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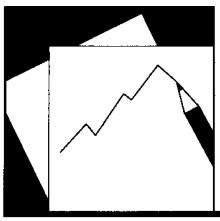

IMF Working Paper

Bank Funding Structures and Risk: Evidence from the Global Financial Crisis

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Bank Funding Structures and Risk: Evidence from the Global Financial Crisis[1]

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Abstract

This paper analyzes the evolution of bank funding structures in the run up to the global financial crisis and studies the implications for financial stability, exploiting a bank-level dataset that covers about 11,000 banks in the U.S. and Europe during 2001–09. The results show that banks with weaker structural liquidity and higher leverage in the pre-crisis period were more likely to fail afterward. The likelihood of bank failure also increases with bank risk-taking. In the cross-section, the smaller domestically-oriented banks were relatively more vulnerable to liquidity risk, while the large cross-border banks were more susceptible to solvency risk due to excessive leverage. The results support the proposed Basel III regulations on structural liquidity and leverage, but suggest that emphasis should be placed on the latter, particularly for the systemically-important institutions. Macroeconomic and monetary conditions are also shown to be related with the likelihood of bank failure, providing a case for the introduction of a macro-prudential approach to banking regulation.

JEL Classification Numbers: G21; G28

Keywords: Bank capital; bank liquidity creation; financial crisis; Basel III; macro-prudential regulations

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I. INTRODUCTION

The global financial crisis raised questions on the adequacy of bank risk management practices and triggered a deep revision of the regulatory and supervisory frameworks governing bank liquidity risk and capital buffers. Regulatory initiatives at the international level included, *inter alia*, the introduction of liquidity standards for internationally-active banks, binding leverage ratios, and a revision of capital requirements under Basel III (BCBS 2009; and BCBS 2010 a, b).[2] In addition to these micro-prudential measures, academics and policymakers argued for the introduction of a complementary macro-prudential framework to help safeguard financial stability at the systemic level (Hanson, Kashyap and Stein, 2010).

This regulatory response was implicitly based on two premises. First, the view that individual bank decisions regarding the size of their liquidity and capital buffers in the run up to the crisis were not commensurate with their risk-taking—and were therefore suboptimal from the social perspective. Second, the perception that the costs of bank failures spanned beyond the interests of their direct stakeholders due, for example, to supply-side effects in credit markets, or network externalities in the financial sector (Brunnermeier, 2009).

The widespread bank failures in the U.S. and Europe at the peak of the global financial crisis provided casual support to the first premise. Still, empirical work on the connection between bank liquidity and capital buffers and their subsequent probability of failure is incipient. Background studies carried out in the context of Basel III proposals, which are based on aggregate data, concluded that stricter regulations on liquidity and leverage were likely to ameliorate the probability of systemic banking crises (BCBS, 2010b).[3] In turn, studies based on micro data for U.S. banks also support the notion that banks with higher asset liquidity, stronger reliance on retail insured deposits, and larger capital buffers were less vulnerable to failure during the global financial crisis (Berger and Bouwman, 2010; Bologna, 2011). Broadly consistent results are reported in Ratnovski and Huang (2009), based on data for large banks from the OECD.

This paper makes two contributions to previous work. First, it measures structural liquidity and leverage in bank balance sheets in a way consistent with the formulations of the Net Stable Funding Ratio (NSFR), and the leverage ratio (EQUITY) proposed in Basel III. Second, it explores for systematic differences in the relationship between structural liquidity,

[2] On liquidity, the proposals comprise two prudential ratios that entail minimum binding standards: a Liquidity Coverage Ratio (LCR), aimed at promoting banks' resilience to liquidity risk over the short-term (a 30-day period); and a Net Stable Funding Ratio (NSFR), aimed at promoting resilience over a one-year horizon. In addition, a leverage ratio computed as shareholders' capital over total assets was introduced to ensure a hard minimum capital level, regardless of the structure of risk-weights in bank balance sheets.

[3] This work also found evidence of non-linear effects at play, as the estimated marginal benefits of stricter regulations seemed to drop with the size of the liquidity and capital buffers.

leverage, and subsequent probability of failure across bank types. In particular, we distinguish between large, internationally-active banks (henceforth Global banks), and (typically smaller) banks that focus on their domestic retail markets (henceforth Domestic banks).

This sample partition is suitable from the financial stability perspective. Global banks are systemically important and extremely challenging to resolve, due to the complexity of their business and legal structures, and because their operations span across borders, entailing differences in bank insolvency frameworks and difficult fiscal considerations. Furthermore, the relative role of liquidity and capital buffers for bank financial soundness is likely to differ systematically across these two types of banks. All else equal, Global banks benefit from the imperfect co-movement macroeconomic and monetary conditions across geographic regions (Griffith-Jones, Segoviano, and Spratt, 2002; Garcia-Herrero and Vazquez, 2007) and may exploit their internal capital markets to reshuffle liquidity and capital between business units. In addition, Global banks tend to enjoy a more stable funding base than Domestic banks due to flight to safety, particularly during times of market distress. To the extent that these factors are incorporated in bank risk management decisions, optimal choices on structural liquidity and leverage are likely to differ across these two types of banks.

The paper exploits a bank-level dataset that covers about 11,000 U.S. and European banks during 2001−09. This sample coverage allows us to study bank dynamics leading to, and during, the global financial crisis. As a by-product, we document the evolution of structural liquidity and leverage in the pre-crisis period, and highlight some patterns across bank types to motivate further research. Contrary to expectations, the average structural liquidity in bank balance sheets in the run up to the global financial crisis (as measured by a proxy of the NSFR) was close to the target values proposed in Basel III recommendations.[4] However, we find a wide dispersion in structural liquidity across banks. A mild (albeit sustained) increase in structural liquidity mismatches in the run up to the crisis was driven by banks located at the lower extreme of the distribution. Pre-crisis leverage was also widely uneven across banks, with the Global banks displaying thinner capital buffers and wider gaps between leverage ratios and Basel capital to risk-weighted assets.

In line with alleged deficiencies in bank risk management practices, we find that banks with weaker structural liquidity and banks with higher leverage ratios in the run up to the crisis were more vulnerable to failure, after controlling for their pre-crisis risk-taking. However, the average effects of stronger structural liquidity and capital buffers on the likelihood of bank failure are not large. On the other hand, there is evidence of substantial threshold effects, and the benefits of stronger buffers appear substantial for the banks located at the lower extremes of the distributions. In addition, we find systematic differences in the relative importance of liquidity and leverage for financial fragility across groups of banks. Global

[4] Structural liquidity was measured by the ratio of long-term stable funding sources to structural asset positions.

banks were more susceptible to failure on excessive leverage, while Domestic banks were more susceptible to failure on weak structural liquidity (i.e., excessive liquidity transformation) and overreliance on short-term wholesale funding.

In the estimations, we include bank-level controls for pre-crisis risk taking, and for country-specific macroeconomic conditions (i.e., common to all banks incorporated in a given country). The use of controls for pre-crisis risk-taking is critical to this study. To the extent that banks perform active risk management, higher risk-taking would tend to be associated with stronger liquidity and capital buffers, introducing a bias to the results. In fact, we find that banks engaging in more aggressive risk taking in the run-up to the crisis—as measured by the rate of growth of their credit portfolios and by their pre-crisis distance to default—were more likely to fail afterward. Macroeconomic conditions in the pre-crisis period are also found to affect bank probabilities of default, suggesting that banks may have failed to internalize risks stemming from overheated economic activity and exuberant asset prices.

All in all, these results provide support to the proposed regulations on liquidity and capital, as well as to the introduction of a macro-prudential approach to bank regulation. From the financial stability perspective, however, the evidence indicates that regulations on capital—particularly for the larger banking groups—are likely to be more relevant.

The reminder of the paper is as follows. Section II places the paper in the context of the literature. Section III presents the dataset, discusses the criteria for the partition of the sample, and describes some stylized facts on the evolution of liquidity and leverage across groups of banks. Section IV describes the quantitative results of baseline regressions and a parallel set of exercises with alternative partitions of the sample to assess the extent of cross-sectional differences and non-linear effects. Section V presents various robustness checks. Section VI concludes.

II. Related Literature and Empirical Hypotheses

The theory of financial intermediation shows that liquidity creation is an essential role of banks and establishes a strong connection between liquidity creation and financial stability (Bryant, 1980; Diamond and Dybvig, 1983). Banks create liquidity on both sides of their balance sheets, by financing long-term projects with relatively liquid liabilities such as transaction deposits and short-term funding.[5] The associated exposure to liquidity risk is an intrinsic characteristic of banks that operates as a discipline device and supports efficiency in financial intermediation (Diamond and Rajan, 2000). In this set up, bank capital (i.e., lower leverage) entails a cost in terms of liquidity creation but provides a buffer against changes in

[5] Banks can also create liquidity via off-balance sheet operations, for example, by issuing commitments and guarantees (see for example Kayshap, Rajan, and Stein, 2002).

the value of bank assets, increasing bank survival probabilities under distressed market conditions (Diamond and Rajan 2001).

The notion of bank liquidity creation in the literature is closely related with the regulatory concept of structural liquidity mismatches in bank balance sheets. The latter reflects the portion of long-term, illiquid assets (i.e., structural positions) that are financed with short-term funding and non-core deposits. Thus, a bank with larger structural liquidity mismatches would create more liquidity. Bank liquidity creation is also related with the leverage ratio, which measures equity capital relative to total assets. To the extent that (the book value of) equity entails a stable funding component, a bank with a higher leverage ratio would also create more liquidity.

The role of bank liquidity in the global financial crisis has been subject to substantial attention. In particular, the reliance of banks on short-term wholesale funding to finance the expansion of their balance sheets in the run-up to the crisis, together with excessive leverage, have been highlighted as key factors in the buildup of systemic risks and the propagation mechanism.[6] Empirical studies show that banking crises in the U.S. have been preceded by periods of abnormal liquidity creation (Berger and Bouwman, 2008, 2009). There is also evidence that banks' reliance on wholesale funding had a negative effect on the performance of their stock prices after the outbreak of the crisis (Raddatz, 2010) and resulted in increased financial fragility, as measured by distance to default and the volatility of bank stock returns (Demirgüç-Kunt and Huizinga, 2009), or by the likelihood of receiving public assistance (Ratnovski and Huang, 2009). In addition, U.S. banks with more stable funding structures continued to lend relative to other banks during the global financial crisis (Cornett *et al*., 2010), and were less likely to fail (Bologna, 2011).

A related strand of literature has focused on the role of capital in the capacity of banks to withstand financial crises. The evidence indicates that banks with larger capital cushions fared better during the global financial crisis in terms of stock returns (Demirgüç-Kunt, Detragiache, and Merrouche, 2010). Related work by Berger and Bouwman (2010) analyzed the survival probabilities of banks in the U.S. during two banking crises and three market-related crises (i.e., those originated by events in the capital markets), and concluded that small banks with higher capital were more likely to survive both types of crises. In contrast, higher capital cushions improved the survival probabilities of medium-size and large banks only during banking crises. Previous studies based on bank-level data also showed that

[6] From the theoretical point of view, however, there are competing views on the effects of bank reliance on wholesale funding on their vulnerability to liquidity risk as well as on market discipline. On the one hand, sophisticated institutional investors may exercise stronger monitoring, enhancing market discipline and offering an alternative to offset unexpected deposit withdrawals (Calomiris, 1999). On the other, in an environment of costless but noisy public signals, short-term wholesale financiers may face lower incentives to monitor, choosing to withdraw in response to negative public signals and triggering inefficient liquidations (Huang and Ratnovski, 2010).

capital ratios had a strong informative content in explaining subsequent bank failure and pointed to the presence of non-linear effects (Estrella, Park, and Peristaki, 2000; Gomez-Gonzalez and Kiefer, 2007).

The combined role of structural liquidity and capital cushions on bank fragility was addressed in the context of Basel III proposals (BCBS, 2010). This work concluded that stronger capital buffers were associated with lower probability of banking crises and also with less severe costs. Evidence on the role of liquidity buffers was somewhat less conclusive possibly due to data limitations, since the analysis was based on aggregate data.

In this paper, we use a bank-level dataset to study the connection between structural liquidity and leverage in bank balance sheets in the run-up to the global financial crisis, and the likelihood of subsequent failure. We also explore for potential differences in the relative importance of liquidity and capital buffers on the likelihood of failure across bank types, distinguishing between large globally-active banks, and domestic retail-oriented institutions. In particular, we try to answer the following questions: (i) are there any connections between structural liquidity and leverage in bank balance sheets during the pre-crisis period and the probability of subsequent failure?, and (ii) is there evidence of systematic differences across bank types? In answering these questions, we also explore the relationship between bank risk-taking and macroeconomic and financial factors in the run up to the crisis and the likelihood of subsequent bank failure.

To guide the analysis, we build upon the theories mentioned above, which imply a direct connection between structural liquidity mismatches in bank balance sheets, leverage, and financial fragility. We note, however, that active implementation of risk management and controls by banks may tend to weaken, or even completely dissipate, this connection. In fact, under the hypothesis that bank decisions regarding their risk-taking and the size of the associated liquidity and capital buffers were optimal, we should find a positive relationship between pre-crisis risk-taking and the size of liquidity and capital buffers, but a weak connection whatsoever between the latter and the probability of failure. Following the same reasoning, proper risk-taking and management by banks would tend to weaken the connections between the macroeconomic environment in the run-up to the crisis and the likelihood of subsequent bank failure. These hypotheses are taken to the data in the next sections.

III. DATA AND TARGET VARIABLES

We obtain bank-level financial statements from the Bankscope database. Using this source has two major advantages. First, the coverage is fairly comprehensive, with sampled banks accounting for about 90 percent of total assets in each country, according to the source. Second, the information at the bank level is presented in standardized formats, after adjusting for differences in accounting and reporting standards across countries. On the other hand, the use of publicly available data has some limitations, in particular the lack of sufficient

granularity in some of the balance sheet accounts. For example, detailed breakdown of loan portfolios by categories, maturity, or currency, is not generally available. Similarly, securities portfolios are not segregated by asset classes, or by maturity. On the other hand, relatively richer information is available on the liabilities' side, as deposits are classified by type, and non-deposit funding is classified in short-term (i.e., residual maturity shorter than one year) versus long-term (i.e., residual maturity longer than one year).

The sample covers about 11,000 banks incorporated in the U.S. and Europe, which were the regions more severely affected by the global financial crisis. Series are yearly, spanning 2001–09. Therefore, we are able to capture the evolution of bank financial conditions in the run up to the crisis (2001–07) as well as throughout the crisis (2008–09). For the purpose of the analysis, we split the sample according to two alternative criteria. First, we distinguish between large internationally active banks versus domestically-oriented banks, and further split the latter in commercial banks, savings banks, and cooperatives. In parallel, we split the sample by target levels of structural liquidity and leverage to explore for potential threshold effects.

Balance sheets and income statements are taken in U.S. dollar terms, using the market rate at the closing dates of the bank-specific accounting exercises. While in many cases BankScope reports both consolidated and unconsolidated financial statements, we use consolidated figures to the extent possible, to reflect the overall liquidity and leverage positions of individual banking groups. Outliers are identified and removed by filtering-out observations with either liquidity or leverage below the 0.5 percentile and above the 99.5 percentile.

A. Indicators of Bank Liquidity and Leverage

To measure structural liquidity and leverage, we use two novel international regulatory standards: the Net Stable Funding Ratio, NSFR, and the leverage ratio, measured by dividing equity capital to assets, EQUITY, (BCBS, 2009, 2010). The NSFR reflects the proportion of long-term illiquid assets that are funded with liabilities that are either long-term or deemed to be stable (such as core deposits). In turn, EQUITY reflects the proportion of shareholders' equity to assets and thus provides a measure of bank leverage. All else equal, a higher NSFR and a higher EQUITY imply lower bank liquidity creation.

Specifically, the NSFR is a ratio between the weighted sum of various types of bank liabilities (L_i) and assets (A_j):

$$NSFR = \frac{\sum_i w_i L_i}{\sum_j w_j A_j} \qquad [1]$$

The weights w are bounded between zero and one, but do not add up to one. They reflect the relative stability of balance sheet components. In the case of assets, larger weights are assigned to less liquid positions. In the case of liabilities, larger weights are assigned to more

stable sources of funding. A higher NSFR is therefore associated with lower liquidity risk. The proposed regulations require banks to maintain a NSFR higher than one.

As noted above, the granularity of bank assets and liabilities required to replicate the NSFR is not publicly available. However, we can still approximate the ratio reasonably well using Bankscope data. A stylized bank balance sheet, together with the weights used in the calculation of the NSFR, is presented in Table 1. Some departures from the NSFR proposed in Basel III are worth noting. First, we cannot split the loan portfolios according to their type or residual maturity, which under Basel III entail different weights (ranging from 0.50 to 1.00). Following a conservative approach, we assume that the total loan portfolio requires stable funding and use an overall weight of 1.00. For other earning assets, which tend to be more liquid, we use an average weight of 0.35, which is within the range proposed in Basel III. Fixed assets and non-earning assets (except for cash and due from banks) receive a weight of 1.00, also following conservative criteria. On the liabilities side, we split customer deposits by type and other liabilities according to their maturity. The weights assigned reflect the assumption that core retail deposits are more stable than other short-term funding sources. Accordingly, the latter are given a weight of zero. Long-term liabilities and equity are considered to be stable at the one-year horizon.

As for leverage, we use the ratio between shareholder's equity to assets, which is broadly used and in line with Basel III proposals.

Robustness checks are performed using alternative indicators of bank liquidity and leverage. For liquidity, we use the Short-Term Funding Ratio (STFR), measured by dividing the liabilities maturing within one-year over total liabilities. For capitalization we use the Basel CAR definition, measured by the ratio of regulatory capital to risk-weighted assets.

B. Global Banks Versus Domestic Banks

As noted before, we classify banks in two categories, namely Global banks and Domestic banks, using information on their size, geographic presence, and ownership. The group of Global banks encompasses internationally-active institutions with consolidated assets surpassing US$10 billion at end-2009. To select only the parent banking groups, we identify banks owing majority stakes in foreign subsidiaries, with no financial institutions listed as their ultimate owners. In turn, the group of Domestic banks encompasses domestically-owned institutions with no majority stakes in subsidiaries abroad. The coverage of the sample is uneven (Table 2). For Domestic banks, it tracks 10,805 institutions during 2001−09, with more than eight years of time coverage for about 57 percent of the banks in the sub-sample. As for Global banks, the sample covers 91 institutions, with more than six years of information for 60 percent of the banks in the sub-sample. Looking closely into the data, there is apparent break in the subsample of European banks in 2005, which is mainly attributable to changes in the accounting information after the adoption of IFRS. We check for potential noise associated with this break by computing the pre-crisis variables according

to three alternative criteria: (i) computing their means over the entire available data for each bank; (ii) computing their means over 2004−07; and (iii) using their values as of end-2007. Not surprisingly, since the target variables are stocks, the results obtained under these three criteria are broadly consistent.

C. Bank Failure

We identify the group of banks that failed during the crisis by using several complementary sources. First, we exploit the information on the ongoing status of each bank contained in BankScope, and single out the banks that changed status from "active" to either: "under receivership", "bankruptcy", "dissolved", "dissolved by merger", or "in liquidation". Second, we track the evolution of the Basel capital (CAR) for each bank and single out the banks with CAR dropping below the 8 percent threshold between 2008−09. Third, we exploit information on Moody's bank financial strength ratings and single out banks downgraded to ratings E+ or E (in distress). These criteria are useful to identify the banks that were allowed to fail and subject to resolution procedures, which were typically the smaller non-systemically important institutions. On the other hand, the failing Global banks were generally assisted by their governments and therefore not properly captured by these criteria. To deal with this issue, we use the information on failing banks from Laeven and Valencia (2010).[7]

IV. Empirical Approach and Quantitative Results

To gauge the relationship between bank structural liquidity, leverage, and their subsequent probability of failure, we compute a probit model exploiting the cross-sectional distribution of bank-level state variables prior to the crisis. In particular, we formulate the empirical model:

$$\Pr(F_i = 1 \mid \mathbf{x}_i) = \Phi(\mathbf{x}_i \beta) \qquad [1]$$

Where F_i is a dummy variable that takes the value of one if bank i failed during the crisis (i.e., between 2008−09) and zero otherwise. The vector $\mathbf{x}_i$ contains the two target variables, namely, the NSFR and the EQUITY ratio, both measured prior to the crisis. The vector also contains a set of bank-level controls, aimed at capturing differences in bank risk profiles in the run-up to the crisis. These include: (i) the yearly average of credit growth, CREDIT GROWTH, (ii) the ratio of non-interest income to total income, NON-INTEREST INCOME, and (iii) the distance to default or Z-SCORE, which conveys the number of standard deviations that bank return on assets has to drop to trigger insolvency. The inclusion of non-interest income follows from the conjecture that bank risk profiles increased with their reliance on trading or

[7] The authors provide a summary of the most relevant banks that failed, or were assisted by their home governments during the global financial crisis, starting from end-2007. This captures banks that received direct assistance from the government (equity injections, bond purchases) as opposed to indirect assistance (general asset purchase programs, reductions in discount rates, and other support measures).

investment banking activities in the run up to the crisis (Demirguç-Kunt and Huizinga, 2009). The vector also contains two country-specific variables (i.e., common to the banks incorporated in a given country) which are aimed at capturing macroeconomic and monetary conditions in the run-up to the crisis. These are the yearly average rate of GDP growth, GDP GROWTH, and the MONEY MARKET RATES. The use of pre-crisis averages for the explanatory variables ameliorates potential endogeneity problems, which comes at the cost of neglecting dynamics along the time dimension. Thus, the specification is purely cross-sectional and does not include bank-level fixed effects.

As noted before, under the premise that banks manage their liquidity and capitalization in a sound way, one should expect to find a positive correlation between their ex-ante risk taking and their capital and liquidity ratios, and a weak connection whatsoever between these and their probabilities of failure. Evidence on the contrary would indicate that banks failed to properly account for their risk taking in the run-up to the crisis, providing some ground for a more intrusive prudential framework regarding capital and liquidity buffers. Following a similar argument, macroeconomic conditions should not play a systematic role in the probabilities of failure of well-managed banks. Evidence on the contrary would imply a link between macroeconomic conditions and systemic financial stability (since the former are common to all banks incorporated in a given country), providing ground for a complementary macro-prudential approach to banking regulation.

A. Stylized Facts

Summary statistics of the variables are presented in Table 3, splitting the sample across Global and Domestic banks. The magnitude of the difference in size between these two groups of banks is striking. The average balance sheet of the Domestic banks was US$0.7 billion at end-2009, compared with US$527.1 billion for Global banks, and the institution in the 99 percentile of the distribution had a balance sheet of US$2.9 trillion at end-2009. The massive size of these banks makes them extremely challenging to resolve, and their interconnectedness and financial complexity compounds with the breath of their operations, which span across borders.

Some additional differences between Global and Domestic banks are worth noting. In the pre-crisis period, Global banks displayed thinner capital cushions than Domestic banks, and weaker indicators of structural liquidity. The structure of Global bank liabilities was also more heavily reliant on non-deposit funding, and tilted to the short-term. The statistics also uncover a wide difference between EQUITY and the Basel CAR, which is mainly attributable to the effect of risk-weighs in the Basel formula. Furthermore, the gap between these two measures is larger for Global banks suggesting a negative relationship between bank size and average risk-weights. For example, Global banks in the first percentile have an EQUITY ratio of only 1.4 percent compared to a Basel CAR of 9.2 percent, which is 6.6 times higher. In turn, Domestic banks have an EQUITY ratio of 2.5 and a Basel CAR of 10.1 percent, which is

4.0 times higher. Other risk indicators, such as the Z-score and credit growth are broadly similar across bank types.

To explore the relationship between the target variables in the pre-crisis period, pair-wise correlations are presented in Table 4. As before, we split the sample between Global banks (lower triangle) and Domestic banks (upper triangle) to gauge the extent of potential cross-sectional differences. Not surprisingly, various measures of liquidity tend to be closely related for both types of banks. For example, stronger structural liquidity is associated with lower reliance on short-term funding (and with money market funding) and positively correlated with deposit funding. Also, the two measures of bank capital seem to convey similar information, despite gaps stemming from risk weights. It is worth noting that the correlation between bank capital and credit growth is positive and statistically significant in both subsamples. This is consistent with the idea that bank governance and risk management mechanisms were at play (i.e., a more aggressive credit expansion was associated with stronger capital cushions). On the other hand, some differences between the two bank types are apparent. In the case of Global banks, higher structural liquidity seems to be associated with more moderate credit growth and a larger distance to default. In the case of Domestic banks, the relationship between these variables is not significant. All in all, these correlations suggest that the expansion of bank balance sheets in the pre-crisis period was associated with riskier liquidity profiles, particularly for Global banks, but do not suggest an immediate connection with potential shortages in capital buffers. The next section explores the link between bank probability of failure with their pre-crisis levels of liquidity and capital in a more rigorous way.

To gauge the time evolution of structural liquidity and leverage across bank types, Figure 1 plots the respective medians together with the 10^{th} and 90^{th} percentiles. Interestingly, the average NSFR before the crisis is relatively stable and close to one. However, there is a wide dispersion across banks, with those located at the lower extreme of the distribution displaying extremely weak structural liquidity. A similar picture emerges for EQUITY capital. While the average bank displayed relatively comfortable equity to asset ratios, those located at the low end of the distribution were extremely leveraged.

A complementary diagram of the evolution of structural liquidity during the sampled period is presented in Figure 2, splitting the sample by bank types and across Failed and Non-Failed banks. The plots reveal interesting cross-sectional patterns. As expected, the failed banks had lower structural liquidity and higher leverage than the non-failed banks. Furthermore, the NSFR follows a declining trend in the pre-crisis period, which reverts from 2007 for the Domestic banks, and from 2008 for the Global banks. In the latter group, there is a sudden drop at the peak of the crisis, followed by an equally sharp increase that reflects the hoarding of liquidity for precautionary purposes. Regarding EQUITY, Domestic banks display more comfortable cushions than Global banks and an upward trend in the pre-crisis period. After the eruption of the crisis, equity collapses in the group of failed Domestic banks, but

increases in the group of failed Global banks, reflecting capital injections and public support due to their systemic importance.

Before turning to the regression analysis, we compare the distributions of pre-crisis structural liquidity and leverage across Failed and Non-Failed banks, further distinguishing between bank types (Figure 3). To facilitate the reading, we exclude banks with NSFR above 1.5 and banks with EQUITY above 20 percent. All the distributions have positive skewness and excess kurtosis, with normality tests rejecting the null in all cases. Comparing across subsamples, the most striking result is the evidence of substantially lower EQUITY in the case of Failed Global banks, with the mean close to 4 percent. The distributions of NSFR for Failed banks are also displaced to the left, but the differences tend to be lower. In fact, tests of differences of means (not shown) suggest that insufficient EQUITY was associated with failure in the case of Global banks while insufficient structural liquidity was a problem associated with the Domestic banks. In the next section we develop a empirical model to formally test these conjectures.

B. Baseline Regressions

The results of baseline probit regressions, properly transformed around the mean of the explanatory variables to show the change in the probability of failure associated with a change in the explanatory variables, support the notion that banks with higher NSFR and EQUITY in the years before the crisis were less susceptible to fail during the turmoil (Table 5). The coefficients associated to the two target variables are negative and statistically significant at the one percent level in all cases and the results are robust to the inclusion of the control variables. At the same time, the evidence indicates that banks with higher risk taking in the pre-crisis period were more likely to fail afterward. In particular, credit growth is positively associated with the probability of failure, while the Z-score (i.e., distance to default) operates in the opposite direction. On the other hand, the ratio of non-interest income to total income is not statistically significant. The latter result contrasts with Demirguc-Kunt and Huizinga (2010), which is likely due to differences in the construction of the variable.[8] Interestingly, the macroeconomic variables (which are common to all banks incorporated in a given country) are also highly significant and operate in the expected direction. Banks incorporated in countries with higher pre-crisis economic growth and with easier monetary conditions were more likely to fail during the crisis. This is consistent with the notion that banks failed to fully internalize risks stemming from their external environment. This may provide justification for the implementation of macro-prudential regulations as a complement to the traditional micro-prudential approach. At the same time, it is also worth noting that the

[8] This paper measures NON-INTEREST INCOME by taking the absolute value of non-interest income to total income, to account for the fact that trading income may take negative values. Therefore, a bank with either large non-interest gains or losses relative to total income is assumed to be riskier.

pseudo R-square of the regression tends to be low, with the model explaining less than five percent of the variation in bank probability of failure.

To assess the economic significance of the results, we take the regression coefficients presented in column [6] and compute the estimated change in the probability of failure resulting from a 0.5 standard deviation change in the explanatory variables. The results (Table 6) indicate that a 10.4 percentage point increase in the NSFR, from 0.99 to 1.09, would cause a drop 0.46 percentage point drop in the probability of failure of the average bank, all else equal. Similarly, a 3.1 percentage point increase in EQUITY, from 10.7 percent to 13.8 percent would cause a drop of 0.64 percentage point drop in bank probability of failure. Thus, the quantitative importance of these effects appears to be small, which is consistent with the results obtained in quantitative impact studies (BCBS, 2010). A caveat of this interpretation is the potential presence of either non-linear or threshold effects operating more severely for banks in the extremes of the distribution. This possibility is assessed in the next section.

Turning back to the results, the probability of failure seems to be relatively more influenced by bank risk profiles, particularly as reflected in the pre-crisis Z-score, and by bank's operating environments. Notably, banks incorporated in countries with a pre-crisis GDP growth 0.5 percentage points higher than the average were 2.2 percentage points more likely to fail, while tighter monetary conditions operated in the opposite direction. This is consistent with the presence of unsustainable economic activity and/or potential asset bubbles in the pre-crisis period.

C. Are There Threshold Effects at Play?

To gauge the extent of threshold effects, we split the sample according to pre-crisis values of NSFR and EQUITY with the help of dummy variables.[9] In particular, we indentify banks with a NSFR below one and banks with EQUITY below seven. These values are relevant references from the regulatory perspective. We then re-estimate the regressions over each subsample and their combinations. As before, the estimated coefficients are transformed to convey the marginal impact of each explanatory variable on the probabilities of bank failure (Table 7). Overall, the results are consistent with the idea that liquidity and capital play a complementary role in financial stability and that threshold effects are at play. In the leftmost three columns, which are computed over the subsamples of banks with weak structural liquidity, the coefficients associated with EQUITY are two and four times higher than those obtained in the matching baseline regressions. Furthermore, the relationship between structural liquidity and the probability of failure reverses sign and becomes statistically

[9] We also computed a set of regressions including squared values of the NSFR and EQUITY to allow for non-linear effects, but the results were not statistically significant.

insignificant for the subsample of banks with low liquidity and capital, indicating that capital shortages were critical for the failing banks in this subsample.

Going back to results, the rightmost three columns display a partition of the sample by levels of EQUITY. Not surprisingly, the strongest marginal benefits of capital cushions originate from the subsample of banks operating below the seven percent threshold, as shown in column [4]. The explanatory variables also account for a more significant proportion of the probability of failure in the subsamples of banks with lower capital ratios, as indicated by the pseudo R-squared at the bottom. As for the subsample of banks operating with intermediate EQUITY levels, both structural liquidity and capital seem to contribute to their capacity to withstand the crisis. The target coefficients are two and three times larger than those obtained in the baseline regression. Conversely, the coefficients are not statistically significant for the subsample of banks with EQUITY above twelve percent, as shown in column [6], which is also consistent with the existence of threshold effects.

These results, together with those obtained in the previous section indicate that the stability benefits of tighter regulations on liquidity and capital are moderate for the average bank, but substantially more relevant for the institutions located at the lower extreme of the distribution. Furthermore, the results suggest that, from the financial stability perspective, regulations on capital are likely to play a more critical role than regulations on liquidity. This poses a question on the extent of potential differences in the target parameters across Global and Domestic banks, as the former were typically more leveraged than Domestic banks in the run up to the crisis. The next section explores for this possibility.

D. Are There Differences Across Bank Types?

To assess the extent of differences across bank types, we compute separate regressions for Global and Domestic banks, and further split the latter by categories, distinguishing between commercial banks, savings banks, and cooperatives. The results (Table 8) provide strong evidence that capital shortages played a more important role in the failure of Global banks, while liquidity was the key factor in the subsample of Domestic banks. It is worth noting the magnitude of the coefficient associated with EQUITY for the subsample of Global banks, which is almost 25 times larger than that obtained in the baseline regression. Using this value, a one percent increase in Global bank capital in the pre-crisis period would cause a material 4.8 percent drop in their probability of failure. This highlights the importance of ensuring adequate capital buffers in the systemically-important institutions. In turn, the coefficient associated with credit growth is also substantially larger for the sub-sample of Global banks, suggesting that those engaged on a more aggressive expansion in the pre-crisis period were more likely to fail. Conversely, country-specific macroeconomic conditions do not play a systematic role in the subsample of Global banks. This is likely due to diversification effects stemming from their international operations. In fact, as their operations span many countries, changes in macroeconomic conditions in their home countries do not have a strong impact on the likelihood of failure of the entire group.

In the subgroup of Domestic banks, cross-sectional differences are less stark, as indicated by the results presented in columns [3] to [5]. Capital shortages appear to be relatively more important in the segment of savings banks, while commercial banks appear to be more vulnerable to problems associated to weak structural liquidity. In the segment of credit cooperatives, those more heavily engaged in non-traditional activities, proxied by the ratio of non-interest to total income, were more likely to fail during the crisis.

V. Robustness Check

To gauge the robustness of the results, we estimate a complete set of parallel regressions using two alternative measures of bank liquidity and capital. As for liquidity, we use the Short Term Funding Ratio, STFR, computed by dividing liabilities with less than one year residual maturity to total liabilities. For capital, we use the Basel Tier 1 capital ratio, CAR, defined as the ratio of Tier 1 regulatory capital to risk-weighted assets. As mentioned before, this measure of capital is larger than the one used in the baseline regressions due to the application of risk weights on bank assets.

In addition, we explore with three variations in the definition bank failure. In particular, we decompose the bank failure dummy according to its components as follows: (i) banks that ceased their active status during the crisis or that were reclassified to risk categories E and E+ by Moody's; (ii) banks with regulatory CAR ratios dropping below 8 percent between 2008–09; and (iii) banks included in the failed list of compiled by Laeven and Valencia (2009).

The full set of results, omitted for brevity, is broadly consistent with those discussed previously. Summary regressions replicating the baseline specification with combinations of the alternative measures of liquidity and capital are presented in Table 9. The coefficients associated with the STFR are positive, indicating that bank reliance on short-term funding before the crisis was associated with increased financial fragility. The set of regressions that use variations in the definition of bank failure, presented in Table 10, are also broadly consistent with the baseline results.

VI. Concluding Remarks

Overall, the findings of this paper provide broad support to Basel III initiatives on structural liquidity and leverage, and show the complementary nature of these two areas. Banks with weaker structural liquidity and higher leverage before the global financial crisis were more vulnerable to subsequent failure. The results are driven by banks in the lower extremes of the distributions, suggesting the presence of threshold effects. In fact, the marginal stability gains associated with stronger liquidity and capital cushions do not appear to be large for the average bank, but seem substantial for the weaker institutions.

At the same time, there is evidence of systematic differences across bank types. The smaller banks were more susceptible to failure on liquidity problems, while the large cross-border

banking groups typically failed on insufficient capital buffers. This difference is crucial from the financial stability perspective, and implies that regulatory and supervisory emphasis should be placed on ensuring that the capital buffers of the systemically important banks are commensurate with their risk-taking.

The evidence also indicates that bank risk-taking in the run-up to the crisis was associated with increased financial vulnerability, suggesting that bank decisions regarding the associated liquidity and capital buffers were not commensurate with the underlying risks, resulting in excessive hazard to their business continuity. Country-specific macroeconomic conditions also played a role in the likelihood of subsequent bank failure, implying that banks failed to properly internalize the associated risks in their individual decision-making processes. Thus, while more intrusive regulations entail efficiency costs, the results point to associated gains in terms of financial stability that have to be pondered. This also supports the introduction of a macro-prudential framework as a complement to traditional, micro-prudential approach. In this regard, further work is needed to deepen the understanding of the role of the macroeconomic environment on financial stability.

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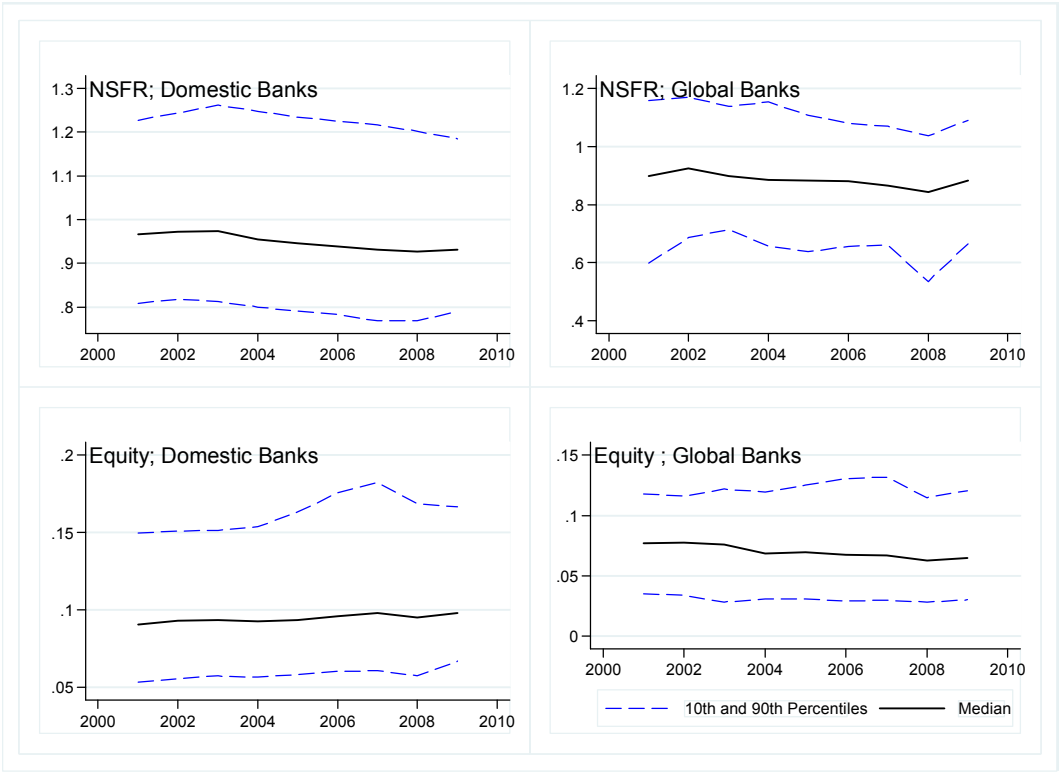
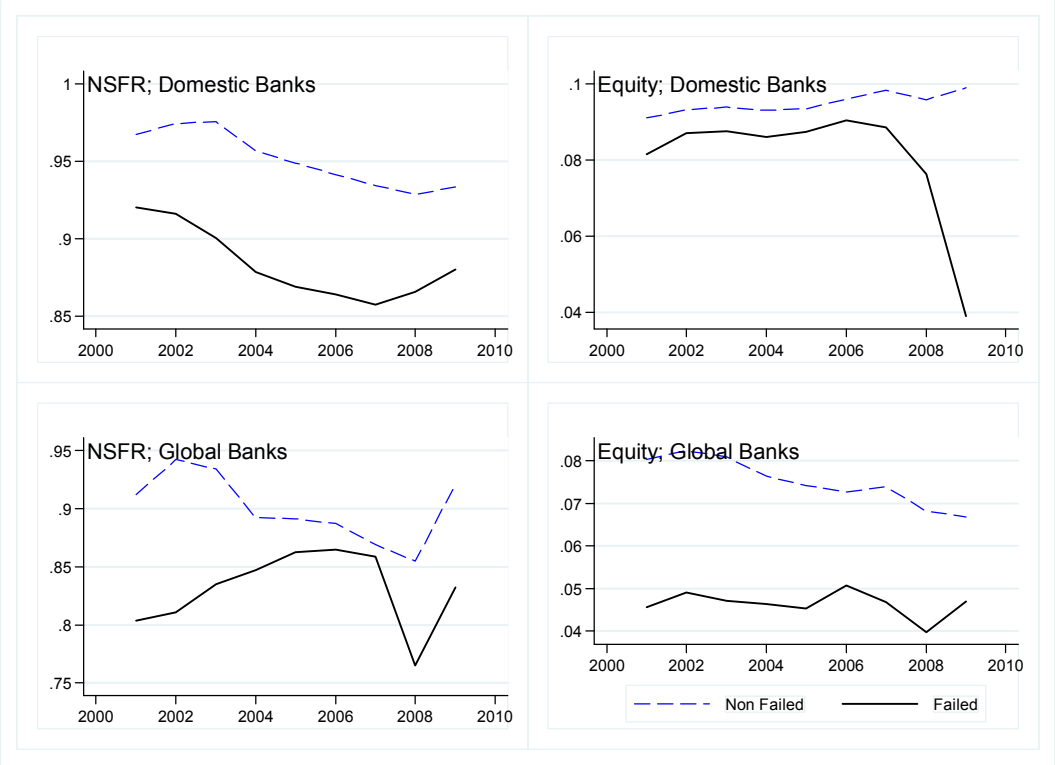
Figure 1. Evolution of Structural Liquidity and Leverage across Bank Types, 2001−09



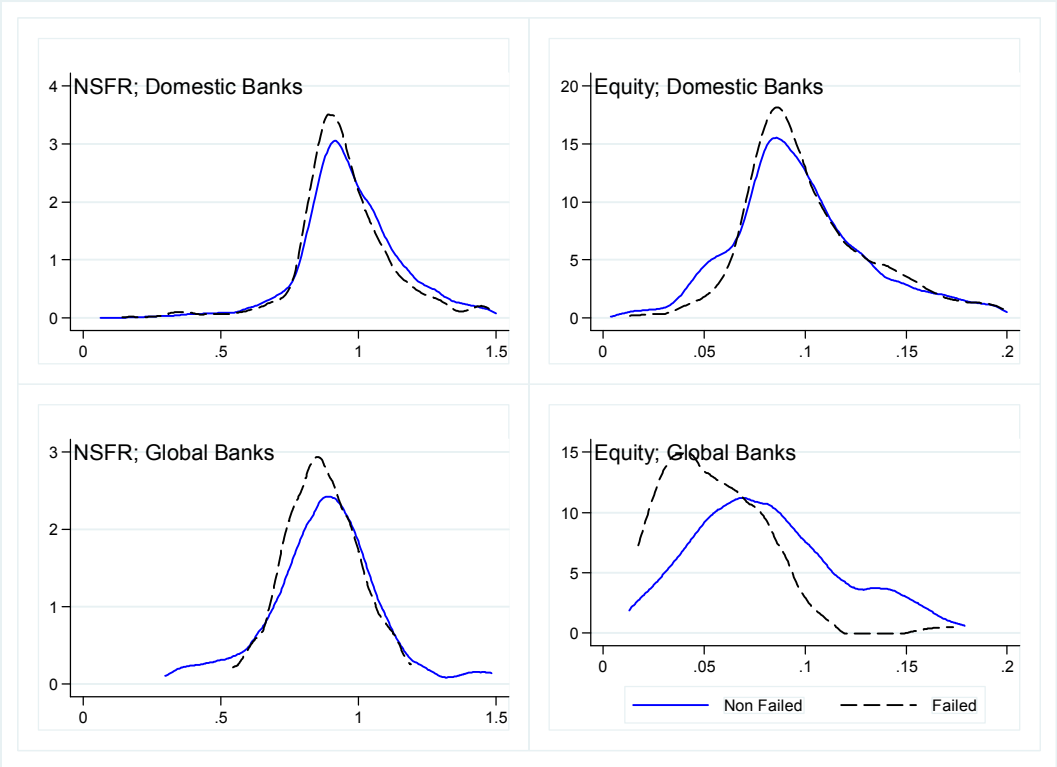
This figure presents the evolution of the structural liquidity and leverage for the subsamples of Domestic and for Global banks during 2001−09. The solid lines correspond to the median and the dotted lines to the 10^{th} and 90^{th} percentiles of the distributions.

Figure 2. Evolution of Structural Liquidity and Leverage across Failed and Non-Failed Banks, 2001−09



This figure presents the evolution of the median structural liquidity and leverage for the subsamples of Domestic and Global banks, further splitting each group in failed versus Non-Failed institutions.

Figure 3. Distributions of Pre-Crisis Liquidity and Leverage across Failed and Non-Failed Banks



This figure plots the pre-crisis density functions of structural liquidity and leverage for the subsamples of Domestic and Global banks, further splitting each group in Failed and Non-Failed institutions.

Table 1. Stylized Balance Sheet and Weights to Compute the NSFR

ASSETS	Wi	LIABILITIES + EQUITY	Wi
1 Total Earning Assets		**1** Deposits & Short term funding	
1.A Loans	100%	**1.A** Customer Deposits	
1.A.1 Total Customer Loans		**1.A.1** Customer Deposits - Current	85%
Mortgages		**1.A.2** Customer Deposits - Savings	70%
Other Mortgage Loans		**1.A.3** Customer Deposits - Term	70%
Other Consumer/ Retail Loans		**1.B** Deposits from Banks	0%
Corporate & Commercial Loans		**1.C** Other Deposits and Short-term Borrowings	0%
Other Loans			
1.A.2 Reserves for Impaired Loans/NPLs		**2** Other interest bearing liabilities	
1.B Other Earning Assets	35%	**2.A** Derivatives	0%
1.B.1 Loans and Advances to Banks		**2.B** Trading Liabilities	0%
1.B.2 Derivatives		**2.C** Long term funding	100%
1.B.3 Other Securities		**2.C.1** Total Long Term Funding	100%
Trading securities		Senior Debt	
Investment securities		Subordinated Borrowing	
1.B.4 Remaining earning assets		Other Funding	
2 Fixed Assets	100%	**2.C.2** Pref. Shares and Hybrid Capital	100%
3 Non-Earning Assets		**3** Other (Non-Interest bearing)	100%
3.A Cash and due from banks	0%	**4** Loan Loss Reserves	100%
3.B Godwill	100%	**5** Other Reserves	100%
3.C Other Intangibles	100%		
3.D Other Assets	100%	**6** Equity	100%

This table presents a stylized bank balance sheet, together with the weights assigned to different assets and liabilities for the computation of the net stable funding ratio.

Table 2. Sample Coverage by Bank Types

	Domestic Banks			Global Banks		
	Non-Failed	Failed	Total	Non-Failed	Failed	Total
Austria	142	0	142	4	3	7
Belarus	2	0	2	0	0	0
Belgium	8	0	8	0	2	2
Bosnia-Herzegovina	3	0	3	0	0	0
Bulgaria	1	0	1	0	0	0
Croatia	5	0	5	0	0	0
Cyprus	3	0	3	2	0	2
Denmark	56	0	56	2	1	3
Finland	0	0	0	1	0	1
France	40	36	76	1	4	5
Germany	1274	6	1280	5	4	9
Greece	2	0	2	0	4	4
Hungary	3	0	3	1	0	1
Iceland	8	0	8	0	0	0
Ireland	1	0	1	1	0	1
Italy	27	0	27	2	3	5
Latvia	0	2	2	0	0	0
Lithuania	1	0	1	0	0	0
Luxembourg	3	0	3	0	0	0
Macedonia (FYR)	2	0	2	0	0	0
Malta	1	0	1	0	0	0
Moldova Rep. Of	3	1	4	0	0	0
Montenegro	2	0	2	0	0	0
Netherlands	2	0	2	3	3	6
Norway	43	1	44	0	0	0
Poland	3	0	3	0	0	0
Portugal	0	0	0	2	0	2
Romania	2	0	2	0	0	0
Russian Federation	60	17	77	1	1	2
Serbia	6	0	6	0	0	0
Slovenia	3	0	3	0	0	0
Spain	28	1	29	2	0	2
Sweden	60	13	73	3	0	3
Switzerland	241	6	247	2	1	3
Turkey	3	0	3	1	0	1
Ukraine	7	6	13	0	0	0
United Kingdom	6	0	6	3	5	8
U.S.	7950	715	8665	19	5	24
Total	10,001	804	10,805	55	36	91

This table presents the sample coverage, classifying banks by their countries of incorporation and type.

Table 3. Summary Statistics of Selected Variables, 2001−07

	Mean	St. Dev.	Perc. 1	Perc. 99	Obs.
Domestic Banks					
NSFR	0.987	0.190	0.599	1.615	10704
STFR	0.059	0.100	0.000	0.480	10704
Money Market Funding to Total Liabilities	0.030	0.056	0.000	0.242	10106
Customer Deposits to Total Liabilities	0.894	0.124	0.429	1.000	10704
Equity Capital to Assets	0.101	0.044	0.025	0.251	10704
CAR Ratio	0.175	0.088	0.101	0.522	9260
Sharpe Ratio	0.050	0.048	-0.006	0.232	10704
Z-score	0.467	0.433	0.042	2.077	10704
Non-Interest Income to Assets	0.009	0.009	0.001	0.049	10704
Credit Growth	0.111	0.130	-0.084	0.661	10704
memo: Total Assets 2009 (Bln. USD)	0.7	2.9	0.0	11.3	
Global Banks					
NSFR	0.895	0.214	0.545	2.352	91
STFR	0.252	0.157	0.013	0.681	91
Money Market Funding to Total Liabilities	0.123	0.109	0.001	0.566	89
Customer Deposits to Total Liabilities	0.499	0.218	0.002	0.921	91
Equity Capital to Assets	0.063	0.035	0.014	0.205	91
CAR Ratio	0.132	0.075	0.092	0.766	83
Sharpe Ratio	0.067	0.118	-0.001	1.035	91
Z-score	0.441	0.712	0.039	5.910	91
Non-Interest Income to Assets	0.018	0.020	0.001	0.127	91
Credit Growth	0.198	0.145	-0.023	0.788	91
memo: Total Assets 2009 (Bln. USD)	527.1	707.6	23.1	2964.3	

This table presents summary statistics of selected variables during 2001−07 (the period preceding the global financial crisis). The statistics are computed over two subsamples: Global banks and Domestic banks.

Table 4. Pair-wise Correlations between Selected Variables, by Bank Types, 2001−07

	NSFR	STFR	Money Market Funding	Deposit Funding	Equity to Assets	CAR	Credit Growth	Z-score	Other Income to Assets
NSFR		-0.6030*	-0.3288*	0.2816*	0.025	0.5899*	0.057	-0.046	0.1052*
STFR	*-0.4480**		0.5504*	-0.6671*	-0.064	-0.066	-0.022	0.088	-0.063
Money Market Funding	*-0.3463**	*0.8658**		-0.3513*	-0.2146*	-0.013	-0.1071*	-0.086	0.054
Deposit Funding	*0.3785**	*-0.8472**	*-0.7452**		0.2430*	-0.1193*	0.016	-0.088	0.1936*
Equity to Assets	*0.3362**	*0.1429**	*0.2449**	*-0.0774**		0.1469*	0.2237*	0.079	0.3864*
CAR	*0.6090**	*-0.0636**	*-0.0667**	*0.1183**	*0.8173**		0.073	0.2353*	0.046
Credit Growth	*0.0140**	*0.0497**	*0.0729**	*-0.0405**	*0.0619**	*0.1186**		-0.036	0.029
Z-score	*0.0722**	*0.0102**	*0.0110**	*-0.0150**	*0.1290**	*0.1738**	*-0.1130**		-0.698
Other Income to Assets	*-0.0868**	*0.3805**	*0.4476**	*-0.3704**	*0.1950**	*-0.0631**	*0.0098**	*-0.0957**	

This table presents pair-wise correlations of selected variables during 2001−07. Starred correlations are statistically different from zero at the one percent level. Correlations in the *lower triangle* are for the subsample of Global banks; correlations in the upper triangle are for the subsample of Domestic banks.

Table 5. Baseline Probit Regressions for the Entire Sample

	[1] All Sample	[2] All Sample	[3] All Sample	[4] All Sample	[5] All Sample	[6] All Sample
NSFR	-0.0690***		-0.0585***	-0.0461***	-0.0421***	-0.0431***
	[0.015]		[0.015]	[0.015]	[0.015]	[0.015]
Equity		-0.2341***	-0.1452**	-0.2512***	-0.2008***	-0.1993***
		[0.068]	[0.069]	[0.073]	[0.072]	[0.073]
Credit Growth				0.0590***	0.0491***	0.0487***
				[0.015]	[0.014]	[0.014]
Z-Score					-0.0471***	-0.0477***
					[0.011]	[0.011]
Non-Interest Income						-0.253
						[0.302]
GDP Growth 2001-07	4.1008***	4.4759***	4.3866***	4.2473***	3.9885***	4.0479***
	[0.336]	[0.361]	[0.356]	[0.357]	[0.363]	[0.366]
Monetary Conditions 2001-07	-0.9138***	-0.8543***	-0.8646***	-0.9469***	-1.0286***	-0.9738***
	[0.281]	[0.264]	[0.266]	[0.280]	[0.341]	[0.334]
Observations	10,896	10,896	10,896	10,896	10,896	10,896
Pseudo R2	0.0243	0.0225	0.0252	0.0322	0.0398	0.0399

This table presents the results of bank-level probit regressions with robust standard errors [in brackets]. The dependent variable equals one for banks failing during the global financial crisis (2008−09) and zero otherwise. The regression coefficients have been transformed to convey the change in the probability of failure associated with a marginal change in the explanatory variables from their pre-crisis mean values. The two target variables are the net stable funding ratio (NSFR), and equity to assets (Equity). The explanatory variables include a set of bank-level controls aimed at capturing bank risk profiles during the pre-crisis period: the average yearly credit growth, the distance to default (z-score), and the absolute value of non-interest income to total income. The explanatory variables also include two macro-level controls, which are common to all banks incorporated in a given country: the average GDP growth in the pre-crisis period, and the money market rates. All the explanatory variables are measured by the average of the respective series during the pre-crisis period (2001−07). Similar results were obtained by averaging the explanatory variables over 2004−07 to check for an apparent break associated with the introduction of International Financial Reporting Standards in 2005, and using their values as of end-2007. Starred coefficients indicate statistical significance at one percent (***); five percent (**), and ten percent (*).

Table 6. Estimates of the Marginal Impact on the Probabilities of Default

Variable	[1] Regression Coefficients	[2] Mean of Variable	[3] Change in Variable	[4] Change in Pr. Failure (Percentage points) 1/
NSFR	-0.043	0.986	0.104	-0.45
Equity Capital to Assets	-0.199	0.107	0.031	-0.63
Credit Growth	0.049	0.130	0.081	0.39
Z-Score	-0.047	0.469	0.230	-1.08
Non-Interest Income to Assets	-0.253	0.010	0.006	-0.16
GDP Growth 2001-07	4.048	0.026	0.005	2.16
Monetary Conditions 2001-07	-0.973	0.031	0.007	-0.67

1/ Associated with a 0.5 standard deviation change in the corresponding variable.

This table presents the estimated impact of a change in the pre-crisis values of the explanatory variables on the likelihood of subsequent bank failure. The coefficients presented in column [1] are taken from the last regression in Table 5. For each explanatory variable, the pre-crisis mean is presented in column [2], and a 0.5 standard deviation is displayed column [3]. The estimate defects, measured in percentage point changes in the probability of bank failure, are presented in column [4].

Table 7. Probit Regressions by Sub-Samples of Liquidity and Leverage

	[1]	[2]	[3]	[4]	[5]	[6]
	NSFR < 1	NSFR<1 and Equity below 7 Percent	NSFR<1 and Equity between 7 and 12 Percent	Average Equity below 7 Percent	Average Equity between 7 and 12 Percent	Average Equity above 12 Percent
NSFR	0.009	0.0704	-0.1091*	-0.0218	-0.0858***	-0.0018
	[0.036]	[0.046]	[0.057]	[0.018]	[0.025]	[0.023]
Equity	-0.3490***	-1.1667***	-0.5937*	-1.0045**	-0.6343**	-0.1475
	[0.112]	[0.447]	[0.353]	[0.404]	[0.262]	[0.105]
Credit Growth	0.1301***	0.0885	0.2897***	0.0881*	0.1902***	0.0180*
	[0.023]	[0.056]	[0.037]	[0.048]	[0.025]	[0.010]
Z-Score	-0.0543***	0.0017	-0.0544***	0.0029	-0.0542***	-0.0657***
	[0.017]	[0.012]	[0.020]	[0.009]	[0.016]	[0.018]
Non-Interest Income	-0.2159	-0.4481	0.1243	-0.3947	0.094	-0.5872
	[0.412]	[0.838]	[0.516]	[0.598]	[0.407]	[0.447]
GDP Growth 2001-07	4.0177***	4.7385***	2.9141***	4.5008***	3.1336***	3.5580***
	[0.479]	[0.679]	[0.959]	[0.585]	[0.755]	[0.715]
Monetary Conditions 2001-07	-0.8515**	2.1617***	-3.0919***	2.1699***	-3.2266***	-0.8456
	[0.378]	[0.800]	[1.002]	[0.809]	[0.960]	[0.542]
Observations	6,744	1,421	4,391	1,798	6,637	2,461
Pseudo R2	0.0478	0.146	0.0489	0.128	0.0424	0.0492

This table presents the results of bank-level probit regressions with robust standard errors [in brackets]. The dependent variable equals one for banks failing during the global financial crisis (2008−09) and zero otherwise. The regression coefficients have been transformed to convey the change in the probability of failure associated with a marginal change in the explanatory variables from their pre-crisis mean values. All the regressions conform to the same specification, applied to alternative sample partitions according to target levels of liquidity and capital. The regressions presented in leftmost three columns correspond to the subsample of banks with a pre-crisis NSFR below one and complementary intervals of EQUITY specified in the headings. The regressions presented in the rightmost three columns correspond to sample partitions by intervals of EQUITY. Starred coefficients indicate statistical significance at one percent (***); five percent (**), and ten percent (*).

Table 8. Probit Regressions by Bank Types

	[1]	[2]	[3]	[4]	[5]
	Global Banks	Domestic Banks	Domestic Commercial Banks	Domestic Savings Banks	Domestic Cooperatives
NSFR	-0.3565	-0.0370**	-0.0619***	0.0520**	-0.0322*
	[0.232]	[0.015]	[0.020]	[0.024]	[0.017]
Equity	-5.9592***	-0.1024	-0.0714	-0.4274***	-0.1476
	[2.236]	[0.065]	[0.081]	[0.142]	[0.135]
Credit Growth	1.6543***	0.0392***	0.0372***	0.0707**	0.0761**
	[0.447]	[0.012]	[0.013]	[0.034]	[0.034]
Z-Score	0.0261	-0.0545***	-0.0777***	-0.0454***	0.0064**
	[0.063]	[0.010]	[0.013]	[0.016]	[0.003]
Non-Interest Income	-2.8068	-0.3172	-0.403	-0.1616	1.8486***
	[3.066]	[0.309]	[0.370]	[0.455]	[0.585]
GDP Growth 2001-07	0.208	4.1505***	2.9101***	5.7008***	1.5062***
	[6.940]	[0.360]	[0.590]	[0.778]	[0.507]
Monetary Conditions 2001-07	-1.1448	-1.1965***	-0.7675*	-0.7383*	2.8008
	[1.512]	[0.449]	[0.440]	[0.383]	[2.688]
Observations	91	10,805	8,243	1,550	1,012
Pseudo R2	0.200	0.043	0.033	0.099	0.161

This table presents the results of bank-level probit regressions with robust standard errors [in brackets]. The dependent variable equals one for banks failing during the global financial crisis (2008−09) and zero otherwise. The regression coefficients have been transformed to convey the change in the probability of failure associated with a marginal change in the explanatory variables from their pre-crisis mean values. All the regressions conform to the same specification, applied to alternative sample partitions according to bank types. The regression in column [1] corresponds to the subsample of Global banks. The regression in column [2] corresponds to the subsample of Domestic banks. Those in columns [3] to [5] further split the subsample of Domestic banks by the types specified in the headings. Starred coefficients indicate statistical significance at one percent (***); five percent (**), and ten percent (*).

Table 9. Robustness Checks by Alternative Definitions of Liquidity and Capital

	[1] NSFR Equity	[2] NSFR CAR	[3] STFR Equity	[4] STFR CAR
Liquidity Measure	-0.0431***	-0.0409*	0.0449*	0.1523***
	[0.015]	[0.022]	[0.025]	[0.037]
Capital Measure	-0.1993***	-0.1453**	-0.2487***	-0.1840***
	[0.073]	[0.061]	[0.070]	[0.055]
Credit Growth	0.0487***	0.0501***	0.0495***	0.0486***
	[0.014]	[0.016]	[0.014]	[0.016]
Z-Score	-0.0477***	-0.0626***	-0.0495***	-0.0641***
	[0.011]	[0.015]	[0.011]	[0.014]
Non-Interest Income	-0.253	-0.1859	-0.3128	-0.4828
	[0.302]	[0.346]	[0.315]	[0.375]
GDP Growth 2001-07	4.0479***	3.6582***	4.1631***	3.9135***
	[0.366]	[0.567]	[0.374]	[0.582]
Monetary Conditions 2001-07	-0.9738***	-2.0121***	-1.0647***	-2.8030***
	[0.334]	[0.728]	[0.366]	[0.945]
Observations	10,896	9,441	10,896	9,441
Pseudo R2	0.0399	0.0352	0.039	0.0379

This table presents robustness checks for alternative measures of structural liquidity and capital. As for structural liquidity, we use the net stable funding ratio (NSFR) and the short-term funding ratio (STFR) as defined in the text. As for capital, we use shareholders equity to total assets (EQUITY) and the regulatory capital ratio (CAR). The corresponding combinations of these measures are indicated in the headings. The regression coefficients have been transformed to convey the change in the probability of failure associated with a marginal change in the explanatory variables from their pre-crisis mean values. Starred coefficients indicate statistical significance at one percent (***); five percent (**), and ten percent (*).

Table 10. Robustness Checks by Sub-Components of Bank Failure

	[1] Baseline	[2] Baseline ex-CAR	[3] Laeven-Valencia	[4] CAR
NSFR	-0.0431***	-0.0186	-0.0282***	-0.0313***
	[0.015]	[0.015]	[0.005]	[0.007]
Equity	-0.1993***	-0.1720**	-0.1465***	-0.0527*
	[0.073]	[0.072]	[0.035]	[0.029]
Credit Growth	0.0487***	0.0327***	0.0182***	0.0119***
	[0.014]	[0.011]	[0.004]	[0.004]
Z-Score	-0.0477***	-0.0348***	-0.0016	-0.0238***
	[0.011]	[0.011]	[0.003]	[0.004]
Non-Interest Income	-0.253	-0.3357	0.1739**	-0.0446
	[0.302]	[0.293]	[0.075]	[0.119]
GDP Growth 2001-07	4.0479***	3.9072***	0.2065*	0.7779***
	[0.366]	[0.360]	[0.107]	[0.114]
Monetary Conditions 2001-07	-0.9738***	-0.7906***	0.0261	-0.4991***
	[0.334]	[0.287]	[0.029]	[0.114]
Observations	10,896	9,713	10,896	10,896
Pseudo R2	0.0399	0.033	0.091	0.0814

This table presents robustness checks for alternative definitions of bank failure. The regression in column [1] is the baseline specification, which identifies a failing bank by combining four criteria: (i) a change in the Bankscope status from "active" to either: "under receivership", "bankruptcy", "dissolved", "dissolved by merger", or "in liquidation" at any point during 2008−09; (ii) a drop in regulatory CAR below the 8 percent threshold between 2008−09; (iii) a downgrade in Moody's bank financial strength ratings to E+ or E (in distress); (iv) a bank identified as failed in Laeven and Valencia (2010). The regression presented in column [2] excludes criterion (ii); the regression presented in column [3] corresponds to criterion (iv) only; and the regression in column [4] corresponds to criterion (ii) only. The regression coefficients have been transformed to convey the change in the probability of failure associated with a marginal change in the explanatory variables from their pre-crisis mean values. Starred coefficients indicate statistical significance at one percent (***); five percent (**), and ten percent (*).