if we start the calculation at the beginning of June 2014 or if we stop at the end of December 2014.
[9] The results are unchanged if we use a $1 billion threshold.

in the case of banks, especially as their raw material is risk. However, they reveal a specificity of banks, in that their main performance measure is strongly associated with risk, which is not the case outside the banking industry. This particular feature poses a serious challenge to ROE as the main performance measure in banks.

5. ROE and CEO pay

The contingent explanation holds even if banks adequately adjust their capital charges to risk. Mistakes in the assessment of capital charges would tend to reinforce the contingent effect. However, ROE is also a central performance measure in banks and as such provides incentives for managers to game this measure. Even when capital is correctly adjusted to risk, managers can inflate ROE in good times, by allocating capital to riskier activities. They also have incentives to make mistakes when ROE is targeted. Heterogeneity in risk-management, flaws in regulation and the ability to circumvent it make these mistakes possible. Moreover, disentangling "naïve" errors from strategic behavior on the side of bank managers is not an easy task.

Anecdotal evidence suggests that ROE serves as a trigger for both bonuses and equity-based compensation granted to bank managers[10]. In a recent paper, Bennett, Gopalan and Thakor (2015) provide strong empirical evidence that bank CEOs and executives have a larger portion of their compensation linked to ROE than their peers from other industries. This sensitivity of bank managers' pay to ROE empirically confirms its role as a central performance measure in banks. It

[10] For example, Reuters (4th April 2014) documents that for Goldman's CEO, "In order to get the full award, Goldman must generate an average return on equity of at least 12 percent over a span of either three or five years, at the board's discretion. That goal is higher than the 10 percent minimum that had been set in the prior year."

also reveals that high-powered incentives to maximize ROE exist in banks. These effects are documented on a sample of U.S. banks for the period 2006-2012. In this section, we intend to check whether the sensitivity of bankers' pay to ROE exist for our sample of international banks in the years preceding the crisis. We are able to carry this analysis for a subsample of 71 banks (276 bank-year observations) for which CEO compensation is available on BoardEx database.

In all specifications, the dependent variable is the natural logarithm of total CEO compensation, which takes into account both cash compensation (salary plus bonus) and equity-based compensation. We control for the size of the bank in all specifications. Talent assignment models such as Gabaix and Landier (2008) predict that CEO pay scales with size and empirical evidence confirms that size is a key determinant of CEO compensation, both in banks and non-financial firms (e.g., Chemmanur, Cheng, and Zhang, 2013; Cheng, Hong, and Scheinkman, 2014). We also control for observable risk variables (beta of the stock and stock return volatility[11]), which proved to be associated with CEO compensation in a sample of U.S. banks (Cheng, Hong, and Scheinkman, 2014). In their interpretation, bank managers are compensated when they bear extra risk. Additionally, we also control for the level of equity. Indeed, testing the model of Berk, Stanton, and Zechner (2010), Chemmanur, Cheng, and Zhang (2013) reveal empirically, for a sample of US non-financial firms, that CEO pay and employee wages increase with firm leverage.

Table 7 presents the results of regressions of total CEO compensation on ROE and control variables for the period 2002-2006. We include year dummies, to control for time-specific variations in CEO compensation, and a deposit-taking bank dummy, to control for possible differences in CEO pay between investment banks and deposit-taking banks. Table 7 indicates

[11] The beta is computed by estimating market models with weekly returns. We use the MSCI World Index as the market portfolio and the three-month T-bill as the risk-free rate.

strongly that monetary incentives associated with ROE existed in banks for CEOs in the years leading up to the crisis. In all specifications, we observe strong sensitivity of CEO compensation to ROE[12]. This provides empirical evidence that the results of Bennett, Gopalan and Thakor (2015) hold for international banks.

Results for the control variables confirm that size is a key determinant of CEO compensation, i.e. large banks appear to pay their CEO more than their smaller counterparts. The negative and significant coefficient of the deposit bank dummy indicates that CEOs at investment banks are paid more than at deposit-taking banks. We also document a strong positive association between the equity ratio and CEO compensation. This result appears opposite to what Chemmanur, Cheng, and Zhang (2013) find for non-financial firms. However, it has to be interpreted by taking into account the fact that equity is adjusted to the level of risk in banks. It therefore appears consistent with the idea that higher risk should command higher compensation[13]. Nonetheless, our other risk variables (beta and volatility) have no effect on CEO compensation.

Finally, in regression 5, we also control for a market-adjusted stock return in order to address the possibility that banks experiencing good stock performance may at the same time achieve higher ROE and pay their CEOs more as a result. Interestingly, the results reveal that the market-adjusted return has no impact on the level of CEO compensation, while ROE still has a strong impact on CEO compensation. This finding is consistent with the results from Bhattacharyya and Purnanandam (2012) and Bennett, Gopalan and Thakor (2015) that executive

[12] For the sake of place, we do not report the regressions with stock volatility, but the results are identical.
[13] In unreported tests, we find that density (the ratio of risk-weighted assets to total assets) is positively associated with CEO compensation.

compensation in U.S. banks depends more on short-term accounting performance metrics than on stock return.

In unreported tests, we find that the sensitivity of bank CEO compensation to ROE is robust to the introduction of a firm-fixed effect. Moreover, we also estimate regression 5 for each year, in the spirit of Fama and Macbeth (1973), in which case ROE coefficients are positive and highly significant for every year between 2002 and 2006. Overall, the results from this section provide evidence of a strong association between total CEO compensation and ROE in the years leading up to the crisis.

6. ROE and risk culture in banks

The results from Section 3 indicate that the association between ROE and the materialization of risk during the crisis holds both for the recent 2007-2008 crisis and for the 1998 crisis. This raises the interesting question of whether ROE plays a role in explaining the persistence of poor bank performance across crises, as documented by Fahlenbrach, Prilmeier, and Stulz (2012) for U.S. banks. The existence of an ROE culture, which Admati and Hellwig (2013) describe as a 'deeply embedded in the banking industry', may contribute to making some banks particularly vulnerable to crises.

First, in Table 8, we assess whether poor performance is persistent across the two crises for our international sample of banks, as documented by Fahlenbrach, Prilmeier, and Stulz (2012) for U.S. banks. The results confirm that bank stock returns during the 1998 crisis have strong predictive power for returns in the recent financial crisis. Moreover, consistent with their results,

unreported tests reveal that this persistence in bank performance is mainly driven by the worst performing banks.

Next, we investigate whether ROE has any predictive power to explain membership in the group of banks that performed worst in both crises. We explicitly investigate the attributes of this group, running Probit regressions in which the dependent variable is a dummy equal to one if a bank is in the bottom tercile of stock returns for both crises. Panel A of Table 9 presents the results using the attributes of banks for 2006 and Panel B for 1997. The results strongly indicate that ROE is a key attribute of the group of worst performers. Indeed, in both panels, ROE has strong predictive power in explaining membership in the group of worst performing banks. Both effects appear to be highly significant. The results for the control variables indicate that larger banks are more likely to belong to this worst performer group. The results are robust both for 1997 and 2006, although the impact of size is lower for 1997. Consistent with Fahlenbrach, Prilmeier, and Stulz (2012), we also find evidence that asset growth in the years leading up to the crisis has some predictive power for membership in the bottom performer group. On the contrary, bank capital ratio and deposit ratio have no impact on explaining membership in the group of worst performing banks. Overall, banks with higher ROE are more likely to perform poorly in both crises, which suggests that ROE is an important element of the risk culture described by Fahlenbrach, Prilmeier, and Stulz (2012). Whereas previous literature emphasizes the role of short-term finance and fast growth in making banks vulnerable, our results highlight the fact that high ROE also accounts for this vulnerability.

7. Conclusion

The bank business model which emerged more than four decades ago, following risk management and regulatory approaches to bank capital, crystallized ROE as the chief performance metric in the banking sector. ROE is not only the main measure of bank performance, but it also drives the allocation of resources across and inside bank divisions. In theory, from a risk management perspective, ROE could be an appropriate performance measure if the measurement and disclosure of risk led to a perfect adjustment of the level of bank equity. However, extreme focalization on ROE may drive managers to take higher risk, in an industry where complexity and opacity considerably alter the ability of outsiders to observe them accordingly, and where bank capital regulation allows arbitrage.

Numerous observers have raised their voice to criticize the use of ROE. Jenkins[14], for instance, begs the question: 'But what if more fundamental change is needed to the way everyone thinks about bank profitability? What if ROE is the wrong measure entirely?' Admati[15] goes even further in this respect, stating that 'ROE is a flawed and misleading measure that should not be used to measure value creation and profitability, or to determine managerial compensation […] The fixation on ROE in the banking sector reflects and breeds a love of leverage and risk that is dangerous for society as a whole'.

Using financial crisis as a risk revelation event, we document a very strong positive effect of pre-crisis ROE on the risks that materialized in the crisis. Our results clearly indicate that ROE is an aggravating factor in making banks more vulnerable to crises. ROE also appears as a main

[14] *Financial Times*, 7th November 2011.

[15] See the article "Rethinking how banks create value," available at: http://www.gsb.stanford.edu/news/packages/PDF/%20AdmatiFocusJune.pdf

variable in explaining the persistence of bank vulnerability across crises, suggesting that it constitutes a major ingredient of risk culture.

The low return environment and the reinforcement of bank capital requirements seem to have strengthened banks' risk management approaches from a perspective of "economizing" equity. Given this evolution, the role of ROE is even more important as a performance measure. From a policy perspective, the response of the regulator, consisting of reinforcing capital requirements, may prove to be counterproductive unless it is accompanied by a radical change in the way performance is assessed in the banking industry and their executives paid.

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Table 1: Summary statistics

This table reports statistics for the whole sample of 273 banks. All variables (except BHR and MES) are computed for 2006, prior to the beginning of the crisis. BHR is the weekly buy-and-hold return from July 2007 to the end of 2008. MES is the average stock return during the worst 5% of days of the MSCI for the period July 2007-December 2008. ROE is the ratio of pre-tax-profit to equity. ROA is the ratio of the pre-tax-profit to total assets. Tangible equity is the ratio of equity minus intangible assets divided by total assets. Tier 1 is the ratio of Tier 1 capital to risk-weighted assets. Deposits is the ratio of customer deposits to total assets. Funding fragility is the ratio between the sum of deposits from banks, other deposits and short-term borrowing to total deposits and short-term borrowing. Non-interest income is the ratio of non-interest income to total operating income. Density is the ratio of risk-weighted assets to total assets. Size refers to the natural logarithm of total assets. BHR 2006 is the weekly buy-and-hold return for the year 2006. Beta is the slope of the regression of weekly excess stock returns on the MSCI World excess return from 2004 to 2006. ADRI is the anti-director index, as revised in Djankov et al. (2008). Institution is the average of the six following indicators provided by Kaufmann et al. (2008): voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption. Official is an index of the power of supervisory authorities. Private monitoring is an index of the intensity of monitoring by the private sector. Capital is an index of regulatory oversight of bank capital. Restrict is an index of regulatory restrictions on the activities of banks. The regulation variables are from Caprio et al. (2007).

	Number of observations	Mean	Median	Std. dev	Min	Max
BHR	273	-0.364	-0.407	0.323	-0.988	0.411
MES (%)	265	-3.69	-3.27	2.29	-13.26	0.001
ROE (%)	273	20.12	18.49	11.06	0.57	52.39
ROA (%)	273	1.41	1.24	1.08	0.04	9.89
Tangible equity (%)	273	6.25	5.76	4.01	-0.34	41.65
Tier 1 (%)	212	9.08	8.57	2.39	4.82	22.9
Deposits (%)	273	57.18	61.57	27.11	0.00	93.40
Funding Fragility (%)	273	24.40	12.83	26.66	0.00	100.00
Non-interest income (%)	273	38.71	35.60	22.66	0.76	109.80
Density	190	0.60	0.59	0.17	0.15	0.92
Size	273	10.92	10.54	1.40	9.21	14.49
BHR 2006	273	0.185	0.19	0.341	-0.657	1.747
Beta	273	1.02	0.98	0.42	0.23	2.39
ADRI	273	3.82	4	0.94	1	5
Institution	273	1.13	1.24	0.50	-0.76	1.83
Official	273	11.07	12	2.15	5	14
Private monitoring	273	7.12	7	0.80	4	8
Capital	273	6.11	6	1.35	2	9
Restrict	273	9.91	11	2.11	4	15

Table 2: Individual risk and ROE in the 2007-2008 crisis

This table reports the OLS regressions of the buy-and-hold return to the ROE and our different control variables. In each specification, the dependent variable is the weekly buy-and-hold return from July 2007 to the end of 2008. ROE is the ratio of pre-tax-profit to equity. Tangible equity is the ratio of equity minus intangible assets divided by total assets. Tier 1 is the ratio of Tier 1 capital to risk-weighted assets. Deposits is the ratio of customer deposits to total assets. Funding fragility is the ratio between the sum of deposits from banks, other deposits and short-term borrowing to total deposits and short-term borrowing. Non-interest income is the ratio of non-interest income to total operating income. Density is the ratio of risk-weighted assets to total assets. BHR 2006 is the weekly buy-and-hold return for the year 2006. Size refers to the natural logarithm of total assets. Beta is the slope of the regression of weekly excess stock returns on the MSCI World excess return from 2004 to 2006. Country variables include ADRI, Institution, Official, Private monitoring, Capital and Restrict. Below the regression coefficient is reported the standard error in parentheses and to the right of the regression coefficient its significance (*** significant at 1%, **significant at 5%, * significant at 10%).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ROE	-1.035***	-0.690***	-0.752***	-0.518***	-0.583**	-0.761***	-0.586***	-0.665***	-0.804***	-0.705***
	(0.177)	(0.184)	(0.178)	(0.196)	(0.234)	(0.213)	(0.183)	(0.225)	(0.197)	(0.226)
Tangible equity		-0.004	-0.006	-0.005	0.028**		-0.003		-0.002	
		(0.005)	(0.005)	(0.005)	(0.011)		(0.005)		(0.007)	
Tier1_ratio						0.016**		0.017**		0.019**
						(0.008)		(0.008)		(0.009)
Deposits		0.444***			0.537***	0.559***	0.422***	0.497***	0.621***	0.541***
		(0.101)			(0.159)	(0.159)	(0.099)	(0.168)	(0.138)	(0.164)
Funding fragility			-0.295***							
			(0.081)							
Non_interest				-0.398***						
				(0.108)						
Density					-0.447***					
					(0.137)					
BHR 2006							-0.123*	-0.095		
							(0.069)	(0.083)		
Size		-0.051***	-0.063***	-0.062***	-0.039**	-0.031**	-0.049***	-0.033**	-0.039**	-0.035**
		(0.015)	(0.013)	(0.015)	(0.017)	(0.015)	(0.014)	(0.015)	(0.016)	(0.016)
Beta		0.025	0.008	0.030	-0.058	-0.028	0.012	-0.044	0.011	-0.002
		(0.046)	(0.048)	(0.052)	(0.062)	(0.055)	(0.047)	(0.059)	(0.049)	(0.055)
Constant	-0.801***	-0.294	0.006	-0.047	-0.202	-0.725**	-0.104	-0.551	-0.316	-0.822**
	(0.239)	(0.302)	(0.275)	(0.278)	(0.386)	(0.355)	(0.329)	(0.401)	(0.366)	(0.402)
Country variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	273	273	273	273	190	212	273	212	245	206
R-squared	0.266	0.428	0.401	0.399	0.530	0.494	0.435	0.498	0.442	0.497

Table 3: Individual risk and ROE quartiles for the 2007-2008 crisis

This table reports the OLS regressions of the buy-and-hold return to the ROE and our different control variables. In each specification, the dependent variable is the weekly buy-and-hold return from July 2007 to December 2008. ROE Quartile 2/Quartile 3/ Quartile 4 denote banks whose ROEs were in the second, third and fourth quartiles before the crisis, with quartile 4 corresponding to the highest ROE. Tangible equity is the ratio of equity minus intangible assets divided by total assets. Tier 1 is the ratio of Tier 1 capital to risk-weighted assets. Deposits is the ratio of customer deposits to total assets. Funding fragility is the ratio between the sum of deposits from banks, other deposits and short-term borrowing to total deposits and short-term borrowing. Non-interest income is the ratio of non-interest income to total operating income. Size refers to the natural logarithm of total assets. Beta is the slope of the regression of weekly excess stock returns on the MSCI World excess return from 2004 to 2006. Country variables include ADRI, Institution, Official, Private monitoring, Capital and Restrict. Below the regression coefficient is reported the standard error in parentheses and to the right of the regression coefficient its significance (*** significant at 1%, **significant at 5%, * significant at 10%).

	(1)	(3)	(5)	(2)	(4)	(6)
ROE Quartile 2	-0.166***	-0.184***	-0.136***	-0.233***	-0.263***	-0.231***
	(0.049)	(0.049)	(0.051)	(0.054)	(0.056)	(0.059)
ROE Quartile 3	-0.228***	-0.250***	-0.173***	-0.276***	-0.318***	-0.278***
	(0.049)	(0.049)	(0.052)	(0.057)	(0.056)	(0.056)
ROE Quartile 4	-0.247***	-0.273***	-0.196***	-0.300***	-0.342***	-0.296***
	(0.057)	(0.056)	(0.062)	(0.063)	(0.062)	(0.068)
Tangible equity	-0.004	-0.005	-0.005			
	(0.005)	(0.005)	(0.005)			
Tier1 ratio				0.011	0.008	0.012
				(0.008)	(0.008)	(0.008)
Deposits	0.454***			0.469***		
	(0.100)			(0.155)		
Funding fragility		-0.327***			-0.236	
		(0.083)			(0.154)	
Non-interest income			-0.358***			-0.185
			(0.102)			(0.152)
Size	-0.047***	-0.058***	-0.061***	-0.030**	-0.045***	-0.048***
	(0.015)	(0.014)	(0.016)	(0.015)	(0.014)	(0.015)
Beta	0.024	0.010	0.022	-0.046	-0.050	-0.061
	(0.046)	(0.047)	(0.053)	(0.052)	(0.052)	(0.057)
Constant	-0.199	0.107	0.063	-0.461	-0.097	-0.219
	(0.299)	(0.275)	(0.277)	(0.358)	(0.349)	(0.357)
Country variables	Yes	Yes	Yes	Yes	Yes	Yes
Observations	273	273	273	212	212	212
R^2	0.453	0.432	0.413	0.533	0.506	0.503

Table 4: Systemic risk and ROE in the 2007-2008 crisis

This table reports the OLS regressions of the marginal expected short-fall (MES) to the ROE and our different control variables. In each specification, the dependent variable is the MES, defined as the average stock return of a bank over the worst 5% of days for the MSCI World for the period July 2007-December 2008. ROE is the ratio of pre-tax-profit to equity. Tangible equity is the ratio of equity minus intangible assets divided by total assets. Tier 1 is the ratio of Tier 1 capital to risk-weighted assets. Deposits is the ratio of customer deposits to total assets. Funding fragility is the ratio between the sum of deposits from banks, other deposits and short-term borrowing to total deposits and short-term borrowing. Non-interest income is the ratio of non-interest income to total operating income. Size refers to the natural logarithm of total assets. Beta is the slope of the regression of weekly excess stock returns on the MSCI World excess return from 2004 to 2006. Country variables include ADRI, Institution, Official, Private monitoring, Capital and Restrict. Below the regression coefficient is reported the standard error in parentheses and to the right of the regression coefficient its significance (*** significant at 1%, **significant at 5%, * significant at 10%).

	(1)	(2)	(3)	(4)	(5)	(6)
ROE	-5.069***	-3.710**	-5.243***	-3.799***	-4.472***	-3.223*
	(1.253)	(0.196)	(1.233)	(1.467)	(1.348)	(0.234)
Tangible equity	-0.024		-0.037		-0.016	
	(0.040)		(0.039)		(0.037)	
Tier1 ratio		0.076		0.074		0.087
		(0.059)		(0.055)		(0.060)
Deposits	0.783	0.245				
	(0.760)	(1.429)				
Funding fragility			-0.112	1.993*		
			(0.598)	(1.142)		
Non-interest income					-1.129	-0.782
					(0.814)	(1.175)
Size	-0.705***	-0.604***	-0.751***	-0.695***	-0.703***	-0.589***
	(0.112)	(0.124)	(0.102)	(0.100)	(0.110)	(0.107)
Beta	-0.913***	-0.471	-0.995***	-0.669*	-0.840**	-0.444
	(0.367)	(0.394)	(0.357)	(0.381)	(0.378)	(0.384)
Constant	8.062***	4.242	8.829***	3.941	8.258***	4.219
	(2.065)	(2.795)	(0.355)	(2.676)	(0.348)	(2.681)
Country variables	Yes	Yes	Yes	Yes	Yes	Yes
Observations	265	205	265	205	265	205
R^2	0.419	0.335	0.414	0.349	0.421	0.338

Table 5: Individual risk and ROE for the 1998 crisis

This table reports the OLS regressions of the buy-and-hold return to the ROE and our different control variables for the 1998 crisis. In each specification, the dependent variable is the daily buy-and-hold return from August 3, 1998 (the first trading day of August 1998) to the day on which the bank attains its lowest stock price during the rest of 1998. ROE is the ratio of pre-tax-profit to equity. Tangible equity is the ratio of equity minus intangible assets divided by total assets. Deposits is the ratio of customer deposits to total assets. Funding fragility is the ratio between the sum of deposits from banks, other deposits and short-term borrowing to total deposits and short-term borrowing. Non-interest income is the ratio of non-interest income to total operating income. Size refers to the natural logarithm of total assets. Beta is the slope of the regression of weekly excess stock returns on the MSCI World excess return from 1995 to 1997. Country variables include ADRI, Institution, Official, Private monitoring, Capital and Restrict. Below the regression coefficient is reported the standard error in parentheses and to the right of the regression coefficient its significance (*** significant at 1%, **significant at 5%, * significant at 10%).

	(1)	(2)	(3)	(4)
ROE	-0.217***	-0.175***	-0.181***	-0.184**
	(0.059)	(0.055)	(0.052)	(0.094)
Tangible equity		-1.348***	-1.374***	-1.020**
		(0.493)	(0.493)	(0.502)
Deposits		0.031		
		(0.051)		
Funding fragility			-0.034	
			(0.094)	
Non_interest income				-0.271***
				(0.051)
Size	-0.032***	-0.044***	-0.044***	-0.033***
	(0.009)	(0.010)	(0.010)	(0.010)
Beta	-0.038**	-0.030*	-0.031*	-0.018
	(0.018)	(0.017)	(0.017)	(0.017)
Constant	-0.091	0.234	0.260	0.398
	(0.223)	(0.254)	(0.255)	(0.236)
Country variables	Yes	Yes	Yes	Yes
Observations	181	181	181	169
R^2	0.353	0.394	0.393	0.474

Table 6: Out-of-sample tests for non-financial firms in the 2007-2008 crisis and oil companies in the 2014 oil shock.

Regressions 1 to 3 of this table report the OLS regressions of the buy-and-hold return during the 2007-2008 crisis on pre-crisis performance measures for non-financial firms. In the three regressions, the dependent variable is the weekly buy-and-hold return from July 2007 to the end of 2008. Regressions 4 to 6 report the OLS regressions of the buy-and-hold return during the 2014-2015 oil shock on pre-crisis performance measures for oil-related companies. In the three regressions, the dependent variable is the weekly buy-and-hold return from June, 2014 to the end of March 2015. ROCE, ROA and ROE, respectively, are the Return on Capital Employed, Return on Assets and Return on Equity. Equity is the ratio of equity to total assets. Cash is the ratio of cash and equivalents to total assets. Short-term debt is the ratio of short-term debt to total assets. Fixed Assets is the ratio of net properties, plants and equipment to total assets. Size refers to the natural logarithm of total assets. Beta is the slope of the regression of weekly excess stock returns on the MSCI World excess return from 2004 to 2006. Country variables include ADRI, Institution. Below the regression coefficient is reported the standard error in parentheses and to the right of the regression coefficient its significance (*** significant at 1%, **significant at 5%, * significant at 10%).

	(1) 2007-08 crisis	(2) 2007-08 crisis	(3) 2007-08 crisis	(4) 2014-15 Oil shock	(5) 2014-15 Oil shock	(6) 2014-15 Oil shock
ROCE	0.526***			0.075		
	(0.175)			(0.166)		
ROE		0.103***			0.004	
		(0.031)			(0.210)	
ROA			0.760***			0.092
			(0.214)			(0.084)
Equity	0.222***	0.246**	0.171*	-0.025	-0.021	-0.016
	(0.082)	(0.093)	(0.099)	(0.080)	(0.081)	(0.082)
Cash	0.001	0.096	0.025	0.340	0.336	0.342
	(0.170)	(0.139)	(0.159)	(0.216)	(0.216)	(0.217)
Short-term debt	0.275	0.187	0.187	0.035	0.028	0.044
	(0.280)	(0.295)	(0.289)	(0.227)	(0.223)	(0.228)
Fixed assets	-0.000	-0.000	-0.000	-0.114*	-0.117*	-0.112*
	(0.001)	(0.001)	(0.001)	(0.063)	(0.062)	(0.062)
Size	0.029	0.032	0.030	0.027***	0.026***	0.027***
	(0.020)	(0.021)	(0.023)	(0.008)	(0.008)	(0.008)
Beta	-0.181***	-0.185***	-0.183***	-0.169***	-0.169***	-0.168***
	(0.044)	(0.064)	(0.065)	(0.037)	(0.037)	(0.037)
Constant	-0.042	0.032	-0.026	-0.117	-0.105	-0.135
	(0.404)	(0.469)	(0.501)	(0.154)	(0.154)	(0.153)
Country variables	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	449	449	449	338	338	338
R-squared	0.379	0.369	0.377	0.605	0.605	0.606

Table 7: CEO compensation and ROE before the crisis (2002-2006)

This table reports the OLS regressions of the natural logarithm of total CEO compensation on ROE and control variables. In each specification, the dependent variable is the natural logarithm of total CEO compensation, composed of cash compensation and equity-linked compensation. ROE is the ratio of pre-tax-profit to equity. Equity is the ratio of equity to total assets. Size refers to the natural logarithm of total assets. Beta is the slope of the regression of weekly excess stock returns on the MSCI World excess return computed annually. Market-adjusted return is the difference between the annual stock return and the market return. Deposit bank is a dummy variable that equals one if a bank customer deposits to a total assets ratio superior to 20%. Below the regression coefficient is reported the standard error in parentheses and to the right of the regression coefficient its significance (*** significant at 1%, **significant at 5%, * significant at 10%).

	Total compensation (1)	Total compensation (2)	Total compensation (3)	Total compensation (4)	Total compensation (5)
ROE	2.758***	1.81***	2.70***	2.76***	2.79***
	(0.622)	(0.589)	(0.628)	(0.626)	(0.657)
Size		0.14***	0.27***	0.29***	0.28***
		(0.033)	(0.039)	(0.043)	(0.041)
Equity			7.02***	7.27***	7.09***
			(1.669)	(1.634)	(1.671)
Beta				-0.13	
				(0.157)	
Market-adj return					-0.15
					(0.485)
Deposit bank		-0.89***	-0.77***	-0.73***	-0.74***
		(0.166)	(0.167)	(0.172)	(0.185)
Constant	8.029***	7.45***	5.10***	5.03***	8.42
	(0.216)	(0.481)	(0.664)	(0.659)	(10.778)
Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	276	276	276	275	275
R^2	0.079	0.165	0.238	0.243	0.241

Table 8: The persistence of bank performance across crises

This table reports the OLS regressions of the buy-and-hold return during the 2007-2008 to the buy-and-hold return of the 1998 crisis. In each specification, the dependent variable is the weekly buy-and-hold return from July 2007 to the end of 2008. BHR 1998 is the daily buy-and-hold return from August 3, 1998 (the first trading day of August 1998) to the day on which the bank attains its lowest stock price during the rest of 1998. Tangible equity is the ratio of equity minus intangible assets divided by total assets. Tier 1 is the ratio of Tier 1 capital to risk-weighted assets. Deposits is the ratio of customer deposits to total assets. Beta is the slope of the regression of weekly excess stock returns on the MSCI World excess return from 2004 to 2006. Country variables include ADRI, Institution, Official, Private monitoring, Capital and Restrict. Below the regression coefficient is reported the standard error in parentheses and to the right of the regression coefficient its significance (*** significant at 1%, **significant at 5%, * significant at 10%).

	(1)	(2)	(3)
BHR 1998	0.647***	0.637***	0.756***
	(0.144)	(0.132)	(0.144)
Tangible equity		0.001	
		(0.004)	
Tier1 ratio			0.028***
			(0.009)
Deposits		0.448***	0.456***
		(0.106)	(0.134)
Size	-0.064***	-0.041**	-0.017
	(0.016)	(0.017)	(0.017)
Beta	0.014	0.080	0.015
	(0.054)	(0.026)	(0.054)
Constant	-0.278	-0.494	-1.098***
	(0.268)	(0.302)	(0.356)
Country variables	Yes	Yes	Yes
Observations	230	230	184
R^2	0.377	0.453	0.528

Table 9: Probit regressions predicting membership to the worst performer group

This table reports Probit regressions predicting whether a bank's BHR is in the lowest tercile both in the 1998 crisis and the 2007-08 crisis. Panel A presents results using variables in 2006 and Panel B in 1997. ROE is the ratio of pre-tax-profit to equity. Asset growth is the growth rate of total assets over the three years preceding the crisis. Other variables are the same as in previous tables. Beta is the slope of the regression of weekly excess stock returns on the MSCI World excess return from 2004 to 2006 (1995-1997 for Panel B). Country variables include ADRI, Institution, Official, Private monitoring, Capital and Restrict. Below the regression coefficient is reported the standard error in parentheses and to the right of the regression coefficient its significance (*** significant at 1%, **significant at 5%, * significant at 10%).

	PANEL A : 2006			PANELB : 1997		
	(1)	(2)	(3)	(4)	(5)	(6)
ROE	4.945***	4.592***	4.680***	2.297***	1.993**	1.950**
	(1.141)	(1.195)	(1.213)	(0.645)	(0.794)	(0.764)
Asset growth		0.397**	0.420**		0.343	0.348
		(0.201)	(0.194)		(0.345)	(0.343)
Tangible equity		-0.023	-0.011		3.501	3.185
		(0.032)	(0.031)		(5.241)	(5.379)
Deposits		-0.353			0.132	
		(0.537)			(0.632)	
Funding_fragility			-0.283			-0.303
			(0.479)			(1.035)
Size	0.232***	0.183**	0.219**	0.181*	0.206*	0.208*
	(0.085)	(0.091)	(0.089)	(0.105)	(0.121)	(0.124)
Beta	0.760**	0.624**	0.728**	0.225	0.196	0.198
	(0.308)	(0.297)	(0.304)	(0.265)	(0.266)	(0.267)
Constant	-1.391	-1.234	-1.929	1.751	0.864	0.935
	(1.831)	(1.917)	(1.934)	(2.306)	(2.687)	(2.688)
Country variables	Yes	Yes	Yes	Yes	Yes	Yes
Observations	230	228	228	181	179	179
R^2	0.354	0.370	0.370	0.302	0.313	0.313

Appendix A: Distribution of banks by country

Country	Number of banks (main sample)	Number of non-financial firms
Australia	3	6
Austria	5	0
Belgium	2	4
Brazil	2	7
China	1	6
Denmark	4	3
France	14	40
Germany	11	31
Great Britain	9	33
Greece	5	2
Hong Kong	7	10
India	15	0
Ireland	3	2
Israel	5	2
Italy	12	11
Japan	75	91
Malaysia	1	3
Netherlands	2	9
Norway	4	2
Portugal	3	2
Russia	2	1
Singapore	3	3
South Africa	5	1
Spain	7	9
Sweden	4	6
Switzerland	13	7
United States	46	159
Taiwan	10	10
TOTAL	273	460

Appendix B: Variable Definitions

Variable Name	Definition
ADRI	Anti-director index, as revised by Djankov et al. (2008).
BHR	The bank's weekly buy-and-hold return from July 2007 to the end of 2008.
BHR 2006	The bank's weekly buy-and-hold return for the year 2006.
BHR 1998	The bank's daily buy-and-hold return from August 3, 1998 (the first trading day of August 1998) to the day on which the bank attains its lowest stock price during the rest of 1998.
Beta	Bank's equity beta from a market model of weekly returns in excess of three-month T-bills from 2004 to 2006, where the market is represented by the MSCI world.
Capital	Index of the regulatory oversight of bank capital, from Caprio et al. (2007).
Density	Ratio of risk-weighted assets to total assets.
Deposits	Ratio of customer deposits to total assets.
Funding Fragility	Sum of deposits from banks, other deposits and short-term borrowing, divided by total deposits and short-term borrowing.
Institution	Average of the six following indicators from Kaufmann et al. (2008): voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption.
MES	The bank's average stock return over the worst 5% of days for the MSCI world index during the period July 2007-December 2008.
Non-interest income	Sum of net fee income, net commission income and net trading income, divided by total operating income.
Official	Index of official supervisory power, from Caprio et al. (2007).
Private monitoring	Index of the private sector monitoring of banks, from Caprio et al. (2007).

Restrict	Index of the regulatory restrictions on bank activities, from Caprio et al. (2007).
ROA	Ratio of pretax-profit to total assets.
ROE	Ratio of pretax-profit to equity.
Size	Natural logarithm of total assets.
Tangible equity	Ratio of tangible common equity to tangible assets.
Tier 1	Ratio of Tier 1 capital to risk-weighted assets.