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THE MANIPULATION OF BASEL RISK-WEIGHTS. EVIDENCE FROM 2007-10

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The Manipulation of Basel Risk-Weights. Evidence from 2007-10.*

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Abstract

In this paper, we analyse a novel panel data set to compare the relevance of alternative measures of capitalisation for bank failure during the 2007-10 crisis, and to search for evidence of manipulated Basel risk-weights. Compared with the unweighted leverage ratio, we find the risk-weighted asset ratio to be a superior predictor of bank failure when banks operate under the Basel II regime, *provided* that the risk of a crisis is low. When the risk of a crisis is high, the unweighted leverage ratio is the more reliable predictor. However, when banks do not operate under Basel II rules, both ratios perform comparably, independent of the risk of a crisis. Furthermore, we find a strong decline in the risk-weighted asset ratio leading up to the crisis. Several empirical findings indicate that this decline is driven by the strategic use of internal risk models under the Basel II advanced approaches. Evidence of manipulation is stronger in less competitive banking systems, in banks with low initial levels of Tier 1 capital and in banks that adopted Basel II rules early. We find tangible common equity and Tier 1 ratios to be better predictors of bank distress than broader measures of capital, and identify market-based measures of capitalisation as poor indicators. We find no relationship between the probability of a bank being selected into a public recapitalisation plan and regulatory measures of capital.

JEL Classification: G20, G21, G28

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1 Introduction

In this paper, we analyse a novel panel data set, comprised of 589 banks from 16 countries.[1] Our aim is to produce a comparison of the predictive powers of different pre-crisis measures of bank capitalisation for bank failure during 2007-10, and to provide evidence in support of the hypothesis that banks strategically manipulated Basel risk-weights (e.g. Financial Times, 2011, Alloway, 2012a or Alloway, 2012b). For this purpose, we estimate a sequence of Probit models with a binary dependent variable (equal to one if a bank was resolved, zero otherwise), and with leverage ratios, risk-weights, broad and narrow measures of capital, and other bank characteristics as regressors. We use 2005 and 2006 vintages of the explanatory variables to assess their predictive power at different points in time - more precisely, to compare their information content at a time when the financial crisis was not anticipated (at the end of 2005) with the situation when the systemic problem had become more visible (at the end of 2006). The corresponding results allow us to conclude that tangible common equity and Tier 1 capital ratios are better predictors of future distress than broader measures of capital; they also show, that 2005, but not 2006, levels of risk-weighted asset ratios are indicative of bank failure, whereas unweighted leverage ratios have predictive power in 2006, but not in 2005. Our findings, therefore, suggest that risk-weights are in principle informative about bank stability, but that they are also subject to manipulation by banks aiming to appear more stable when under stress.

This interpretation suggests itself, in particular, because the aforementioned effects are stronger in banks that face less competition, in banks that adopted the Basel II standards early (as opposed to late, or not at all) and that have lower initial levels of high quality capital. In other words, when there is little scrutiny from customers and competitors, when banks have the legal opportunity to apply discretion when risk-weighting their assets, and when banks are particularly pressured to avert failure. From a multinomial Logit regression we can also see that unweighted leverage ratios contain information about public recapitalisations and about "other forms of resolution" (forced mergers, nationalisations, bankruptcy), whereas lower risk-weighted asset ratios are only associated

[1] This is the same data set that we have used in Mariathasan and Merrouche (forthcoming).

with a reduced probability of being subjected to the latter. We can draw two conclusions from this finding. Firstly, that fragile banks did not only have the opportunity to manipulate risk-weights, but also a motive (avoiding mergers, nationalisation or bankruptcy). Secondly, that regulators took the potential manipulations into account and relied on unweighted leverage ratios when selecting banks for their recapitalisation schemes.

It is an established fact among researchers and policymakers, that higher levels of bank capital are associated with improved bank stability. They act *ex post* as a buffer against adverse conditions, protecting banks from defaulting on their payment obligations. At the same time, they serve *ex ante* to discipline shareholders and managers by having them participate in the losses of the banks (see for example Perotti et al., 2011). Despite this general consensus, however, ample disagreement about the details of efficient regulation persists in practice. Opinions differ, in particular, with respect to the correct level of required capital and the valuation of banks' portfolios. When the Basel Committee on Banking Supervision (BCBS) adopted the first Basel accords (*Basel I*) in 1988, for example, it defined four risk-weight categories for the banks' assets and required a risk-weighted capital ratio of 8% in order for a bank to be deemed "sufficiently capitalised."[2]

Under the second Basel accords (*Basel II*, initially published in 2004) instead, the BCBS extended the number of risk-weight categories to six, adding "buckets" with weights of 35% and 150%, and, more importantly, changing the rules for assigning assets into these categories. However, the counterparty was no longer the only important factor in calculating an asset's risk-weight. In addition, one could use either the asset's external credit rating (under the *standardised* or *basic approach*) or the banks' internal risk models (under the *advanced approaches*; or, more specifically, the *Foundational Internal Ratings-Based* (FIRB) approach and the *Advanced Internal Ratings-Based* (AIRB) approach). While all of these changes were intended to improve efficiency, in

[2]The Basel accords are an international set of rules for banking regulation, proposed by the supranational Basel Committee on Banking Supervision (BCBS) at the Bank of International Settlements (BIS) in Basel, Switzerland. The four initial risk-weight categories were 0% (e.g. for cash), 20% (e.g. for assets involving banks located in OECD countries), 50% (e.g. for loans secured by mortgages secured by residential property) and 100% (e.g. for personal consumer loans); the percentages correspond to the weights that the corresponding assets were assigned in the calculation of the banks' risk-weighted assets (RWA). The 8% refers to the level capital relative to RWA that the banks were required to hold, implying that higher risk-weights (i.e. riskier assets) correspond to higher capital requirements. For more detail on the Basel regulation, see Tarullo (2008) or http://www.bis.org/bcbs/index.htm.

practice their most significant contribution was a raising of the level of complexity and as a result compromising transparency.[3] The new regulatory framework failed to account for correlations of credit risks between mortgage assets and derivatives, as well as between counterparty credit risks and the underlying risks in derivatives or other hedge contracts. For risk-modelling, for instance, it relied on short times series that exhibited substantial non-stationarity and it did not account for the endogeneity of the involved risks. Deficiencies such as these lead some commentators to conclude that risk calibrations under the Basel II regime caused excessive indebtedness and maturity transformation, in particular among large banks operating under the model-based approaches.[4] Deficiencies were also "beginning to become apparent to the members of the BCBS well before the start of the global financial crisis" (Larson, 2011, p. 23). However, it was of course the crisis itself that eventually provided incontestable evidence of their inefficacy.

Since then, the task for regulators and researchers has been to analyse precisely what went wrong and to devise new rules for the global financial system. However, whilst the former have effectively opted for augmenting the existing framework in the new Basel III accords (released in September 2010) with "more of the same - and better" (Haldane, 2011, p. 2), the latter have only just begun to study the role of bank capital and risk-weights in the run-up to and during the events of 2007-10. In this paper, we shall contribute to these efforts by bringing new evidence to bear and by uncovering the obfuscating forces that were introduced by options to employ complex internal risk models for regulatory purposes.

2 Related literature

Haldane (2011) formulated three desirable principles of a regulatory framework (simplicity, robustness and timeliness) and explains that the Basel II framework was not successful in abiding by them. Having analysed a panel of 33 large international banks, he stresses that risk-weighted

[3] Haldane (2011) speaks of about 200,000 effective risk categories under the Basel II regime. Financial Services Authority (2010) finds a wide range of reported capital requirements when it asks different banks to assess a common portfolio under their respective internal risk models.

[4] Hellwig (2010)

Tier 1 capital ratios not only violated the simplicity principle, but also failed to be informative about future bank distress;[5] that is to say, they did not allow regulators and market participants to respond in a timely manner and thus, if not avert the global collapse altogether, at least mitigate its intensity. In compliance with earlier studies, e.g. by Berger et al. (2000), he then proceeds to propose market-based metrics on the grounds of the hypothesis that market prices contain superior information to those available to an individual regulator. He supports his proposal by showing that, in his sample, marked-based ratios would have provided timelier signals of distress and thus he concludes that they should be incorporated into revisions of the regulatory framework. We believe that Haldane's three principles offer an intriguing framework for thinking about financial regulation and are able to corroborate criticism concerning the predictive power of risk-weighted indicators in our richer sample. In contrast to Haldane (2011), however, we are unable to affirm the superiority of market-based ratios in our richer sample and, in fact, find evidence that the market severely mispriced the riskiness of banks' portfolios.

Alluding to both their predictive power and the information content of market-based metrics, Demirguc-Kunt et al. (forthcoming) analyse the relationship between capital and asset ratios and listed banks' stock return. They find that differences in capital ratios were uninformative about stock returns prior to the financial crisis, but show that better capitalised banks exhibited higher returns during the period of distress. The relationship is stronger for larger banks and when capitalisation is measured as the unweighted leverage ratio. They also find that banks with lower risk-weighted assets perform better during the crisis and indicate the risk of manipulated risk-weights when they find stock market participants to be primarily concerned with the unweighted leverage ratio (and not with the Basel capital ratio). For European banks, which were allowed more flexibility in using internal risk models, they find that the leverage ratio, but not the risk-weighted capital ratio, can explain performance during the crisis. Our study complements their insights with respect to regulatory recommendations and book value-based metrics. By investigating the suspicion of manipulation explicitly, we fortify their conclusion that the opportunity

[5]Distressed banks according to Haldane (2011) are banks that "in autumn 2008 either failed, required government capital or were taken over in distressed circumstances" (p. 18).

to use internal models under the advanced approaches inspires banks to manipulate and to lead regulatory authorities as well as market participants astray.

Additional supportive evidence from the US is provided by Estrella et al. (2000) and Berger and Bouwman (2012), who show that unweighted leverage ratios and risk-adjusted measures of capital have comparable predictive power in samples covering the 1990s and the period between 1984 and 2010, respectively. We are able to confirm their findings among the late Basel II adopters in our sample, but identify the unweighted leverage ratio as a superior predictor among early Basel II adopters - specifically in the vicinity of the crisis.[6] For the recent crisis, the Basel Committee on Banking Supervision (2009) indicates dubious behaviour on account of the banks when it reports that some institutions succeeded in appearing strongly capitalised according to their regulatory capital, while actually they were holding only low levels of high quality capital (e.g. of tangible common equity).

Huizinga and Laeven (2009), instead, offer insights into the (ab)use of discretionary accounting practices when they show that banks tend to overvalue real estate-related assets such as mortgage-backed securities. Their results differ from ours in that they suggest even unweighted leverage ratios may offer "a distorted view of the financial health of the banks" (Huizinga and Laeven, 2009, p. 1). However, they are consistent with our conclusions, to the extent that they show how banks (more specifically, listed US bank holding companies) take advantage of regulatory ambiguities. Comparable intentions are also identified more recently, by Acharya et al. (2012), who find evidence that guarantees were structured so as to reduce regulatory capital requirements. Like us, they find these tendencies to be stronger for banks with lower levels of capital. In view of the role of bank size, Berger and Bouwman (2012) offer additional data, showing that higher levels of pre-crisis capital increase the survival probability of small banks and improve the performance of medium and large banks during crises.

Going beyond our conclusions, Hau et al. (2012) indicate problems even with the use of external risk assessment, when they find larger and more leveraged banks receiving systematically higher

[6]Late Basel II adopters are most banks from the US, from Japan and from the Republic of Korea; early Basel II adopters are banks from all other countries. See the discussion below and Table 2 for more detail.

credit ratings.

LeLesle and Avramova (2012) provide evidence of heterogeneity with respect to the calculation of risk-weights, across and within regulatory regimes. They discuss the possible driving forces behind this variation. For instance, the banks' business models, the quality of their portfolios but also institutional, accounting and regulatory parameters and, like us, document decreasing risk-weights over time - specifically among European banks who were allowed more flexibility than most banks under US regulation. While they repeatedly refer to the possibility that "[b]anks may 'game' the system by underestimating risks to optimize their capital beyond what prudence requires" (p. 7) their sample size (55 banks) does not allow them to control, for example for regional effects, and thus prevents them from investigating the hypothesis of manipulation further. Using a larger sample and focusing on the evolution of the risk-weights' predictive powers over time, we are able to go beyond their analysis. More precisely, we are able to provide evidence consistent with the view that banks did indeed make strategic use of "methodological changes" to improve return on equity (ROA) and to signal stability.

While most of the recent literature remains primarily concerned with establishing the empirical facts about capital ratios, risk-weights and financial stability, there are few theoretical papers that can assist these efforts and the interpretation of the emerging patterns. Marcus (1984), for instance, explains how a depreciating value of the bank charter (e.g. in the vicinity of a crisis) can induce risky behaviour on behalf of the banks. This provides a rationale for why banks under stress, in particular, may want to misreport the true riskiness of their investment choices. Calem and Rob (1999) reconcile previously contradictory work by explaining the emergence of a U-shaped relationship between capital and risk-taking as the consequence of a trade-off between the option value of deposit insurance and the expected return on risky investment. These insights are helpful for understanding the non-linearities in the relationship between bank capitalisation and financial fragility that we identify as part of our robustness analysis. Blum (2008), instead, relates to our more general insight that unweighted leverage ratios can be superior predictors of bank distress and explains how a risk-independent leverage ratio may induce "truthful risk reporting." He finds that

when authorities cannot perfectly identify (or sanction) manipulative banks, a non-manipulable leverage requirement may reduce incentives for manipulation. This is true, because it reduces the bank's option value of limited liability ex ante, and increases its net worth (i.e. the possibility to sanction) ex post.

3 Sample

Our analysis of the link between bank capitalisation and bank failure relies, for the most part, on the same sample of banks that we have used in Mariathasan and Merrouche (forthcoming).[7] It contains information on public recapitalisations, nationalisations, forced mergers and bankruptcies for 589 banks from 16 countries and has been collected from sources such as central banks, treasury departments and law firms.[8] The resolution data is augmented with annual bank balance sheet information from Bankscope and, on occasion, with quarterly data from Bloomberg that we collected for the 174 listed banks in our original sample. Since we have no access to quarterly capital ratios for the remaining banks, we restrict attention to the annual frequency for our main analysis, and use the quarterly sub-sample only for robustness and to aid the interpretation of our results. The panel includes all countries that have allocated at least two per cent of their gross domestic product (GDP) towards bank resolutions or resolved at least three banks during the period between 2007 and 2010; it is also restricted to include only the 100 largest banks (by total assets) from each country in order to maintain a balanced sample.[9]

Before proceeding to compare the predictive power of risk-weights and capital ratios, it is worthwhile to explore the properties of the data in some more detail; not only in view of the subsequent analysis, but also because it allows for insights into the dynamics of risk-weights in the

[7] In our earlier work, we were interested in the relationship between public bank recapitalisations and bank lending. In contrast to the current paper, we eliminated Spain from the previous sample, because most of its recapitalisations took place in 2010 and we did not have access to the corresponding lending data at the time of writing.

[8] For more detail on the way the sample was assembled, see the Data Appendix of Mariathasan and Merrouche (forthcoming).

[9] The latter restriction applies only to Japan and the United States (US), for all other countries less than 100 banks provide the relevant information to Bankscope.

run-up to the crisis. To this end, we provide summary statistics and graphic illustrations of our key variables and their dynamic properties at the end of this section.

3.1 Bank resolution policies during 2007-10

Table 1 reports summary statistics for our benchmark sample. It comprises 589 banks from 16 OECD countries and includes 178 (30.22%) banks that were resolved in one of four ways (recapitalised, nationalised, bankrupted, merged) during 2007-10; the majority of these resolutions were recapitalisations (Figure 1) and took place during 2009. In terms of absolute numbers, the US (38), Spain (34) and Denmark (32) stand out as the countries with the most bank resolutions; relative to the total number of banks, however, the top three countries are Iceland (75%), Denmark and Greece (both 66%). The evidence is consistent with the fact that the epicentre of the crisis shifted from the US to Southern Europe between 2007 and 2009-10. It shows that 84% of the US resolutions in our sample took place in 2008, compared to 16% in 2009 and 0% in 2010, whilst Spain did not intervene in 2008, but conducted 91% of its total resolutions in 2010. Similarly, Greek bank resolutions took place entirely (100%) in 2009. Globally, i.e. across the 16 countries in the sample, banks appear to have been under most severe pressure in 2009, when almost half of all resolutions (47%) occurred.

The closest sample to ours that we are aware of is the one used in Claessens et al. (2010); we use it to assess the coverage of our data and provide a comparison of the respective recapitalisation costs relative to GDP (Table 1). The IMF sample includes data for the entire banking sector up to June 2009, whereas we cover public interventions only for the 100 largest banks from each country that report to Bankscope, but up to December 2010. As a result, we are missing some of the smaller banks in Japan or Korea that do not report to Bankscope. Instead, we include evidence from countries such as Denmark or Ireland that witnessed the majority of interventions only after the IMF study was concluded. Table 1 also provides an implementation timeline for the basic and advanced approaches under the Basel II regulatory regime. We will use these dates to assess the behaviour of capital ratios and risk-weights during the quarters leading up to and succeeding them.

An important observation to make is that the US, as well as Japan and Korea, allowed the use of internal risk models only after 2008.[10] The distinction between these "late" and "early" Basel II adopters, and also the fact that only some US institutions were permitted to operate under the advanced approaches, will be helpful for our analysis later on.

If we split the 178 observations on resolved banks into the four resolution categories, the following pattern emerges: at the beginning of the crisis, in 2007, we observe only two resolutions, both of which are bankruptcies. In 2008 and 2009 instead, the number of interventions jumps up and the preferred form of resolution seems to be recapitalisation (followed by nationalisation). Towards the end of the sample, the total number of failing banks decreases again and forced mergers emerge as the dominant form of resolution (Figure 1). Based on a simple graphic inspection, we can only speculate about the underlying dynamics. One interpretation, however, could be that, in 2007, governments were still largely unaware of the dangerous systemic implications of allowing banks to file for bankruptcy. After the collapse of Lehman Brothers (15 September 2008), they understood the risks and were henceforth primarily concerned with preventing failure by recapitalising or nationalising fragile financial institutions, thereby maintaining their operability. Finally, in 2010 they understood that keeping unprofitable institutions afloat sent the wrong signals to their constituencies and to bank managers. In order to mitigate moral hazard, they therefore forced failed banks into mergers. While this exegesis is consistent with narrative evidence, other interpretations are also possible. Firstly, it might have simply been the case that in 2007, unlike during 2008-09, no systemically relevant bank was at risk, allowing regulators to permit resolution by bankruptcy and explaining why we would observe bankruptcies in 2007 and recapitalisations during 2008-09.[11] Similarly, one could explain the transition towards forced mergers by the fact that, in 2010, the immediacy of the peak crisis years had been overcome and fiscal resources had been exhausted. This would imply that policymakers then had the time and the incentives to devise alternative (less costly) mechanisms for bank resolution. In addition, it is also worth noting that

[10] US regulators were cautious to implement the IRB approaches (see Tarullo, 2008 or Verdier, 2011) and did so only under certain conditions, even after 2008. For more details on these conditions, see for example Board of Governors of the Federal Reserve System (2008).

[11] Think, for example, of the non-systemic case of Northern Rock in the UK during 2007-08.

the results in 2010 are to a large extent driven by the policies that the Spanish government devised for the relatively small *Cajas*. It may be the case that for their organisational form, forced mergers were simply a more applicable tool than, for example, for the large US banking conglomerates or the German Landesbanken (even though forced mergers did occur in both of these countries as well).

At this stage, we cannot validate (or discard) either of these explanations and it is possible that all contain a grain of truth. For our purposes, however, it suffices to say that our dataset is consistent with a variety of narratives about policymaking during the crisis, indicating that it is sufficiently rich to capture the relevant dynamics well. In this context, it is also interesting to note that the provided evidence complements our findings in Figure 1 of Mariathasan and Merrouche (forthcoming), where we have shown that also the cost of recapitalisations (relative to bank and system equity) peaked during 2009.

More analysis, however, is clearly needed. In the remainder of this section, we will therefore report summary statistics for a number of key variables and illustrate the corresponding dynamics. In the subsequent section we will then proceed to analyse the relationship between capital ratios, risk-weights and forms of bank resolution more systematically.

3.2 Variables

Besides uncovering evidence of risk-weight manipulation we are, in this paper, also interested in examining the information content of different capital ratios. It is therefore helpful to examine the sample properties of these ratios in advance and to provide some information on their dynamic behaviour. The ratios that we consider in our analysis are defined as follows: the *Risk Weighted Capital Ratio* (RWR) is equal to the ratio of capital to *Risk Weighted Assets* (RWA) as reported by the banks, measured in 2005 and 2006. In Table 2, *Tier1 Capital (RWR)* and *Tier2 Capital (RWR)* are then the ratios of Tier 1 and Tier 2 capital relative to RWA. Under Tier 1 capital, we include shareholder funds, perpetual, non-cumulative preference shares and retained earnings. Instead, Tier 2 capital comprises of subordinated debt, hybrid capital, loan loss reserves, and

valuation reserves.

In contrast to the RWR, the *Leverage Ratio* (LR) is defined as the ratio of capital (Tier 1 and Tier 2, respectively) over total, i.e. unweighted, assets. Since a risk-weight of one corresponds to a very risky asset, while an asset that is considered to be relatively safe (e.g. because of its AAA rating, under the basic approach) has a risk-weight smaller than one, RWRs should, on average, be expected to be larger than the LRs; this is precisely what we see in the data (e.g. a mean of 11.288% for Tier1 Capital (RWR) in 2005 versus a mean of 6.896% for Tier1 Capital (LR)).

Furthermore, we also consider the ratio of *Tangible Common Equity* to total assets (Tangible CE); this choice is motivated by arguments made, for example, in Hanson et al. (2011) and by our analysis in Mariathasan and Merrouche (forthcoming), in which we demonstrate that bank lending (as an indicator of bank stability) depends importantly on whether governments recapitalise banks with common equity or with preference shares. Since the denominator is identical and Tier 1 capital comprises to an important part of tangible equity, however, one would not expect Tangible CE to behave very differently from the Tier1 Capital (LR) ratio. Indeed, the ratios are, on average, similarly high, both in 2005 (6.896% versus 6.949%) and in 2006 (6.852% versus 7.353%). Indeed even though Tangible CE appears to be slightly more volatile, the correlation between both variables is significant at the 5% level and as high as 0.905 (Table 3).

The final measure of bank stability that we consider is the ratio of RWA over total assets (RWA/TA). It measures the *reported* riskiness of the banks' portfolios and has also been referred to as *RWA density* (e.g. in LeLesle and Avramova, 2012). If all assets were assigned a risk-weight of one, RWA/TA would be equal to 100%. Some assets, however, will typically be considered safe and assigned a risk-weight of less than unity; this explains the average RWA densities of 59.739% in 2006 and 30.266% in 2005.

Additional variables that we use to control for bank characteristics, include:

- a measure of liquid assets (Liquidity), including trading assets and loans and advances with a maturity of less than three months, scaled by total assets to capture banks' (expected) ability to improve their leverage ratio through asset sales;

- the ratio of bank deposits over gross loans (Deposits/ Loans) as a measure of the banks' exposure to risk from maturity mismatch;
- Provisions (scaled by total assets) and Non-interest income (scaled by total operating income) to account for the ability to hedge financial risks via intrabank transfers;
- the percentage *return on assets* (ROA) to condition on bank profitability, and thereby indirectly on the ability of the management;
- and bank size measured as Ln(Assets).

In preview of some of the later results, it should be noted that for this latter set of variables, there is no significant difference between the subsamples of resolved and not resolved banks (with the exception of ROA, which, at the 5% but not at the 1% level, is higher for banks that were later resolved).[12] The corresponding differences for capital ratios and measures of bank stability (e.g. Tier1 Capital, Tier2 Capital or RWA/TA), instead, are highly significant.

In summary, Table 2 shows that the sample contains considerable variation in capital ratios across banks and over time; this variation constitutes the basis of our analysis and allows us to explore the relationship between these ratios and subsequent forms of bank resolution. Before proceeding, however, we will first use our quarterly information in order to explore the dynamic properties of our key variables in even more detail; this is helpful in view of the interpretation of our regression analysis, but also, more generally, for understanding the role of bank capital and risk-weights in the run up to the 2007-10 crisis. The reader should bear in mind however that the underlying quarterly data is limited to those listed banks in our sample for which Bloomberg provides information. In our regression analysis, instead, we will use the entire sample (based on the annual information reported to Bankscope).

[12]Based on the P-value t-test reported in Table 2.

3.2.1 Capital and asset ratios over time

Figure 2 illustrates the evolution of the total leverage ratio and the Tier1 Capital (LR) ratio between 2000Q1 and 2007Q4, for banks that were later resolved and for banks that were not resolved.

The first thing to notice is that the differences between the two subsamples are not striking. The Tier1 Capital (LR) ratio is at a similar level throughout (slightly higher among not resolved banks) and behaves comparably over time. The only discrepancy is that, in the subsample of resolved banks, it drops more significantly from 2005 onwards. The total leverage ratio, instead, is somewhat higher for resolved banks, certainly so before the sharp drop in Tier1 Capital (LR). This suggests that weaker banks were characterised by more holding larger quantities of lower tier capital (illustrated by the difference between the Tier1 Capital (LR) ratio and the total leverage ratio) prior to the crisis. These observations (on listed banks and quarterly Bloomberg data) are consistent with the averages (based on annual Bankscope data and our entire sample) that we have reported in Table 2. There we observed no significant difference between the average Tier1 Capital (LR) ratios, and found significantly higher Tier2 Capital (LR) ratios in the subsample of resolved banks.

In summary, Figure 2 suggests that, in particular as a result of the relatively steeper decline in the Tier1 Capital (LR) ratio and also potentially as a result of differences in the Tier2 Capital (LR) ratio, unweighted leverage ratios might contain explanatory power with respect to future needs for resolution. It also indicates that the horizon over which one attempts to predict bank distress will be an important factor to consider.

Figure 3 plots the evolution of average RWA densities for resolved and not resolved banks over the pre-crisis period, 2000Q1 to 2007Q4. It exhibits a stable RWA/TA ratio of around 60% in the subsample of not resolved banks, and a drop of about 10-15 percentage points (from around 80%) in the group of resolved banks. The drop occurred during 2004, i.e. precisely when the Basel II accords were first released. Such a drop suggests that the regulatory change served to reduce capital requirements in particular for those banks that had a riskier portfolio *ex post*. If

we look at the evolution of the same ratio around the dates from which the law required full implementation of the advanced (Figure 4) and the basic (Figure 5) approach, this impression is reinforced. About four quarters prior to the implementation date the ratios begin to decline, implying that the average RWA density among resolved banks is clearly lower after the date of implementation than before.[13]

RWA densities among resolved banks also seems to level out after the initial drop. Assuming that risk managers were able to choose risk-weights in a strategic fashion, this could be interpreted as showing that resolved banks were targeting the RWA/TA ratio of their more stable counterparts. Such a strategic choice could then be implemented in one of two ways: on the one hand, banks could have shifted resources towards assets that regulators considered particularly riskless. Since these assets would appear in the denominator with a weight of one, while they would enter the nominator with a weight smaller than one, the ratio as a whole would decline. On the other hand, one could also conjecture that banks (ab)used the opportunity to employ internal risk models in order to manipulate regulatory risk-weights down (i.e. to "optimise" their risk-weights and to communicate stability to regulators and counterparties) as they approached failure. In this case, the nominator would decline, while the denominator would remain constant. When we look at the two time series individually (RWA and total unweighted assets; Figure not provided), we find both trending upwards with a widening gap starting from around the time of the regulatory change; this suggests that both mechanisms were actually at work. If we look at the evolution of banks' loan books over time, however, differences between resolved and not resolved banks seem to be moderate. Figure 6 provides the ratio of average loans for resolved banks over average loans for not resolved banks between 2004 and 2008, for government securities, corporate loans, residential mortgages, other consumer retail loans, loans and advances to other banks and a residual category of other loans.[14] It shows that resolved banks reduced their residential mortgage exposure relative to not resolved banks between 2004 and 2005, while they increased the holding of government securities in relative terms over the same period. At the same time, holdings of other loans seem to increase until 2007

[13]For the implementation dates used in Figures 4 and 5, see Table 1.

[14]Prior to 2004 the data becomes unreliable due to too few banks reporting.

before they drop in 2008 - again relative to the positions of not resolved banks. While in particular the change towards government securities has certainly aided the development of the RWA density, the portfolio reallocations are anything but drastic and not sufficient to explain the trend that we have documented in Figure 3. To us, this suggests that the discrepancy between resolved and not resolved banks results primarily from changes in the calculation of risk-weights.

In any case, however, it should be pointed out that both mechanisms put blame on the regulatory framework. If the decline in the RWA/TA ratio is the result of a shift towards seemingly safe assets, regulators are consequently responsible for incentivising investment in what turned out to be overly risky ("toxic") assets. If it is instead a matter of manipulated risk-weights, regulators are to be held accountable for trusting the banks to adequately assess themselves for exposure to risk.

In anticipation of the analysis later in the paper, we also consider the evolution of average Tier1 Capital (LR and RWR) ratios (Figure 7) and of RWA density (Figure 8) among resolved banks, relative to the quarter of their resolution. In Figure 7, two observations stand out. Firstly, it seems that until 16 quarters before the resolution, the unweighted and the risk-weighted ratio behave fairly similar, whilst after that the unweighted leverage ratio declines relatively more. Secondly, the volatility of the (average) Tier1 Capital (LR) ratio increases relative to the volatility of the RWR Tier 1 ratio as the resolution approaches.[15] Both observations suggest that the unweighted Tier 1 ratio might, in fact, be a superior predictor of future distress. Thus, in line with arguments made, for example, by Hellwig (2010) or Dewatripont et al. (2010) one may conjecture that banks, under the Basel II regime, were able to manipulate risk-weights in a way that made the risk-weighted Tier 1 ratio appear larger and more stable.[16] This interpretation receives further support, when the fact that Basel II implementation was scheduled in most countries for January 2007 is taken into consideration.[17] Since most resolutions took place in 2009, this implies that the changes in the Tier1 Capital (LR) ratio relative to the risk-weighted Tier 1 ratio occurred around the time of

[15]We have performed Zivot-Andrews unit root tests for structural breaks in the two time series. The tests identify a highly significant (1%) break for the Tier1 Capital (LR) ratio, 16 quarters before failure, and no significant break in the RWR ratio.

[16]There is also plenty of narrative evidence in support of this conjecture. See for example, Financial Times (2011), Alloway (2012a), or Alloway (2012b).

[17]See Table 1 or Demirguc-Kunt et al. (forthcoming) for more detail.

the regulatory change. Figure 8, complements the analysis by showing the evolution of the average RWA density prior to resolution. It adds to the impression that risk managers chose regulatory risk-weights in a strategic fashion as it exhibits an undisputable downward trend, overall dropping by about 15 percentage points over the nine reported years.

A different way of looking into the effect of the regulatory change is to split the sample between those banks that - according to the dates in Table 1 - adopted the Basel II regulatory standards early and those that adopted them late (or not at all). From Figure 9 it is then evident that the average RWA density in those two groups differs substantially. Early adopters started from a higher density in 2000 and went through a period of substantial volatility, before settling at a significantly lower level after 2004. Among late or non-adopters, the ratio of risk-weighted over total assets instead appears to be stable throughout and unaffected by the events of 2004. This too suggests that those banks that were able to, used the new regulatory options to (seemingly) stabilise and lower their average risk-weights.

3.2.2 Dividend payments and cash holdings

As LeLesle and Avramova (2012) emphasise, finding direct evidence of opportunistic behaviour of banks is difficult, as intentional misbehaviour needs to be separated from mere mishap. For this reason, we provide two more figures - one on dividend payments (Figure 10) and one on cash holdings (Figure 11), to support our hypothesis indirectly. Figure 10 shows the resolved banks' *Dividend Payout Ratio* (the ratio of dividend payments over net income) to jump up just before the peak of the crisis and to drop back in the midst of it. This suggests that resolved banks were aware of their troubles prior to their resolution and that they used discretion with respect to dividend payments in order to benefit their shareholders. Figure 11 tells a similar story, but also complements our conclusion from the evolution of the loan book (Figure 6); it reports the banks' cash ratio (i.e. the ratio of cash holdings over total assets) and shows that resolved banks started depreciating their cash holdings relative to their balance sheet size (and relative to not resolved banks) from 2004 onwards. This too suggests that banks (ab)used the regulatory discretion that

they were endowed with by Basel II to reduce the holdings of their most liquid assets, while at the same time maintaining the illusion of stability.

Whilst we will explore the validity of this conjecture further in our regression analysis, the graphic inspection of the data strongly indicates a regulatory responsibility, at least for part of the public costs associated with resolution policies. More specifically, the evidence seems to suggest that banks exploited the opportunities that they were provided with when regulators permitted them to use highly complex internal models to calculate the risk-weights for their asset portfolio and thus, effectively, their regulatory capital requirements. The evidence thus lends support to researchers who have advocated for simpler and more transparent capital requirements, for precisely these reasons (Dewatripont et al., 2010; Hellwig, 2010).

Before proceeding to analyse the relationship between capital ratios, risk-weights and bank failure in more detail, however, it is worthwhile to also look into the role of accounting practices; in particular, to scrutinise the data in view of comments made by Haldane (2011), who suggests that market-based measures of capital ratios could be more reliable than book values when it comes to identifying fragile banks (e.g. because market prices incorporate a more complete information set than is available to individual regulators).

3.2.3 Market-based ratios over time

In Figure 12 we consider the evolution of banks' *Market-based Capital Ratios* (MCR; the ratio of share prices times total equity over total, unweighted and book valued, assets) prior to the crisis. With equity being an important subset of Tier 1 capital, it is expected that MCR behaves in a similar fashion to the Tier1 Capital (LR) ratio in Figure 2. However, the supposedly superior information of market prices, along with their computational simplicity and the - in contrast to internal risk models - public availability of the required information nonetheless makes them interesting for regulatory purposes and explains why they have been so frequently mentioned in the policy debate.[18]

[18]E.g. in Haldane (2011) or Haldane and Madouros (2012).

Despite their prominence, however, our evidence does not provide support for the superiority of market-based measures. If we split the observations into subsamples of resolved and not-resolved banks and consider the dynamics of the MCR during the decade leading up to the crisis, the data seems to be decisively in favour of using book value-based measures. In Figure 2, we have seen that, in 2005, the Tier1 Capital (LR) ratio exhibits a pronounced drop in the subsample of resolved banks, which is not visible in the subsample of not-resolved banks. In contrast, the MCRs reported in Figure 12 implicate the group of not resolved banks as, on average, more weakly capitalised. This indicates that, in fact, the market did not price equity adequately. Indeed, whilst for banks that did not require resolution, market based and book value based measures appear to behave comparably (e.g. because they were not expected to receive public support), equity of fragile banks appears to have been overpriced (e.g. because the subsequent public resolution was already priced in).

If market based values would indeed represent fundamental values, Figure 12 would also inspire an altogether different set of questions: one could ask, for example, why the banks that had to be resolved later on did not (attempt to) prevent failure by wearing down their capital buffer; just as the banks that did not get resolved later on seemed to have done. Interpreted in this way, the evidence suggests that some banks (those that were resolved later) were able to anticipate and, in fact, gamble for publicly aided resolution.

In summary and across the figures that we have discussed, the evidence provides ample food for thought. In order to explore some of the suggested channels in more detail and to move away from only graphic analysis, we now proceed to analyse the link between bank capital and bank failure more thoroughly. We focus on the information content in risk-weights and simple capital ratios that are used in bank capital regulation, and we are particularly interested in uncovering evidence of their manipulation. Along the way, we will also comment on what the data has to say in view of proposals for financial regulation that have been discussed, or implemented, in the aftermath of the crisis.

4 Risk-weights and bank resolutions

The analysis of variable characteristics and the graphic inspection of their dynamic properties has suggested that there is considerable heterogeneity across banks and over time, and also that there are systematic differences between the subsamples of resolved and not resolved banks. In order to understand these heterogeneities better and to learn, more systematically, about the relationship between bank capital, leverage ratios and bank distress during crises, we now proceed to estimate a range of binary response models. While they are inspired by the patterns that emerged from Section 3, they will allow us to test our conjectures statistically, and to condition appropriately on variables such as bank type, bank size or management ability. In what follows, we will first provide a brief description of the econometric model and then proceed to discuss the corresponding estimation results.

4.1 Model

We estimate two different models. As a benchmark, and for most of our analysis, we employ a standard Probit model and in order to analyse the selection between different forms of resolution we estimate a multinomial Logit model. In the benchmark case, the dependent variable, Y, is equal to one if the bank was resolved during 2007-10 and zero otherwise. The corresponding Probit model is then given by $\Pr(Y = 1|X) = \Phi(X'\beta)$, where X is a vector of explanatory variables, including Tier 1 and Tier 2 capital ratios, measures of liquidity and bank profitability, and bank characteristics such as size and type;[19] $\Phi(\cdot)$ is the cumulative distribution function of a standard normal distribution and β is a vector of coefficients that we estimate, using Maximum Likelihood (ML) methods. We do not report the coefficients β in the tables but, to facilitate the interpretation, the marginal effect; i.e. the changes in probability associated with changes in the (continuous) regressors. In the case of the multinomial Logit model, the dependent variable takes value one if a bank was recapitalised during 2007-10, and value two if any of the three other forms

[19] See the respective tables for information about the exact set of variables.

of resolution was applied;[20] if a bank was not resolved, the value remains equal to zero.

4.2 Results

4.2.1 Benchmark

Table 4 provides the results of our benchmark specification. Throughout, the dependent variable is equal to one if a bank was resolved during the period 2007-10 and zero otherwise. Control variables are in 2006 levels in columns (1)-(4) and in 2005 levels in columns (5)-(6). The focus is on the predictive power of different capital ratios and, more specifically, on the role of regulatory risk-weights. To this end, we define capital ratios as Tier1 Capital (RWR) and Tier2 Capital (RWR) in column (1), as Tier1 Capital (LR) and Tier2 Capital (LR) in columns (2), (3) and (5), and as TCE in columns (4) and (6).

The key insights are the following: independent of whether they are calculated with or without risk-weighted assets, high quality capital ratios (Tier 1 and tangible common equity) are important and significant predictors of bank distress (higher ratio, lower probability of distress) in 2006; no other independent variable turns up as consistently significant. Comparing columns (1) and (2), it seems that the unweighted leverage ratio contains more predictive power than the risk-weighted Tier 1 ratio; an insight that seems to be confirmed in columns (3) and (4). To compare the information content in Basel measures of capital and in the leverage ratio more directly, we include RWA/TA together with the Tier1 Capital (LR) ratio in column (3) and with TCE in column (4); whilst the corresponding coefficients have the expected signs (higher risk-weights and lower capital ratios correspond to higher probability of resolution), we find again, that the information content in the unweighted ratios is more significant.

If we repeat the regressions with 2005 data instead (columns 5 and 6), we find that the predictive power of the capital ratios disappears, whereas the risk-weights become more relevant. Consistent with Figures 2 and 3, our findings therefore suggest that risk-weights contain more predictive power

[20]The grouping together of these other forms of resolution becomes necessary because we do not have sufficient observations to consider them individually. Because they are all more punitive forms of resolution compared to recapitalisations, however, bundling them is not illegitimate.

over the longer horizon and that unweighted high quality capital ratios are particularly informative over a shorter horizon.

These results relate closely our graphic analysis. They appear to confirm the hypothesis that the option to use internal models for the calculation of risk-weights provides banks with the opportunity and the incentives to conceal the risk in their asset portfolios. The consequence is that the predictive power of risk-weight based capital ratios is diffused as banks approach a state of distress, i.e. specifically when accurate information is of the essence for regulators and market participants. In tune with the arguments made in Blum (2008) or Hellwig (2010), this implies that the Basel II capital ratios are poorer predictors than the unweighted ratios that were customary under Basel I - especially when banks are distressed.

As in Section 3, we will use the remainder of this section to elaborate on this conjecture and to provide further supportive evidence.

4.2.2 Early versus late Basel II implementers

Earlier in this paper, it was mentioned that legislation in compliance with the Basel II rules was introduced later for (some) US banks, for Japanese banks and for banks from the Republic of Korea. Under the premise that Basel II risk-weights are more easily manipulable, this would imply that risk-weighted capital ratios are superior predictors of bank distress for late implementers, i.e. for banks in the aforementioned countries that were not complying with the Basel II rules. This is precisely the hypothesis that we test in this section and it is also precisely what we find.

The model we use is our benchmark Probit model used in columns (3) and (5) of Table 4; augmented with a dummy variable "Early", that is equal to one if a bank is an early implementer of Basel II, i.e. not operating under the US, the Japanese of the South Korean regulatory regime, and equal to zero otherwise. This dummy variable is then interacted with Tier1 Capital (LR) and with RWA/TA.

In accordance with the conjecture that banks are able to manipulate risk-weights in their favour under the Basel II regime, the results in Table 5 proceed to show the following: first, they replicate

the pattern that we have identified in Table 4, for the early adopters; that is, they show how risk-weights contain predictive power in 2005, while the unweighted leverage ratio explains subsequent distress better in 2006, when the risk-weighted asset ratio seems to be no longer relevant. We also find that the risk-weighted asset ratio *and* the unweighted Tier 1 capital ratio can help to indicate bank distress among late or non-adopting banks, both, in 2005 and in 2006. On the one hand, this shows that for banks that were allowed less discretion with respect to the choice of risk-weights, there is little room for manipulation. On the other it shows that, although the use of internal risk models can lead to superior information about bank solvency (when no crisis is anticipated), the information advantage vanishes in the proximity of crises.

As mentioned earlier, US regulators were particularly hesitant when it came to allowing banks to use internal risk models for the calculation of risk-weights; under certain requirements, however, they eventually did. The corresponding requirements consisted of "three major stages: (i) adoption of a bank's board of directors-approved implementation plan; (ii) completion of a satisfactory parallel run; and (iii) advancement through the three distinct transitional periods" (Board of Governors of the Federal Reserve System, 2008), and implied that not all institutions had the resources and the incentives to actually adopt the advanced approach.[21] By comparing the information content of risk-weights reported by "US adopters" and "US Non-adopters", this difference enables us to shed additional light on the implications of using internal risk models. From the analysis in Table 6, two observations stand out: first, Basel II adopters in the US were significantly more likely to be resolved - even controlling for whether they were listed banks or not and for bank characteristics including banks size; second RWA density is a relatively less important predictor of bank failure among US adopters, than among US non-adopters.

While - also due to the relatively small sample size - Table 6 tells us little about the dynamics between 2005 and 2006, it does say that Basel II was particularly attractive for more risky institutions. It also says that - in the immediate proximity of the crisis - lower RWA densities

[21] According to the Fed's press release from November 2, 2007: "Basel II would be mandatory for large, internationally active banking organizations (so-called "core" banking organizations with at least $250 billion in total assets or at least $10 billion in foreign exposure) and optional for others" (Board of Governors of the Federal Reserve System, 2007).

among non-adopters would have been associated with a more pronounced reduction in failures than among Basel II adopters. This suggests that risk-weights that were not calculated based on internal models were more closely linked to the actual risk exposure of the bank. Or, in other words, that Basel II risk-weights were less closely linked to fundamentals.

In summary, the evidence in Tables 5 and 6 therefore lends additional support to the hypothesis that banks, under the Basel II rule, were more able to obfuscate their risk exposure and that they made increasing use of this option as they came under strain.

4.2.3 Competition

In the previous section, our argument has relied on the assumption that adopters of the Basel II advanced approach were more able to manipulate their risk-weights as they were allowed more regulatory discretion. In the same spirit, one could argue that banks that face more intense competition are under more scrutiny from their customers and competitors and that this scrutiny would prevent them from using their internal models strategically.[22] If this is true, we should expect to see our benchmark pattern (RWA density is more informative than the unweighted leverage ratio in 2005, but less in 2006) being replicated in particular among banks operating in a highly competitive environment. To test whether this is true indeed, we augment our benchmark specification (Table 4; columns 3 and 5) with a dummy variable ("High Competition") that is equal to one if a bank's Rosse-Panzar H-statistic is above the median for the banking sector in its host country and zero otherwise.[23]

The corresponding results in Table 7 then serve to support our hypothesis. They show that, in 2005, risk-weights are informative about banks that face little competition, but that this information disappears in 2006; instead, the unweighted leverage ratio provides no superior information in 2005 but becomes highly relevant in 2006. If we look at banks that face high competitive

[22]The implicit positive relationship between competition and prudence is consistent with the work of Boyd and DeNicolo (2005); Boot and Marinc (2009), instead, show that "competition improves the monitoring incentives of better quality banks and deteriorates the incentives of lower quality banks."

[23]"The Rosse–Panzar H-statistic is the sum of the elasticities of a firm's total revenue with respect to its factor input prices"(Goddard and Wilson, 2009); if it is negative we speak of a monopoly; if it is positive but smaller than one, we speak of monopolistic competiton and if it is equal to one we speak of perfect competition.

pressures instead, we see that the information content of RWA density and Tier1 Capital (LR) remains consistent over both years. The two ratios have no predictive power in 2005, but both become relevant as the crisis approaches. Whilst one may speculate about the lack of explanatory power when it comes to the capital ratios of banks facing high competition in 2005, the overall pattern is clearly in support of our conjecture: a competitive environment enhances scrutiny from competitors and customers and reduces the ability to tweak regulatory risk-weights in ones favour. As a result, we see weighted and unweighted ratios provide consistent information for banks that face dire competition, while we see the information content of risk-weights vanish in banks that are under less scrutiny.

Since one may suspect a relationship between bank size and competition, we have also estimated our benchmark regression including a dummy variable for "Large" banks (i.e. banks with a total asset value of larger than $50bn). Intuition suggests, that larger banks are more complex and that the manipulation of risk-weights should be easier for them. This view is supported, for example by Larson (2011), who asserts that larger banks, operating under the IRB approaches, were more likely to employ internal risk models; for smaller banks these options were often too time and cost intensive, implying that they opted for the use of external ratings under the standardised approach instead. Other explanations have been provided by Caprio and Honohan (1999), among others, and include accounting difficulties and problems related to the correct measurement of loan values. If we suspect that larger banks face a less competitive environment, these considerations would also be consistent with our results in Table 7. In the corresponding regression (unreported), however, we find that the pattern we observe in Table 7 is replicated in the subgroup of "Small" banks, while neither the RWA/TA nor the unweighted Tier 1 capital ratio seems to contain any predictive power with respect to "Large" banks; independent of whether we use 2005 or 2006 data. In combination with Table 7, this suggests that it is really the scrutiny from competitors and not so much the size or the resources of a bank that determine the risk of manipulation; the fact that small banks seem to be more prone to making strategic use of their risk-weights may instead be the result of their higher risk of failure, and thus their more urgent need to signal stability to

outsiders.

4.2.4 Alternative forms of bank resolution

In this section we use a multinomial Logit model in order to determine whether the information content in leverage ratios or risk-weights varies, depending on the future choice of resolution policy that was applied. Since the data does not contain sufficient information to introduce four categories, i.e. one for each form of resolution (recapitalisation, bankruptcy, forced merger, nationalisation), we can only analyse three different values of the dependent variable: we set it equal to one if a bank received a public recapitalisation; equal to two, if it was subjected to any other form of resolution and equal to zero if it was not resolved. The independent variables are in 2006 (columns 1-2) and 2005 (columns 3-4) levels.

The corresponding results in Table 8 then offer the following insights; first, and consistent with our previous findings, they show that the unweighted leverage ratio is a strong and significant indicator of all types of resolution policies, in 2006 but not in 2005. Instead, RWA/TA is significant for all forms of resolution in 2005, but only for "Other Resolutions", i.e. not for recapitalisations in 2006. Besides suggesting a systematic difference between the banks, these results have the following implications. Firstly, that only "fundamentally sound" institutions were provided with recapitalisations, while fundamentally unprofitable banks were forced into mergers, nationalisation or bankruptcy. That is to say, regulators were successful in identifying the fundamentally sound and, consequently, in applying the most appropriate form of resolution. This would also be consistent with evidence provided in Bayazitova and Shivdasani (2012), who find that "equity infusions were provided to banks that posed systemic risk and faced high financial distress costs *but had strong asset quality* [emphasis added]" (p. 377). In addition, however, the evidence also implies that regulators did not consider the Basel risk-weights to be a reliable factor in determining those banks that were worth bailing out.

Finally, Table 8 also offers additional insights about the potential motives behind the manipulation of risk-weights. From the significant and positive coefficient on RWA/TA in column (2),

for instance, we learn that, conditional on a given Tier1 Capital (LR) ratio, (seemingly) lower risk-weights were associated with a lower probability of being subjected to more painful forms of resolution. If risk managers were able to avert a forced bankruptcy by presenting lower risk-weights and better capitalisation this provides strong incentives to use the available discretion in ones favour, particularly in the vicinity of a crisis.

4.2.5 Non-linear effects

In this section, we analyse whether there is a non-linearity in the predictive contribution of capital ratios and risk-weights; we test, more specifically, whether capital ratios are more or less indicative of future resolutions depending on banks initial capitalisation. To this end, we estimate our benchmark Probit model, for the subsamples of highly capitalised (Tier1 Capital (LR) equal to or above the median) and weakly capitalised (Tier1 Capital (LR) below the median) banks.

From the analysis in Table 9, the following result transpires: we find that the RWA density is only indicative of future resolutions in the subsample of weakly capitalised banks, and only based on 2005 data; instead, Tier1 Capital (LR) is indicative of subsequent bank resolutions in 2006, and, again, only in the subsample of weakly capitalised banks. In other words, the benchmark pattern is replicated for weakly capitalised banks but not for well capitalised banks. The main conclusion is, therefore, that the tendency to manipulate risk-weights is indeed stronger among weakly capitalised banks. This insight is both intuitive and also consistent with theoretical (Calem and Rob, 1999) and comparable empirical work (Demirguc-Kunt et al., forthcoming). In addition, we also find that capital ratios - risk or unweighted - are uninformative about the probability of failure among highly capitalised banks. This is to be expected because banks that were well capitalised prior to the crisis did not need to be resolved during the crisis to begin with.

For further robustness, it is worth noting that the results on bank size are robust to splitting the sample according to operating income (see Demirguc-Kunt et al. (forthcoming) for the underlying rationale) instead of initial capitalisation and to running an OLS regression with changes in non-performing loans as the dependent variable (as a proxy for the need for resolution).

All of our findings are also robust to adding additional control variables, such as the fraction of long-term funding, measures of efficiency (overhead costs) or the ratio of non-deposit funding over total funding. In fact, these variables are insignificant in all specifications, i.e. in Tables 4 through 9.

5 Conclusion

In this paper we have shown that the option to employ complex, internal risk models for the calculation of regulatory capital requirements (e.g. under the IRB approaches in the Basel II framework) provides banks with the opportunity and the incentives to obfuscate the riskiness of their asset portfolio. The ratios based on these models provide superior information about the stability of the bank during normal times, but become subject to manipulation in the vicinity of distress. That is to say, they become uninformative for regulators and market participants, precisely when information is most urgently needed. Since we identify those institutions that are most likely to require and receive public aid as those that appear to manipulate risk-weights most severely (monopolistic banks and weakly capitalised banks), our findings should be of particular concern for policymakers and taxpayers. The analysis lends empirical support to commentators like Dewatripont et al. (2010) or Hellwig (2010) who have advocated simple rules for the calculation of capital requirements and offers arguments in favour of non-discretionary financial regulation.

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Table 1: **Bank resolutions in 2007-10**

This table provides a description of the distribution of bank resolutions across countries and over time. Bank resolutions include recapitalisations, nationalisations, forced mergers and bankruptcies. The sample includes all countries that allocated at least two per cent of their gross domestic product (GDP) to resolve banks in the period 2007 to June 2009, or that have at least three resolved banks reporting to Bankscope. The sample is further restricted to include only the largest 100 banks (in terms of total assets) per country to maintain a balanced sample. Basel II implementation dates are taken from Financial Stability Institute (2010) and Yetis (2008). The Data Appendix in Mariathasan and Merrouche (forthcoming) provides additional information on data sources and classifications.

Country	**Number of banks**	**Number resolved**	**Banks resolved by year**				**Number resolved with risk-weighted assets in Bankscope**	**Recapitalisation cost until December 2010 (*)**	**IMF estimate until June 2009 (**)**	**Basel II implementation timeline**	
			2007	2008	2009	2010		% of GDP	% of GDP	Basic approach	Advanced approach
Austria	26	6	0	0	6	0	5	2.84%	5.30%	Q4-2006	Q4-2007
Belgium	12	4	0	4	0	0	1	7.98%	4.80%	Q4-2006	Q4-2007
Denmark	32	21	0	1	20	0	18	0.85%	-	Q4-2006	Q4-2007
France	41	9	0	4	5	0	2	0.95%	1.40%	Q4-2006	Q4-2007
Germany	23	5	0	1	4	0	5	2.16%	3.80%	Q4-2006	Q4-2007
Greece	13	8	0	0	8	0	5	1.96%	2.10%	Q4-2006	Q4-2007
Iceland	12	9	0	3	4	2	7	10.51%	-	Q4-2006	Q4-2007
Ireland	14	5	0	0	4	1	4	19.24%	5.90%	Q4-2006	Q4-2007
Japan	100	5	1	0	4	0	5	0.07%	2.40%	Q2-2007	Q2-2008
Korea Rep. of	14	5	0	0	5	0	4	0.21%	2.30%	Q4-2007	Q4-2008
Netherlands	31	4	0	3	1	0	1	4.18%	3.40%	Q4-2006	Q4-2007
Norway	38	10	0	2	8	0	5	0.66%	2.00%	Q4-2006	Q4-2007
Spain	58	34	0	0	3	31	33	2.63%	0.00%	Q4-2006	Q4-2007
Sweden	22	3	0	0	2	1	3	0.29%	2.10%	Q4-2006	Q4-2007
United Kingdom	53	12	1	6	4	1	10	4.18%	3.90%	Q4-2006	Q4-2007
United States	100	38	0	32	6	0	36	1.31%	5.20%	n/a	Q4-2008
Total	589	178	2	56	84	36	144				

(*) Low coverage for Japan and Korea is due to the fact that small banks (outside our sample) or banks not reporting to Bankscope were recapitalised.
(**) IMF estimation covering the entire banking system until June 2009 from Claessens et al. (2010).

Figure 1: **Form of resolution by year**

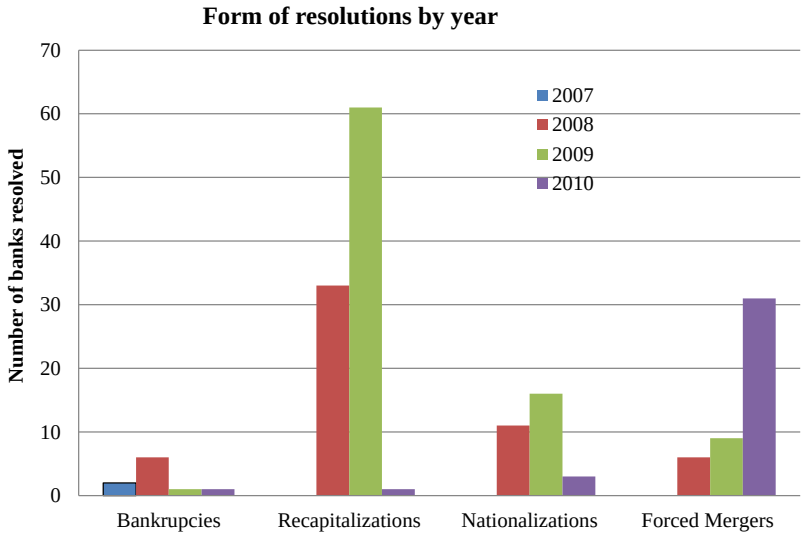


Table 2: **Descriptive statistics**

This table reports descriptive statistics of capital ratios and other financial ratios for the banks in our sample. The benchmark year is 2006. RWR indicates the ratio of capital over risk-weighted assets and LR the unweighted leverage ratio. Tier 1 capital is defined as shareholder funds plus perpetual, non-cumulative preference shares plus retained earnings. Tier 2 capital includes subordinated debt, hybrid capital, loan loss reserves, and valuation reserves. CE stands for common equity and RWA/TA is the ratio of risk-weighted assets to total assets. All capital ratios and risk-weighted assets are in percentage. Liquidity (scaled by total assets) include trading assets, and loans and advances with a maturity of less than three months. Deposits/Loans is gross loans in percentage of deposits. Deposits include savings and demand deposits. Provisions are scaled by total assets and non-interest income by total operating income. ROA stands for return on assets (in %). All variables are winsorized at the 1% and 99% level.

	Observations	Mean	Std	Median	Mean resolved (1)	Mean not resolved (2)	P-value t-test (1)=(2)(*)	Mean 2005	Std 2005
Capital									
Tier1 Capital (RWR)	531	11.763	8.780	9.100	9.798	12.673	0.000	11.288	6.927
Tier2 Capital (RWR)	527	2.575	1.951	2.600	2.976	2.389	0.001	2.582	2.968
Tier1 Capital (LR)	470	6.852	4.649	5.497	6.784	6.884	0.811	6.896	4.803
Tier2 Capital (LR)	449	0.849	4.067	1.450	1.889	0.368	0.000	0.942	6.507
Tangible CE	571	7.353	6.752	6.060	6.801	7.597	0.114	6.949	6.660
RWA/TA	462	59.739	37.931	57.970	68.171	55.921	0.000	30.266	32.284
Other explanatory variables									
Liquidity	589	15.912	17.040	9.215	14.134	16.682	0.054	15.016	16.239
Deposits/Loans	572	114.724	141.694	90.492	81.807	129.234	0.009	113.653	114.476
Provisions	572	0.175	0.319	0.097	0.197	0.165	0.246	0.209	0.592
Non-interest income	589	0.362	0.232	0.324	0.376	0.356	0.299	0.350	0.243
ROA	589	1.017	1.297	0.710	1.261	0.911	0.004	1.046	1.833
Ln(Assets)	589	16.718	2.011	16.765	16.961	16.613	0.067	16.629	2.029

(*) Two-tailed p-value allowing for difference in variance between the two groups.

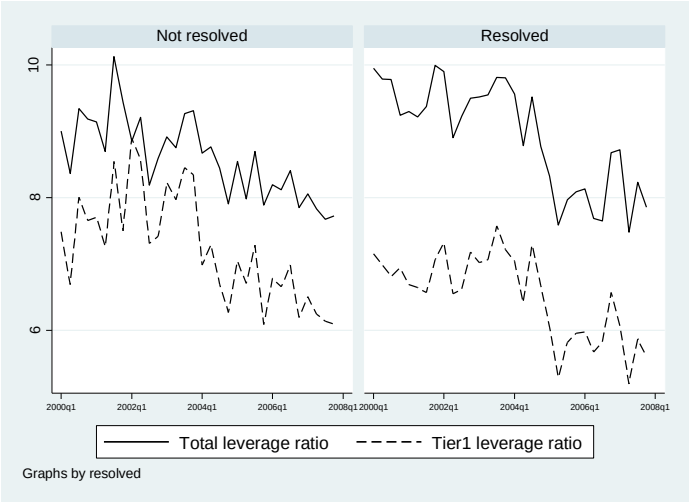
Table 3: **Correlations**

This table reports correlations among the variables used in the regression analysis. See Table 2 for more detailed definitions.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)	Tier1 Capital (RWR)	1											
(2)	Tier2 Capital (RWR)	-0.328*	1										
(3)	Tier1 Capital (LR)	0.609*	-0.387*	1									
(4)	Tier2 Capital (LR)	-0.541*	0.514*	-0.380*	1								
(5)	Tangible CE	0.663*	-0.297*	0.905*	-0.329*	1							
(6)	RWA/TA	-0.383*	0.200*	0.145*	0.650*	0.209*	1						
(7)	Liquidity	0.219*	0.017	-0.130*	0.041	0.024	-0.097*	1					
(8)	Deposits/Loans	0.114*	-0.152*	-0.013	-0.142*	-0.034	-0.163*	0.312*	1				
(9)	Provisions	-0.086	0.165*	-0.014	0.083	0.060	0.005	-0.112*	-0.108*	1			
(10)	Non-interest income	0.163*	0.046	0.021	-0.026	0.008	-0.036	0.518*	0.214*	-0.071	1		
(11)	ROA	0.353*	-0.166*	0.543*	-0.224*	0.405*	0.084	0.138*	0.046	0.017	0.391*	1	
(12)	Ln(assets)	-0.323*	0.309*	-0.581*	0.266*	-0.473*	-0.145*	0.085*	-0.097*	0.025	0.125*	-0.274*	1

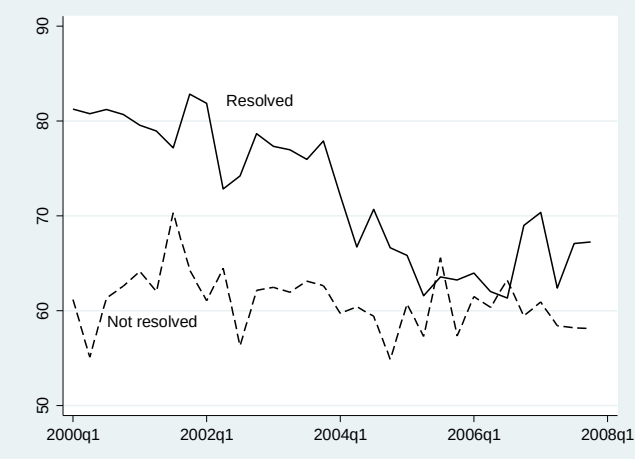
(*) indicates statistical significance at the 5% level

Figure 2: **Capital ratios (%) over time: resolved versus not resolved**



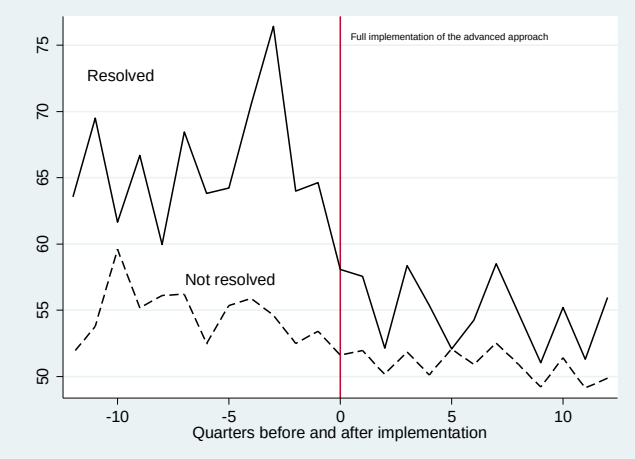
Note: Quarterly data are from Bloomberg and cover a subsample of 174 listed banks; out of these, 52 were resolved (i.e. recapitalised, nationalised, or forced into a merger or into bankruptcy).

Figure 3: **RWA densities (%) over time: resolved versus not resolved**



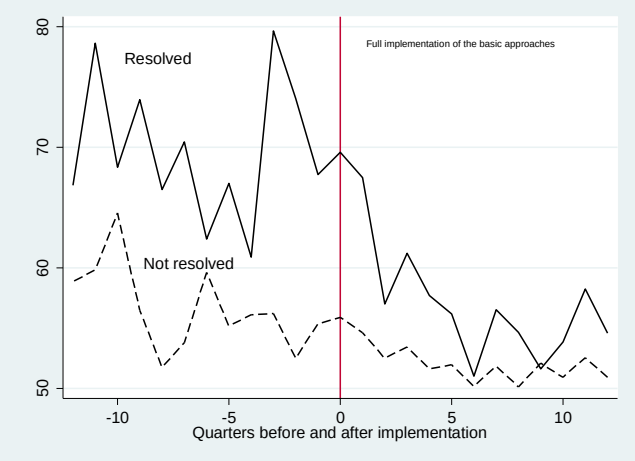
Note: Quarterly data are from Bloomberg and cover a subsample of 174 listed banks; out of these, 52 were resolved (i.e. recapitalised, nationalised, or forced into a merger or into bankruptcy).

Figure 4: **RWA densities (%) before and after implementation of advanced approaches: resolved versus not resolved**



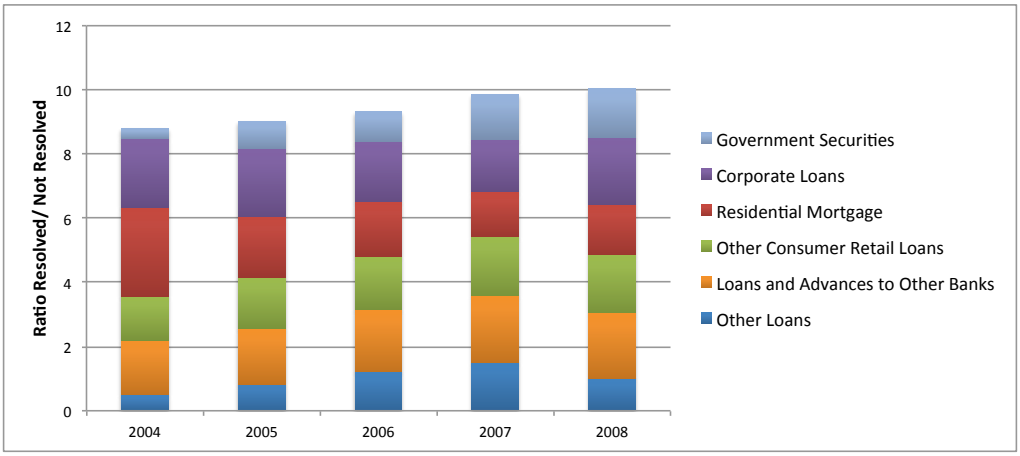
Note: This chart is obtained taking as threshold the quarter by which the law required full implementation of the advanced approaches (see Table 1 for more detail).

Figure 5: **RWA densities (%) before and after implementation of basic approach: resolved versus not resolved**



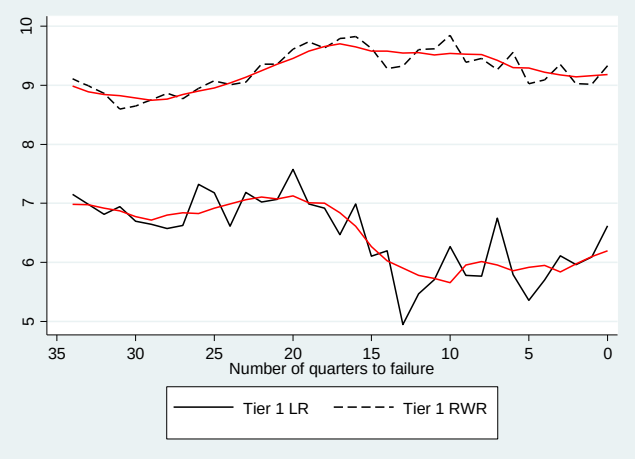
Note: This chart reproduces the same exercise as in Figure 4, using as threshold the quarter by which the law required full implementation of the basic approach.

Figure 6: **Differences in loan book structures over time: resolved versus not resolved**



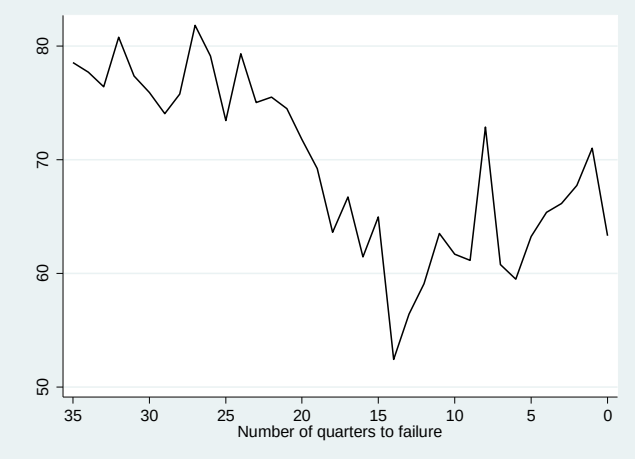
Note: This figure illustrates the evolution of resolved banks' portfolios relative to not resolved banks' portfolios over time. For example, the value for Residential Mortgage in 2004 is equal to the ratio of average Residential Mortgage holdings of banks that were later resolved over the average holdings of Residential Mortgage by banks that were not resolved - both measured in 2005. Data before 2004 are unreliable due to too few banks reporting.

Figure 7: **Capital ratios (%) by quarters to failure: resolved banks**



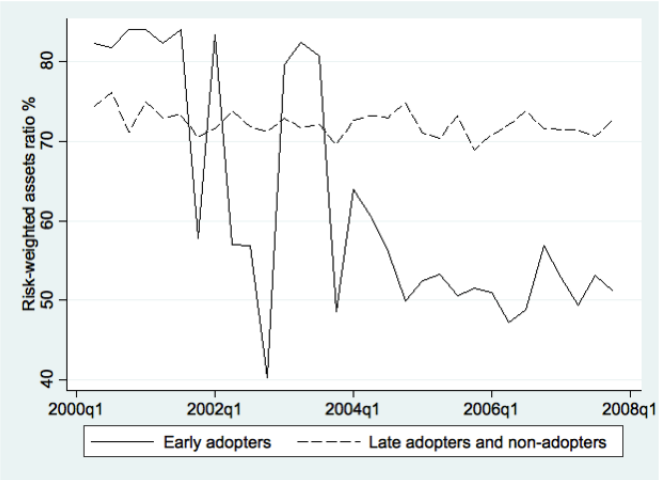
Note: The quarterly data are from Bloomberg and cover only the 52 listed and resolved banks in our sample. Red lines illustrate averages over two lags, one contemporenous observation and two leads.

Figure 8: **RWA density (%) by quarters to failure: resolved banks**



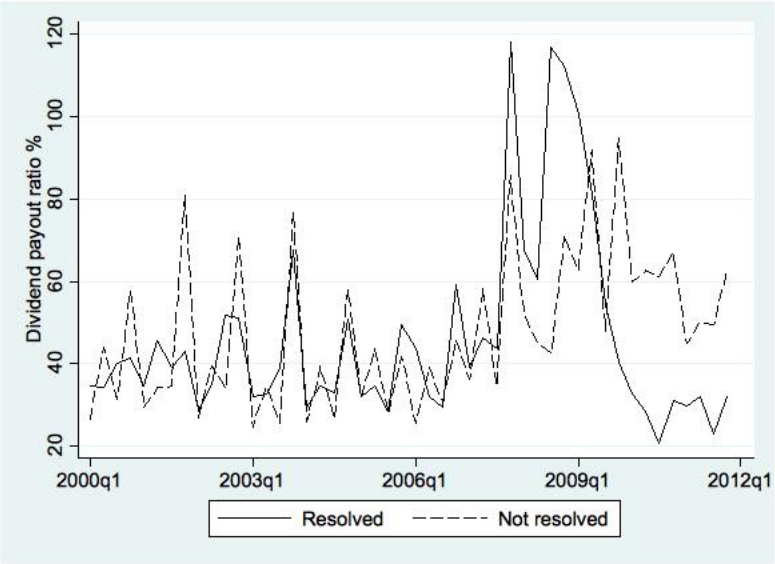
Note: The quarterly data are from Bloomberg and cover only the 52 listed and resolved banks in our sample.

Figure 9: **RWA density (%) over time: early versus late adopters**



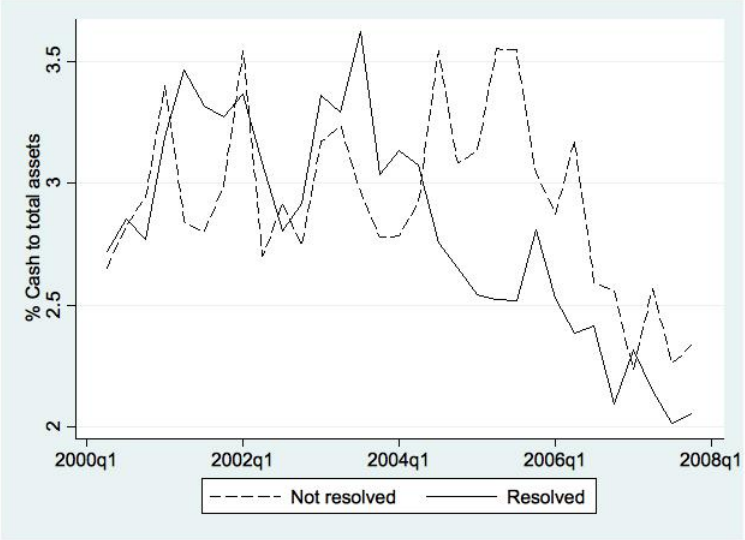
Note: Quarterly data are from Bloomberg and cover the 174 listed banks in our subsample. Late and non-adopters are banks from the US, from Japan and from Korea; early adopters are all other countries.

Figure 10: **Dividend payout ratio (%) over time: resolved versus not resolved**



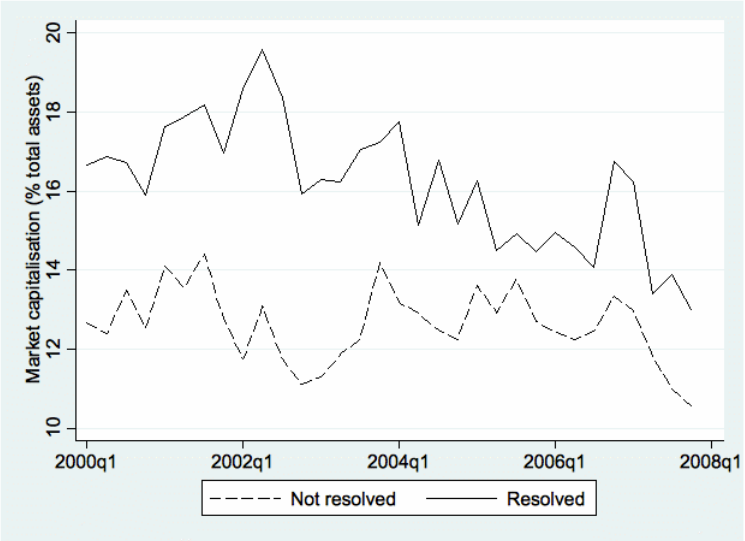
Note: Quarterly data are from Bloomberg and cover a subsample of 174 listed banks; the dividend payout ratio is the ratio of dividend payments over net income.

Figure 11: **Cash ratio (%) over time: resolved versus not resolved**



Note: Quarterly data are from Bloomberg and cover a subsample of 174 listed banks; the cash ratio is the ratio of banks' cash holdings over total assets.

Figure 12: **Market-based leverage ratio (%) over time: resolved versus not resolved**



Note: Quarterly data are from Bloomberg and cover a subsample of 174 listed banks; out of these, 52 were resolved (i.e. recapitalised, nationalised, forced into a merger or into bankruptcy).

Table 4: **Bank capital as a predictor of bank distress**

This table reports marginal effects of a probit regression where the dependent variable is equal to one if a bank has been resolved in the period 2007-10 and equal to zero otherwise. In columns (1)-(4) variables are measured in end of 2006 terms, in columns (5)-(6) end of 2005 data are used. In column (1), Tier 1 and Tier 2 capital ratios are measured relative to risk-weighted assets (RWR); in columns (2), (3) and (5) relative to total assets (LR), and in columns (4) and (6) we are looking tangible equity relative to total assets. In columns (3)-(6) we also include RWA density (RWA/TA). See Table 2 for a definition of all the explanatory variables and corresponding descriptive statistics. We consider a prediction to be correct if the predicted probability of being resolved exceeds the sample probability and the bank is in fact resolved (and correspondingly for not-resolved banks). Standard errors are clustered by country and reported in parentheses.

	2006				2005	
	(1)	(2)	(3)	(4)	(5)	(6)
	RWR	LR	LR	TCE	LR	TCE
Tier1 Capital	-0.0243***	-0.0344***	-0.0398***		-0.00585	
	(0.00631)	(0.0126)	(0.0135)		(0.0138)	
Tier2 Capital	0.0183	0.0130*				
	(0.0153)	(0.00695)				
Tangible CE				-0.0343***		0.00115
				(0.00615)		(0.0100)
RWA/TA			0.00126*	0.000656	0.00243**	0.00216**
			(0.000715)	(0.000488)	(0.00117)	(0.00106)
Liquidity	-3.16e-05	-0.00216	-0.00168	-0.00137	-0.00150	-0.000860
	(0.00233)	(0.00264)	(0.00265)	(0.00254)	(0.00308)	(0.00245)
Deposits/Loans	-0.000391	-0.000559	-0.000536	-0.000534*	-0.000536	-0.000384
	(0.000312)	(0.000347)	(0.000359)	(0.000319)	(0.000329)	(0.000248)
Provisions	0.109	0.189*	0.193*	0.218**	0.0855	0.0920
	(0.135)	(0.101)	(0.101)	(0.111)	(0.0965)	(0.106)
Non-interest Income	-0.314**	-0.270*	-0.286*	-0.211	-0.113	-0.238
	(0.130)	(0.159)	(0.158)	(0.141)	(0.119)	(0.161)
ROA	0.0411	0.0393	0.0413	0.0507	-0.0358	-0.0373
	(0.0539)	(0.0262)	(0.0277)	(0.0389)	(0.0426)	(0.0482)
Ln(Assets)	0.0358*	0.0358	0.0401*	0.0250	0.0390*	0.0480**
	(0.0204)	(0.0236)	(0.0233)	(0.0185)	(0.0215)	(0.0224)
Listed	0.138	0.152	0.161	0.195**	0.196	0.248*
	(0.0967)	(0.106)	(0.105)	(0.0976)	(0.137)	(0.130)
Investment bank	0.0654	0.239*	0.257**	0.397*	0.123	0.267
	(0.165)	(0.127)	(0.122)	(0.203)	(0.149)	(0.169)
Real estate bank	0.0237	0.134	0.152	0.161	-0.0564	-0.000195
	(0.114)	(0.182)	(0.195)	(0.191)	(0.137)	(0.136)
Savings bank	0.320	0.382	0.402	0.417	0.465*	0.493**
	(0.224)	(0.253)	(0.257)	(0.260)	(0.255)	(0.237)
% Resolved correct	81%	84%	84%		80%	
% Not resolved correct	68%	69%	69%		76%	
Observations	498	425	423	422	385	408
Pseudo R2	0.272	0.325	0.327	0.327	0.285	0.282

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: **Early versus late adopters**

This table reports marginal effects of a probit regression where the dependent variable is equal to one if a bank has been resolved in the period 2007-10 and zero otherwise. In column (1) we use end of 2006 data while in column (2) we use end of 2005 data. The Tier 1 capital ratio is measured relative to total (unweighted) assets. See Table 2 for a definition of all the explanatory variables and for descriptive statistics. "Late" is a dummy variable that takes values one if a bank is operating under Japanese, South Korean or US jurisdiction. Instead, "Early" indicates banks that are subject to regulatory rules in any of the remaining countries.

	2006	2005
	(1)	(2)
Tier1 Capital (LR) * Late	-0.0419**	-0.0470***
	(0.0163)	(0.0164)
Tier1 Capital (LR) * Early	-0.0363**	0.0230
	(0.0169)	(0.0170)
RWA/TA * Late	0.00144**	0.00103*
	(0.000602)	(0.000563)
RWA/TA * Early	0.00101	0.00280**
	(0.00103)	(0.00131)
Liquidity	-0.00171	-0.00156
	(0.00269)	(0.00298)
Deposits/Loans	-0.000531	-0.000458
	(0.000374)	(0.000326)
Provisions	0.191*	0.132
	(0.100)	(0.0991)
Non-interest Income	-0.292*	-0.289***
	(0.159)	(0.100)
ROA	0.0419	-0.0272
	(0.0308)	(0.0360)
Ln(Assets)	0.0398*	0.0558**
	(0.0224)	(0.0242)
Listed	0.159	0.175
	(0.105)	(0.130)
Investment bank	0.250**	0.165
	(0.125)	(0.184)
Real estate bank	0.150	-0.0508
	(0.195)	(0.135)
Savings bank	0.397	0.453*
	(0.265)	(0.274)
Observations	423	385
Pseudo R2	0.327	0.315

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: **US adopters versus US non-adopters**

This table reports marginal effects of a probit regression where the dependent variable is equal to one if a bank has been resolved in the period 2007-10 and zero otherwise. In the specification we allow the coefficients on Tier1 Capital (LR) and RWA/TA to vary between US banks that operated under the advanced approach and US banks that could not use internal risk-models. In column (1) we use end of 2006 data; in column (2) end of 2005 data. See Table 2 for a definition of all the explanatory variables and the corresponding descriptive statistics. Standard errors are clustered by country and reported in parentheses.

	2006	2005
	(1)	(2)
Tier1 Capital (LR)	0.00562	-0.0113
	(0.0258)	(0.0271)
Tier1 Capital (LR) * Adopter	-0.158**	-0.874**
	(0.0767)	(0.423)
RWA/TA	0.00454*	0.00135
	(0.00243)	(0.00245)
RWA/TA * Adopter	-0.0164**	-0.00847
	(0.00801)	(0.0317)
Adopter	0.974***	0.999***
	(0.0415)	(0.00241)
Liquidity	-0.0279**	-0.0287**
	(0.0114)	(0.0140)
Deposits/Loans	-0.000296	-0.000601
	(0.00112)	(0.00103)
Provisions	0.166	0.161
	(0.298)	(0.150)
Non-interest income	-0.0582	0.0411
	(0.477)	(0.487)
ROA	-0.0112	-0.0574
	(0.0719)	(0.0714)
Ln(Assets)	0.00831	0.0716
	(0.0614)	(0.0683)
Listed	0.549***	0.620***
	(0.0999)	(0.106)
Observations	88	85
Pseudo R2	0.452	0.481

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: **Competition**

This table reports marginal effects of a probit regression where the dependent variable is equal to one if a bank has been resolved in the period 2007-10 and zero otherwise. In the specification we allow the coefficients on Tier1 Capital (LR) and RWA/TA to vary depending on whether the bank operates in a high or a low competition environment. "High competition" is a dummy variable equal to one in the Rosse-Panzar H statistic is above the sample median in the host country of a given bank. In column (1) we use end of 2006 data; in column (2) end of 2005 data. See Table 2 for a definition of all the explanatory variables and the corresponding descriptive statistics. Standard errors are clustered by country and reported in parentheses.

	2006 (1)	2005 (2)
Tier1 Capital (LR) * High Competition	-0.0982***	0.0240
	(0.0191)	(0.0287)
Tier1 Capital (LR) * Low Competition	-0.0342***	-0.0123
	(0.0113)	(0.0117)
RWA/TA * High Competition	0.00719**	0.000878
	(0.00352)	(0.00288)
RWA/TA * Low Competition	0.00115	0.00271**
	(0.000792)	(0.00126)
Liquidity	-0.00113	-0.00153
	(0.00272)	(0.00330)
Deposits/Loans	-0.000518	-0.000532
	(0.000345)	(0.000326)
Provisions	0.180*	0.0782
	(0.102)	(0.0940)
Non-interest income	-0.243	-0.132
	(0.162)	(0.118)
ROA	0.0289	-0.0239
	(0.0239)	(0.0350)
Ln(Assets)	0.0379	0.0427*
	(0.0233)	(0.0243)
Listed	0.152	0.199
	(0.106)	(0.136)
Investment bank	0.302***	0.129
	(0.0943)	(0.131)
Real estate bank	0.149	-0.0482
	(0.193)	(0.142)
Savings bank	0.384	0.482**
	(0.266)	(0.242)
Observations	423	385
Pseudo R2	0.333	0.292

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: **Alternative forms of bank resolution**

This table reports coefficient estimates of a multinomial logit regression where the dependent variable is equal to one if a bank has been recapitalised in the period 2007-10, equal to two if it has been forced into merger, closed-down or nationalised, and equal to zero otherwise. Mergers, nationalisations, and bankruptcies are grouped together because they are not frequent enough to consider them individually and because they constitute a more severe punishment for the bank than recapitalisations. The Tier 1 capital ratio is measured relative to total (unweighted) assets. In columns (1)-(2) we use end of 2006 data; in columns (3)-(4) end of 2005 data. See Table 2 for a definition of all the explanatory variables and descriptive statistics. Robust standard errors are reported in parentheses.

	2006		2005	
	Recapitalisations	Other Resolutions	Recapitalisations	Other Resolutions
	(1)	(2)	(3)	(4)
Tier1 Capital (LR)	-0.178**	-0.345***	0.00244	-0.0427
	(0.0820)	(0.124)	(0.0557)	(0.153)
RWA/TA	0.00736	0.0151**	0.0134***	0.0173*
	(0.00508)	(0.00757)	(0.00410)	(0.00945)
Liquidity	-0.00756	-0.0144	-0.0184	0.000503
	(0.0212)	(0.0285)	(0.0203)	(0.0396)
Deposits/Loans	-0.00114	-0.0217**	-0.000566	-0.0187***
	(0.00208)	(0.00864)	(0.00119)	(0.00542)
Provisions	1.165**	1.075	0.453	-0.0815
	(0.571)	(1.295)	(0.398)	(1.891)
Non-interest income	-2.263*	1.059	-0.496	0.402
	(1.354)	(1.701)	(0.951)	(0.978)
ROA	0.269	-0.0635	-0.186	-0.340
	(0.203)	(0.523)	(0.148)	(1.112)
Ln(Assets)	0.0903	0.520*	0.0716	0.408
	(0.157)	(0.305)	(0.137)	(0.257)
Listed	1.772**	-0.658	1.946**	-0.298
	(0.802)	(0.578)	(0.970)	(0.565)
Investment bank	0.727	1.715	0.369	-0.118
	(1.133)	(1.589)	(0.926)	(2.171)
Real estate bank	2.102*	0.232	1.058	-1.028
	(1.129)	(1.149)	(1.068)	(1.188)
Savings bank	1.120	2.743**	1.026	2.862**
	(1.055)	(1.224)	(0.855)	(1.281)
Observations	428	428	389	389
Pseudo R2	0.459	0.459	0.429	0.429

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: **High versus low capital**

This table reports marginal effects of a probit regression where the dependent variable is equal to one if a bank has been resolved in the period 2007-10 and zero otherwise. In this specification we split the sample into two groups depending on whether the bank has an unweighted Tier 1 ratio above ("High") or below ("Low") the sample median. In columns (1)-(2) we use end of 2006 data; in columns (3)-(4) end of 2005 data. See Table 2 for a definition and descriptive statistics of the explanatory variables. Standard errors are clustered by country and reported in parentheses.

	2006		2005	
	High Capital	Low Capital	High Capital	Low Capital
	(1)	(2)	(3)	(4)
Tier1 Capital (LR)	-0.0653	-0.0761**	-0.0206	-0.00629
	(0.0429)	(0.0376)	(0.0200)	(0.0420)
RWA/TA	0.00127	0.00755	0.00168	0.00514*
	(0.000986)	(0.00513)	(0.00128)	(0.00268)
Liquidity	0.00427	-0.00255	0.00779	-0.00712
	(0.00393)	(0.00553)	(0.00817)	(0.00500)
Deposits/Loans	1.64e-05	-0.00201*	-0.00169*	-1.84e-05
	(0.000201)	(0.00119)	(0.000918)	(0.000389)
Provisions	0.675***	0.000528	-0.0466	0.181**
	(0.239)	(0.125)	(0.108)	(0.0824)
Non-interest income	-0.413	-0.204	-0.359	-0.108
	(0.322)	(0.319)	(0.325)	(0.263)
ROA	0.0303	-0.137	0.0112	-0.294*
	(0.0839)	(0.102)	(0.0573)	(0.152)
Ln(Assets)	0.0254	0.0597*	0.0279	0.0708**
	(0.0666)	(0.0339)	(0.0493)	(0.0311)
Listed	0.402***	-0.00580	0.412***	0.00639
	(0.126)	(0.0561)	(0.153)	(0.0685)
Investment bank		0.711***		0.0610
		(0.151)		(0.132)
Real estate bank	0.431**	0.0271	0.338	-0.142***
	(0.216)	(0.161)	(0.310)	(0.0516)
Savings bank	0.625***	0.268	0.541***	0.618**
	(0.221)	(0.320)	(0.204)	(0.313)
Observations	170	208	167	199
Pseudo R2	0.342	0.360	0.286	0.359

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1