# Net Stable Funding Ratio and Financial Stability: Global Evidence

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**Abstract:**

In this paper, we use an extensive global dataset comprising above 11.500 banks, in order to explore the explanatory power of the Net Stable Funding ratio (NSFR) in explaining future risk. We do so by looking at the effect of previous structural liquidity on future probability of default and distance to default. Our main finding is that the NSFR is a robust predictor of probability of failure and financial instability, competing with other important bank risk predictors in the literature. While non stable funding is a critical factor for policy actions by itself, its interaction with the currency appreciation is found to be significant. We detect heterogeneous patterns in the effects of bank-specific lending performance across the distribution of distance to default. Although NSFRs are lower in developing economies, the incidence of default was lower during the whole period, as the effect of NSFR on default is three times larger in developed economies.



*Keywords*: Bank liquidity; Net Stable Funding Ratio; Regulation; Financial Distress.
*JEL Classification*: G01; G15; G21; G28

## *1. Introduction*

It is broadly argued in the literature that the global financial crisis starting in 2007 was so severe due to massive illiquidity in the financial sector. Coordination failures among institutions and/or investors, fire - sale externalities, liquidity spirals, "predatory short-selling" and network externalities of all sorts were salient features of the crisis. (Brunnermeier et al. 2009). They affected *funding liquidity* at bank´s liability side, and *market liquidity*, which concerns their asset side (Brunnermeier and Pedersen 2009). Liquidity critically conditioned leverage. According to Gambacorta and Marques-Ibanez (2011), banks with lower core capital and greater dependence on market, non-deposit funding and sources of income greatly decreased loan supply during the crisis, lending support to the bank lending channel (Kashyap and Stein 2000). Still, the literature on liquidity regulation is still at an early stage, especially when compared to the abundant literature on capital regulation (Allen, 2014). Practice seems to go ahead of theory and empirical support is lacking.

As a regulatory response to that crisis, two global liquidity standards in Basel III accord for banks were introduced. Firstly, the Liquidity Coverage Ratio (LCR), which was designed to promote short term resilience of the liquidity risk profile of banks by ensuring they have sufficient high-quality liquid assets to survive a significant stress scenario lasting 30 calendar days. Secondly, the Net Stable Funding Ratio (NSFR) is proposed to promote over-a-year resilience of the liquidity risk profile of banks by limiting overreliance on unstable sources of funding, aiming to reduce the stability mismatch between assets and liabilities (Basel Committee on Banking Supervision 2013, 2014).

In this paper, we use an extensive global dataset in order to explore the explanatory power of Net Stable Funding ratios in explaining future risk. We do so by looking at the effect of previous structural liquidity on future probability of default and distance to default. We find our computed Net Stable Funding ratio to be a robust predictor of probability of failure and financial instability, competing with other important predictors in the literature such as leverage, credit growth, credit gaps and the overvaluation of foreign currency. We also assess the role of heterogeneity in the risk distribution, finding evidence

of heterogeneous patterns in the effects of bank-specific lending performance. In addition, we explore the robustness of results across countries' income groups and regulatory stances.

The rest of the paper is structured as follows. In section 2, we review the related literature and present our research hypotheses. Section 3 presents the methodological aspects of the empirical exercise. Data elaborations are presented in section 4. The empirical results are contained in section 5 and section 6 concludes.

## *2. Related Literature and Research Hypotheses*

Regarding theoretical contributions on structural liquidity, the recent Basel-style liquidity regulations have been analyzed by Diamond and Kashyap (2016) and Perotti and Suarez (2011). In Perotti and Suarez (2011), a liquidity market failure emerges when each individual bank takes into account its own exposure to refinancing risk, while not internalizing the system-wide effect of its decision. They analyze bank heterogeneity in two regards. When banks differ in credit opportunities, NSFRs do impose an upper limit on short-term debt but distribute liquidity risk inefficiently across banks. Banks with better credit opportunities will be constrained, while reduced systemic risk will encourage banks with low credit ability to expand. In this case, using Pigovian taxes is optimal. Short-term ratios, such as LCR, play a similar role of taxes when holding liquidity is costly. On the other hand, if banks differ in risk profiles, taxes will not be appropriated as the most gambling-inclined banks will also be the most willing to pay the tax and increase risky lending. In this scenario, quantity restrictions, such as the NSFR, are preferred. As heterogeneity across those dimensions is likely to exist and be time varying, the authors recommend, for preventive policy, to control liquidity risk by a combination of stable ratios and variable levies. As a matter of fact, this is the prevailing view of the Basel's proposals.

Diamond and Kashyap model bank's liquidity choices, under different informational assumptions. Within a Diamond and Dybvig (1983) framework, where banks provide liquidity insurance to depositors facing uncertain idiosyncratic withdrawal needs, banks additionally invest in liquid assets with a rate of return higher than the return from

liquidating illiquid assets. As a result, banks face a trade-off between lending expansion and liquidity. Secondly, the informational environment allows banks to have knowledge on the aggregated withdrawal needs of its depositors. On the other hand, some depositors receive imperfect signals on the ability of banks to honor its commitments, not completely knowing if banks have sufficient liquidity holdings to withstand a run. Thus, depositor´s belief formation becomes critical for stability. Under certain configurations of liquidity disclosure, bank's profitability and illiquidity of assets, banks would hold on a sufficient amount of liquidity by themselves to prevent a run. Under more informational fuzziness, however, this amount can be insufficient to guarantee stability, and banks could be forced to hold enough liquidity to withstand worst-case scenarios. The additional liquidity is costly, as curtailed lending and profits could make the bank unable to sustain future runs. This tension of objectives will be persistent, leading banks to constantly decide on the liquidity needed to prevent runs. As a result, their model produces "benchmark" regulations whose nature would differ across banks, so they do not mimic the ones from the Basel's accord. Comparing the latter with their regulation proposal, they proved that Basel-style regulations over liquidity produce better outcomes than the ones that arise from pure self-interest of banks. However, under certain circumstances, each brings potential inefficiencies. The main cost of LCR is that the bank is required to keep funds invested in liquid assets even if a run has already occurred, preventing loans to grow up in a context where it would be needed. On the other hand, the NSFR becomes inefficient in the case where the regulator has limited knowledge about the fundamental needs of depositors. In this case, the best the regulator can do is to always induce banks to be protected against a worst-case set of withdrawals, which would result in over-regulation.

As a corollary, while banks use liquidity as an imperfect signaling device to stability, the levels of informational asymmetry for both depositors and regulators, the depth of markets for illiquid assets and regulatory factors such as the supervisory power and banks accounting practices, are critical for the outcomes. We proposed that, as suggested by this model and controlling for these factors, actual NSFR are bound to affect the probability of failure, bank stability and bank ability of withstanding a run.

The stability and composition of bank's funding and its role in predicting financial instability have been studied by Shin and Shin (2010), Hahm, Shin and Shin (2012) and

Demirgüç-Kunt and Huizinga (2010). In Hahm, Shin and Shin (2013), a lending boom is reflected in the composition of bank liabilities in situations when traditional retail deposits (core liabilities) cannot keep pace with asset growth. Their model rising credit supply, where a large stock of noncore liabilities serves as an indicator of the erosion of risk premiums and financial instability. When credit is expanding rapidly, the bank will turn to other sources of funding to support its credit growth. This bank behavior, which fuels the credit boom, is financed through capital inflows via the external sector, creating a link between credit and currency crises. In this respect, the model is consistent with Kaminsky and Reinhart (1999) twin-crisis study. Based on Gourinchas and Obstfeld (2012), who finds a critical role for rapid increase in leverage and a sharp real currency appreciation, Kaminsky and Reinhart's empirical cross-country exercise finds evidence supporting the role of non-core funding as a critical predictor of financial crisis. They find measures of the noncore bank liability ratio to have significant predictive power for currency and credit crises. Also, most of the predictive power of the noncore liability ratio stems from the information contained in the banking sector's liabilities to the foreign sector.

Demirgüç-Kunt and Huizinga (2010) examine the implications of bank activity scope and short-term funding strategies for bank risk and returns using a global sample of 1,334 banks in 101 countries, leading up to the 2007 financial crisis. They find that non-deposit, wholesale funding, contributes to lessen the return on assets and increase banks' fragility.

An emerging consensus is that high levels of banking credit and leverage increase the probability of observing financial crises, as argued in Schularick and Taylor (2009) and Gourinchas and Obstfeld (2012). Schularick y Taylor (2009), use long historical data on the evolution of monetary and credit aggregates as predictors of financial crises. They use data for 14 developed countries between 1870 and 2008, identifying structural breaks in the data around WW2. In fact, their main result relates to the post-WW2 period, when credit growth and increased leverage are found to be robust predictors of financial instability, in particular, when compared to growth liquidity. Evidence in Gourinchas and Obstfeld (2012) equally points out to the role of real currency appreciation. Jordà, Schularick and Taylor (2013) extend the analysis to private credit overhangs. Past credit accumulation is found to impact not only output but also other key macroeconomic variables, lending support to the view of a relevant role of financial factors in the cycle.

Jordà, Schularick and Taylor (2016) underline the role of increasing mortgage financing over the course of the 20th century. Using historic data for 17 advance economies, they identify rising household debt to assets ratios as a key financial instability driver.

Regarding NSFRs as a crisis predictor, Vázquez and Federico (2012) analyze empirically whether the type of financing structure of banks in the run up to the financial crisis (2001-2007) has an influence on the probability of bank failure in the US and Europe in the two subsequent years period. In particular, they test if two of the indicators included in the regulatory response arising from the crisis (Basel III), such as the NSFR and the leverage ratio, contribute to a lower probability of bank failures. They find that banks with low structural liquidity ratios and high leverage ratios prior to the crisis were more vulnerable, controlling for risk decisions. Although this effect is not so large on average, when separating banks by size and capital buffer levels, they find that the magnitude is greater in the lower strata of their distributions (threshold effects). The benefits of high buffers are substantial in the case of banks that on average have buffers of less than 7%. While global banks are more susceptible to fail due to excessive leverage, the vulnerability of domestic banks is generated mostly by a weak structural liquidity. Moreover, they find that countries´ macroeconomic environment variables influence the likelihood of bankruptcy.

In summary, banks use liquidity as a signaling device with regard to stability, while conditioned by the levels of informational asymmetry for depositors and regulators. The liquidity of markets and regulatory factors such as the supervisory power and banks accounting practices are critical for the outcomes. Also, the informational content of bank liquidity should be dependent on bank heterogeneity with regard to lending ability and risk profiles. Furthermore, bank liquidity is closely interlinked with leverage manifestation, being as such, both predictors of financial distress. In this paper, we use different measures of banks credit growth, both at aggregated and bank-level, in order to compare their predictive ability with that of structural liquidity. We also look at currency appreciation, another important variable in the literature, and its interaction with.

*Research hypotheses*

Our literature review gives us elements to guide our empirical work. We next enumerate these insights in the form of research hypotheses:

1. Structural liquidity is a significant predictor of financial distress. The greater the magnitude and significance of NSFRs, the lower the risk.
2. NSFRs are significant and relevant predictors of risk, when compared to other different measures of leverage and credit growth, at bank and country levels.
3. Exchange rate appreciation, the external sector and its interaction with liquidity are significant predictors of future financial distress.
4. Banking sector characteristics such as the size distribution, foreign and government ownership are significant controls in the relationship between liquidity and risk.
5. We also explore differential patterns of these effects in developed and developing banking systems, so as the role of bank heterogeneity.

## *3. Methodology*

*Notational remarks*

Here we introduce the notation used in the document. Both vectors and matrices are denoted with capital letters. In particular, $X_i^t$ would be a bank-level variable, where subscript $i = 1, \dots, N$ represents a bank observation and $t = 0,1$ the time in which the variable was calculated, i.e., t=0 if the variable was defined prior to the crisis (average of 2001-2007), and $t = 1$ if it was defined after the crisis (average of 2008-2013 for Z-scores and average 2008-2015 for probability of default). The other sets of country economic and regulatory variables have a country sub-index $g = 1, \dots, G$.

### *3.1 Logit model, average marginal effects*

To estimate the relationship between NSFR and other potential determinants of vulnerability at $t = 0$, and the subsequent probability of failure at $t = 1$ , measured by a binary variable that accounts for banks that failed during or after the crisis, we compute a logit model. In particular, our empirical specification is as follows:

$$P\left(STATCH_i^1 = 1 \middle| X_i^0, W_g^0\right) = \frac{\exp(\delta_0 + X_i^{0\prime}\beta + W_g^{0\prime}\alpha)}{\left[1 + \exp(\delta_0 + X_i^{0\prime}\beta + W_g^{0\prime}\alpha)\right]}$$

Where STATCH is a dummy variable that takes the value of one if bank *i* failed during or after the crisis (i.e., between 2008-2015) and zero otherwise, and $X_i^0$ is a vector that contains, computed as averages over 2001-2007: i) the target variable NSFR computed as a proxy of Basel-style regulation; ii) a set of bank-level controls to account for heterogeneity in bank risk profiles during the previous period, such as the natural logarithm of total assets as a measure of bank's size, the credit growth deviation with respect to the national credit growth, and the leverage ratio; iii) a set of country-specific controls $W_g^0$ that contains variables aimed to capture environmental effects from macroeconomic, financial, and regulatory conditions[1], such as the growth of credit to the private sector as a percentage of GDP, the currency appreciation, measured by the annual change of exchange rate, a measure of overall restrictions of banking activities, the ratio of total assets held by state-owned banks, the ratio of total assets held by foreign-owned banks, the ratio of money to GDP. Finally, we add an interaction between NSFR and the currency appreciation indicator to account for the hypothesis on the effect of external capital inflows on the non-core funding (Hahm, Shin and Shin, 2013). By including that term, we can evaluate whether variations on the nominal exchange rate strengthen the effect of the NSFR over financial stability. See Table C in the Appendix for a detailed description of the variables. Notice that, by design, our empirical experiment guarantees independent variable´s exogeneity, as average past values of $X_i^0$ and $W_g^0$ are used as predictors of future financial performance $STATCH_i^1$. Also, we know the status of banks as of June 2015, but our dataset does not register the exact moment each bank ceases to be active during the interval 2008-2015, which prevent us to implement duration-type econometric analysis.

In the logit model outcomes, we will present the average marginal effects of *X* conditional on the values of the determinants of $P\left(StatCh_i^1 = 1 \middle| X_i^0, W_g^0\right)$, which are useful

[1] Diamond and Kashyap (2016) argue that other regulatory conditions that induce banks to disclose information about deposits risk, combined with a proper regulation on structural liquidity, could improve the outcome over financial stability.

to simplify the coefficients' interpretation due to the continuous nature of most of the explanatory variables included in the regression.

*3.2 The robust OLS regression model for distance to default*

We also evaluate the impact of pre-crisis average values of NSFR and the rest of controls in $t = 0$ over the post-crisis Z-score, $t = 1$. The conditional mean function of Z-score given the bank-level $X_i^0$ and country and regulatory variables $W_g^0$ is:

$$E\left(Z - score_i^1 \middle| X_i^0, W_g^0\right) = \delta_0 + X_i^{0\prime}\beta + W_g^{0\prime}\alpha$$

Some characteristics of our bank-level database could suggest the presence of potential heteroskedasticity and error-serial correlation that arises from having clustered or grouped errors within countries. To account for this possibility, Cameron and Trivedi (2009) suggest estimating cluster-robust standard errors when using state-level regressors (such as country level controls in our case) that do not vary within the state, due to the possibility of having intra-state correlation, even in a slight level, when any state has many individuals. In our model, we estimate a cluster robust matrix of covariances to capture possible correlation among banks in the same country. In the next subsection we will prove the robustness of this approach through a quantile regression to assess the heterogeneity of our banks sample, and a statistical test on the necessity of introducing clusters.

*3.3 Quantile estimations for Z-scores: heterogeneity and intra-cluster correlation*

In order to test the heterogeneity in bank risk profiles and lending ability (Perotti and Suarez, 2011), we estimate quantile regressions of Z-scores. Similarly to section 5.2, we estimate the effect of NSFR and other control variables in $t = 0$ on Z-score in $t = 1$. Given that the Z-score is a continuous variable, we estimate quantiles of Z-score in $t = 1$ conditional on set of bank-level variables ($X_i^0$) and country-specific variables ($W_g^0$) in $t = 0$ as follows:

$$Quantile_\tau\left(Z - score_i^1 \middle| X_i^0, W_g^0\right) = \delta_0(\tau) + X_i^{0\prime}\beta(\tau) + W_g^{0\prime}\alpha(\tau)$$

We use $\tau = 0.25, 0.50, 0.75$ , which represent the first, second and third quartile of the distributition of Z-score, respectively. We also use the least-absolute-deviations (LAD) estimator with robust intra-cluster correction proposed by Parente and Santos Silva (2016). As we discussed earlier, some characteristics of our cross-sectional database could suggest the possible correlation of banks within countries. Parente and Santos Silva also developed a specification test to check for intra-cluster correlation, and we used under our specifications in Table 3. Overall, the test rejects the null hypothesis of not having intra-cluster correlation among our specifications (Table 16).

*3.4 AUC, ROC analysis*

Similarly to Schularick and Taylor (2009), we evaluate the predictive power of our specifications by using a tool of binary classification ability known as ROC curve (Receiver Operating Characteristic). An empirical ROC curve displays the discriminatory ability of a marker or test curve. Suppose that D=0 denotes controls and D=1 denotes cases of failure given by STATCH, and assume that Y is a model that aims to explain the probability of a bank to take D=1. Then, the ROC curve for a marker Y is a plot of the true positive rate TP(c) = P(Y ≥ c | D = 1) against a false positive rate FP(c) = P(Y ≥ c | D = 0) for the threshold criterion Y ≥ c on the real line. Therefore, the binary classifier is:

$$I(\hat{Y} - c > 0)$$

Where $I(\cdot)$ is an indicator function and $\hat{Y}$ is the linear prediction of the model which form a continuous signal. An informative marker has a ROC curve that rises sharply over the 45° line (which marks an uninformative marker similar to a "coin toss").

The predictive ability of our different specifications is compared by calculating their individual areas under the ROC curve (henceforth AUROC). In this sense, if the marker has an AUROC equal to 0.5 then the model has no predictive ability at all, whereas if the marker has an AUROC that tends to 1 the model could be very aggressive in making calls[2].

[2] Schularick and Taylor (2009) argue that an AUROC about of 0.7 is considered a good threshold in medical researching, for example.

Therefore, a model that has an AUROC higher than 0.5 and reasonably lower than 1 has predictive power with respect of its dependent variable.

## *4. Data and Empirical Results*

### *4.1 Data*

Our initial database consisted of an unbalanced annual bank-level panel with a set of country-level regulatory indicators and macroeconomic variables (see Tables 1-2). So we performed some calculations to get our final database. Firstly, we calculated averages of the NSFR, and other potential determinants of vulnerability prior to the crisis (2001-07). Second, we measured two indicators of bank's vulnerability— average Z-score and change in bank's status—for a span of time after the crisis (2008-13 and 2008-15, respectively). After merging these data sets, we have cross-section data base with 106 countries and 11,536 banks. A complete description of variables and sources for these and other control variables used in the regression exercise is presented in Table C in the Appendix.

*Net Stable Funding Ratio (NSFR):*

Our main explanatory variable of interest is the regulatory standard on structural liquidity implemented since Basel III: the Net Stable Funding Ratio. This is a regulatory indicator aimed to prevent banks for having an overreliance on unstable funding. The NSFR reflects the proportion of stable or long-term illiquid assets funded with liabilities that are considered to be stable (e.g. core deposits). For bank $i$, we can express the NSFR as the ratio between the sum of assets ($A_j$) and liabilities ($L_i$), weighted by their specific stability, as follows:

$$NSFR_i^0 = \frac{ASF_i^0}{RSF_i^0} = \frac{\sum_l w_l L_i^0}{\sum_j w_j A_i^0}$$

Where $ASF_i^0$ indicates the available structural funding and $RSF_i^0$ represents the required structural funding related to illiquid assets, whereas $w_l$ and $w_j$ are weights that reflect the

relative stability of the liabilities and assets in bank's balance sheet, respectively. The weights are bounded between zero and one, though do not add up to one. In the case of assets, larger weights belong to less illiquid accounts, whereas regarding to liabilities, larger weights are assigned to more stable sources of funding. Banks are required to maintain a NSFR equal or higher than one, where value one reflects a perfect match between required an available stable funding.

Despite of having a lack of granularity of bank assets and liabilities required to replicate Basel's NSFR exactly, due to some detailed accounts are not publicly available, we can approximate the ratio accurately using the Bankscope dataset. Figure 1 shows our alternative approximations of *ASF* and *RSF*, at different data-aggregation levels.

**<Insert here Figure 1>**

These different definitions for ASF and RSF allow us to compute several alternative versions of NSFR:

- NSFR = $\frac{ASF}{RSF}$ ; which uses relatively more disaggregated data and is the closest approximation to the Basel-style NSFR. However, NSFR is available for 1,053 out of 11,536 banks that represent only the 9.1% of the whole sample. Alternatively,
- NSFR1 = $\frac{ASF}{RSF1}$ ; calculated for 8,301 banks (72% of the whole sample).
- NSFR2 = $\frac{ASF}{RSF2}$ ; calculated for 10,713 banks. (92.9% of the whole sample)
- NSFR3 = $\frac{ASF1}{RSF2}$ ; NSFR3 is the measure that uses the most aggregated items in the balance, as it allows calculating the ratio for our entire sample of 11,536 banks. By looking at the distribution of NSFR and NSFR3, it is clear that both have similar means. Actually, the volatility of NSFR3 (measured by its variance) is lower than the volatility of NSFR. Thus, we use NSFR3 as it represents the best combination of data generation and the highest fidelity to the Basel proposed measure[3] (See Figure 2). Notice that, according to our measure, the average global bank in our sample does approximately match required

[3] Henceforth, we refer to NSFR3 as NSFR in the regression tables.

and available funding, as the mean of NSFR is close to one. The same is true for developed economies. For developing economies, however, average NSFRs are substantially lower, reaching a value of 0.76 (see Table 2)[4].

**<Insert here Figure 6>**

*Growth loans to GDP:*

It is the gap to GDP growth of real growth of domestic credit to the private sector at a country-level. It is averaged over 2001-2007. In particular, after the crisis there are seminal contribution regarding the role of banking credit, credit booms, and the probability of observing financial crises (Schularick and Taylor, 2009; Gourinchas and Obstfeld, 2012). Growth loan to GDP was on average 3.8% (10.94% for developing and 3.04% for developed economies).

*Leverage:*

It is the ratio of total assets to equity, at bank level, averaged over 2001-2007. Basel III and empirical evidence (Gourinchas and Obstfeld, 2012; Vázquez and Federico, 2012) supports the claim that an increase leverage ratio contributes to a higher probability of bank failures. According to Table 2, on average, global banks have a leverage ratio of 11.78 (8.738 for developing and 17.95 for developed economies).

*Growth Loan Deviation:*

For each country and year, we calculated the average growth rate for the sample of banks. For each bank and year, we calculate the growth rate of loans[5]. Growth Loan Deviation is defined as the ratio of latter to the former, averaged over 2001-2007. It is intended to measure the loan growth gap of individual banks with respect to country loan

4 We separate the data also in four groups: OECD non-emerging, OHI (other high income, non-OECD), emerging and other developing, following recent classification in Claessens, Stijn and Neeltje van Horen, 2015.

5 Measured as the deviation of bank's individual yearly growth rate of loans over the country average growth rate of loans. In those observations where yearly data of loans were unavailable, we estimated the annual rate using geometric interpolation between the two closest years, prior and after those periods. Additionally, outliers were removed by taking values from the 5th percentile to the 95th percentile.

growth. This variable, alternatively, is an indicator of lending aggressiveness. Banks with positive value were increasing their loan market shares during the initial period.

*Dependent variables:*

*Status change (STATCH): Default indicator*

We define a dummy variable equal to 1 if a bank was active at the end of 2006 and "failed" in 2015. A bank is considered to have failed between end- 2006 and June 2015 if a bank had a positive NSFR at the end of 2006 and holds any of the following status as of June 2015: "Bankruptcy", "Dissolved", "Dissolved (merger)", "In liquidation", or "Inactive (no precision)"; and 0 otherwise, according to Bankscope status definitions. Additionally, we tested alternative specifications of status change (Table A, Appendix). In line with previous literature, we used STATCH1 as our dependent variable.[6] For our dependent variable, out of 11,536 reporting banks that were strictly active in 2006, 2,944 ceased to be so as of June 2015 (25.52%). The main reason for these status changes were banks becoming dissolved due to mergers (2,088 banks or 18.1% of the total number of initial banks) and banks becoming dissolved and under receivership (5.85%). The corresponding percentages of status-changing banks are 22.10% for developing and 25.90% for developed economies.

*Time-varying Z-score (ZSCORE):*

Our second dependent variable refers to the individual bank's distance to default, and it is regularly approximated in the literature by using the Z-score (e.g. Laeven and Levine, 2009; Demirgüç-Kunt and Huizinga, 2010; Vázquez and Federico, 2012) which is an indicator that reflects the levels of individual bank's risk taking. It represents the number of standard deviations that bank return on average assets (ROAA) has to drop to wipe out all equity of the bank. It is formally expressed as follows:

$$Z_i^1 = Ln\left[1 + \frac{ROA_{it}^1 + EA_{it}^1}{\sigma(ROA_{it}^1)}\right]$$

[6] Overall, the reminder specifications for this dependent variable yield robust results in our empirical exercise. Robustness results available upon request from the authors.

Where: $ROA_t^1$ : Return on total assets; $EA_t^1$ : Equity over total assets; $\sigma(ROA_t^1)$ : Standard deviation of *ROA* from 2008 to 2013. Logarithms are used to smooth the bias of the indicator, because it is usually considered to be highly skewed (Beck et al, 2013), and 1 is added to avoid the truncation to 0. Figure 6 shows the distribution of our transformed Z-scores in our sample, with a mean value of 3.69.

## 5. Empirical results

*Future probability of default determinants:*

Table 3 shows the average marginal effects results from logit regressions over status change. In all of our four specifications, NSFRs are included besides alternative predictors of financial failure. NSFR shows robust and significant effects for explaining status change. The larger the NSFR the lower the probability of changing status. Notice that, as we are implementing logistic regressions with country clustering, the results are also indicative of systemic-risk effects. Also, there is evidence that larger size reduces the probability of changing status, possible indicating a *too big to fail* effect. The change in the exchange rate is negatively related to this probability. Thus, currency appreciation is a clear predictor of future financial failure, as found in previous literature. Regarding controls, the probability of changing status is lower in countries where the proportion of government and foreign owned bank assets is larger, and the regulatory restrictions on the scope of banks activities are lower. Also, the probability is lower in countries with greater financial depth.

**<Insert here Table 3>**

With regard to alternative leverage risk-predictors, a higher deviation from average growth loan significantly increases the likelihood of failure, whereas the leverage, another bank-level indicator, is non-significant. Growth loans to GDP, a country credit indicator, is also non-significant. NSFR* FX change interact structural liquidity with exchange rate movements. It is significant and negative, indicating that when local currency appreciates,

the probability of future status change is larger for less liquid banks. This effect may lend support to evidence presented in Hahm, Shin and Shin (2013), regarding the role of external funding of credit booms. The magnitude of this effect is substantially lower to the total NSFR effect, indicating that the latest has an independent larger effect on the probability of future status change.

Due to the relative importance of US banks in our sample, we ran the same set of regressions excluding US banks. This sensitivity results are shown in Table 4. Whereas in our previous overall sample results we have up to 10,958 banks, excluding the US yields 2,494 banks. For non-US banks, the results regarding the significance of NSFR remain unmodified. The same result holds for the exchange rate variable. Regarding controls, however, all the regulatory variables lose their significance. Financial depth remains significant and negatively associated with future bank status change. Remarkably, for the non-US sample, our bank-specific leverage variables become significant at 10% level of significance and with the expected sign. However, while leverage is associated positively with the probability of future status change, growth loan deviation has a negative sign. A possible explanation is that this variable is indicating greater lender ability, heterogeneity of which could be a relevant for future survival. As previously, the interaction of NSFR and foreign currency variation is significantly negative.

**<Insert here Table 4>**

**<Insert here Table 5>**

Further we check for status change determinants by including a dummy that accounts for developing economies in our baseline global regressions. The results are displayed in Table 5, which are similar to those in Table 3 for the general sample. Also, the dummy variable for developing economies is negative and significant, indicative of a lower probability of status change for banks belonging to this set of countries.

*AUC analysis*

In Table 6, we regress a set of three specifications that reproduce the first three equations in Table 3, but excluding our NSFR indicator. We then compared the area under

the curve for each corresponding equations to evaluate the marginal predictive power of equations that include NSFR, over those that exclude it. The results are shown in Figures 3,4 and 5, which correspond, each, with a different credit variable.

**<Insert here Table 6>**

**<Insert here Figures 3, 4 and 5 >**

For all three pairs of equations, the area under the curve (AUROC) for regression specifications that include NSFR is significantly larger than the area for those specifications excluding it, indicating additional predictive ability of NSFR for future status change. Figure 3 depicts a comparison between ROC curves for model 1 on Table 3 (which has NSFR and Growth Loan Deviation as regressors, among others) and for model 1 on Table 6 (which has the same regressors, including Growth Loan Deviation, but excluding NSFR). We can observe that the model with NSFR as a regressor has a larger AUROC than the model without it, which is confirmed through the chi-square test of equality of the AUROCs. We reached the same conclusion when comparing with models that has "Growth Loan to GDP" and "Leverage" (model 2 on Table 3 against model 2 on Table 6, and model 3 on Table 3 against model 3 on Table 6, respectively). This shows that the Basel's NSFR is not only the most meaningful and significant regressor to explain the likelihood of a bank's status change after the crisis, but it has also valuable predictive ability to forecast financial distress (see Figures 3 - 5).

*Z-scores determinants:*

We now turn to our regression results regarding bank Z-scores in the period 2008-2013. Notice that, although similar in their general specifications, this set of results differs critically form the ones referred to the probability of status change. Whereas the first set of results presented thus far refers to determinants of bank´s future *survival* (status change over the window 2008-2015), the results for Z-score refers to determinants of financial instability of firms mostly *surviving* over at least some years of our second period. Table 7 shows regressions results for the baseline specifications. According to these results, previous NSFRs relate positively and significantly with future distance to default. As

before, the result is robust to all specifications presented in our empirical exercise. The variable change in the exchange rate in the previous period is significant and negatively correlated with future distance to default. Thus, for countries that experienced nominal currency appreciation during the first period, distance to default was increased for their banks in the sub-sequent period. The result is in contrast with the results for status change in our previous section. One possible explanation is this variable affects financial stability in a more contemporaneous ways. Thus, countries that experienced currency appreciations during the first period rapidly depreciated their currency after 2008, with improving effect on financial stability of *surviving* banks. The effect also prevails when FX change is interacted with NSFR, even as the total sign of NSFR is positive on stability. Remarkably, for this set of results, the country variable growth of loans to GDP is negative and significant, in line with results by Schularick and Taylor (2009), Gourinchas and Obstfeld (2012), and Jordà, Schularick and Taylor (2013). However, growth loan deviation, in this case, is non-significant. The variables size and foreign-bank assets are now non-significant. On the other hand, fewer restrictions in bank activities enhance future financial stability.

**<Insert here Table 7>**

**<Insert here Table 8>**

**<Insert here Table 9>**

As before, we re-ran the set of regressions in Table 7 without US banks. The results are shown in Table 8. Results remain unchanged with respect to NSFR and the remaining variables. As noticed before, these sets of regressions are estimated assuming intra-country correlation, thus indicating potential systemic effects. In Table 9, we also include a dummy variable for developing economies. In this case, no difference is detected with regard to future stability for this set of countries. In both tables, the country-level variable growth of loans to GDP remains negative and significant.

*Future probability of status change determinants by country income group*

In Tables 10-11, we return to our regression results for status change, by separating the global sample in two sub-samples: developed and developing economies. We separate the

data also in four groups: OECD non-emerging, OHI (other high income, non-OECD), emerging and other developing, following recent classification in Claessens, Stijn and Neeltje van Horen (2015). We refer to the first and second groups as "developed" and "developing", respectively.

Our regression results indicate that the effects of variables are similar in both groups. For both income regions, previous NSFR remains a robust determinant of probability of future status change. Notably, however, the magnitude of the effect of previous NSFRs on future status change is around three times larger in developed than in developing economies, despite the fact that NSFRs tend to be lower in the latter. Also, the effect of foreign currency variation is robust and significantly negative only for developing countries, which is consistent again with Hahm, Shin and Shin (2013) results, as developing economies are relatively more subject to sudden capital flow movements. The beneficial effect of financial deepening on future survival is significant only for developed economies, indicating a possible threshold effect[7]. Notice also, a dual effect of growth loan deviation in both regions. For developed economies, larger growth deviation increases the probability of financial failure. The opposite is verified for developing economies, where the probability is reduced with larger deviations.

**<Insert here Table 10>**

**<Insert here Table 11>**

*Z-scores: Heterogeneity*

As suggested by the work of Perotti and Suarez (2011), heterogeneity in bank risk profiles and lending ability is a key element mediating the relationship between liquidity regulation and market efficiency. Building on this idea, we now turn to our Z-score regressions in order to assess bank heterogeneity effects with regard to risk and lending

[7] We also ran the exercise for developed economies excluding the US. Again, results with regard to NSFR remain unchanged. We also decomposed the effect of the numerator and denominator of NSFR, with generally non-robust results. Thus, it is the combination ratio that consistently and robustly predicts financial stress. Finally, we checked for the effect of different items of the liability side. Remarkably and consistent with Hahm, Shin and Shin (2013), the ratio of "other deposits and short-term funding" to total liabilities, which include wholesale deposits, is positively and robustly correlated to the probability of default. Results are available upon request from the authors.

ability. Tables 12-14 show Z-score quantile regression results for the three first specifications in Table 7. The three first quartiles estimates are shown in conjunction with the average effects, already shown in Table 7. Besides including NSFR coefficients in each table, the variables growth loan deviation, growth loans to GDP and leverage, are respectively included.

With respect to NSFR, the average effect in the three tables is positive and significant. The same is true for three quartiles in all three specifications in Tables 12-14. An upward trend can be detected in the results, meaning that the sensitivity of future Z-scores to previous NSFRs is larger for the highest values of Z-score, that is, those representing a larger distance to default.

With respect to "growth loan deviation", its average effect is non-significant, while, like NSFR, the variable "growth loans to GDP" has a detrimental effect on future distance to default across various points of the distribution (Table 13), whereas leverage is non-significant for the whole distribution of Z-scores (Table 14). The heterogeneity trends described are also noticed when we examine the whole distribution of Z-scores, as shown in Figure 7, where the results of estimating quantile regressions for each decile, with 95% confidence intervals, are represented.

**<Insert here Tables 12-15>**

**<Insert here Figure 6>**

As indicated above, we used the Parente and Santos Silva (2016) test for intra-cluster correlation. Table 15 shows results for this specification test for the four equations of Table 7. Test results indicated the presence of intra-country correlation for the three quartiles. This result justifies the use of country-clustering in the specification of errors in all the regression results of the paper. It also provides strong evidence of systemic risk effect underlying in the data. Table 15 also shows test results for developed and developing countries. In both cases, country-clustering correlation is present. Notice the magnitude of the test statistics, however, seems to indicate stronger correlation for developed economies,

which in turn may explain why liquidity and leverage variables turned out to have a larger effect in this region.

## *6. Conclusions*

Our main finding is that the NSFR is a robust predictor of probability of bank's status change and financial instability, competing with other important predictors in the literature (leverage, credit growth, credit gaps and overvaluation of the currency). It has additional predictive ability over credit measures as indicated by our AUROC analysis. We also find evidence of the type of the effects emphasized by Hahm, Shin and Shin (2013): exchange rate overvaluation, when combined with low stable funding carries about larger probability of failure.

Regulation restricting the scope of bank activities increases the probability of failure and financial instability. Also, financial instability and probability of failure is lower for financial banking systems with a larger share of foreign and government banks, and higher financial depth. Moreover, both financial instability and probability of failure prove to be marginally lower in developing countries. Although, NSFRs are lower in developing economies, the incidence of default is lower during the whole period. Also, the effect of NSFR on default is three times larger in developed economies.

Our empirical evidence provides strong support for Basel regulation on structural liquidity (NSFR). While non stable funding is a critical factor for policy actions by itself, its interaction with the external sector of the economy should be paid close attention. However, other potential sources of non-stable funding, both domestic and external, from other formal markets and institutions or from the shadow banking, should be also the object of regulation. Other relevant issue is the implicit or explicit public guarantees. Finally, regulators should be aware of potential heterogeneous patterns that could be observed in the effects of bank-specific lending performance.

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# Tables

Table 1: Descriptive statistics by sub-regions and countries

| | NSFR | Size | CHG_FX | GOB | M2toGDP | ORBA | FOB | GLOANDEV | GLOAN_GDP | LEV | N. Bank |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Total*** | **0.97** | **12.08** | **-0.45** | **6.36** | **82.26** | **7.63** | **13.94** | **0.67** | **3.83** | **11.79** | **11536** |
| ***Developed*** | **1.00** | **12.09** | **-0.60** | **2.95** | **86.18** | **7.68** | **13.72** | **0.73** | **3.05** | **12.12** | **10398** |
| Andorra | 0.84 | 15.28 | . | . | . | . | . | 2.78 | . | 7.67 | 1 |
| Australia | 0.78 | 17.46 | -4.72 | 0.00 | 77.94 | 8.57 | 16.23 | 1.51 | 4.68 | 19.71 | 10 |
| Austria | 0.72 | 13.17 | -5.29 | 0.04 | 161.19 | 5.00 | 19.40 | 0.50 | 1.63 | 15.86 | 118 |
| Bahamas, The | 1.00 | 13.99 | 0.00 | . | 59.59 | . | . | 4.22 | 3.98 | 2.16 | 1 |
| Belgium | 0.83 | 18.03 | -5.29 | 0.00 | 122.56 | 6.14 | 21.00 | 0.46 | 2.30 | 31.31 | 3 |
| Belize | 0.73 | 12.81 | 0.00 | 0.00 | 58.58 | 10.43 | 74.05 | 0.63 | 5.74 | 6.44 | 1 |
| Cameroon | 0.85 | 11.91 | -5.29 | 0.00 | 16.26 | 7.29 | 0.00 | 0.54 | 2.47 | 8.86 | 2 |
| Canada | 0.85 | 16.90 | -4.40 | 0.00 | 144.59 | 5.43 | 5.83 | 0.88 | 8.63 | 20.22 | 18 |
| Cyprus | 0.70 | 16.01 | -5.09 | 3.69 | 180.66 | 8.00 | 23.11 | 0.98 | 2.51 | 31.93 | 2 |
| Denmark | 0.84 | 17.10 | -5.28 | 0.00 | 64.92 | 7.00 | 9.00 | 0.63 | 5.95 | 18.78 | 3 |
| Finland | 0.68 | 17.68 | -5.29 | 0.00 | 79.75 | 6.43 | 28.06 | 4.61 | 6.23 | 13.31 | 2 |
| France | 0.67 | 15.81 | -5.29 | 0.30 | 115.48 | 5.29 | 15.50 | 0.28 | 3.17 | 17.95 | 65 |
| Georgia | 0.89 | 11.43 | -2.22 | . | 16.13 | . | . | 1.06 | 20.05 | 5.23 | 1 |
| Germany | 0.86 | 13.31 | -5.29 | 41.25 | 177.25 | 5.00 | 5.26 | 1.28 | -1.80 | 19.71 | 679 |
| Greece | 0.84 | 16.87 | -5.11 | 22.80 | 90.62 | 7.14 | 10.80 | 4.21 | 10.47 | 17.24 | 5 |
| Hong Kong SAR, China | 0.88 | 17.02 | 0.02 | 0.00 | 256.79 | 3.57 | . | 0.16 | -1.34 | 13.23 | 11 |
| Iceland | 0.89 | 13.02 | -2.05 | 0.00 | 66.85 | 7.43 | 0.00 | 0.53 | 16.91 | 8.69 | 4 |
| Iran, Islamic Rep. | 0.66 | 16.45 | 7.28 | . | 38.23 | . | . | -0.01 | 9.97 | 15.53 | 2 |
| Ireland | 0.74 | 18.22 | -5.29 | . | 171.83 | 5.00 | . | 2.51 | 9.58 | 58.79 | 2 |
| Israel | 0.93 | 16.26 | 0.28 | 46.10 | 94.77 | 9.57 | 1.20 | 0.75 | 3.57 | 18.93 | 9 |
| Japan | 0.98 | 15.48 | 1.48 | 0.00 | 204.53 | 8.00 | 6.44 | 0.64 | -2.49 | 29.87 | 282 |
| Kuwait | 0.82 | 15.88 | -1.08 | 0.00 | 68.08 | 6.29 | . | 0.93 | 6.58 | 8.83 | 3 |
| Libya | 0.71 | 13.29 | . | . | 35.49 | . | . | 0.79 | -16.91 | 17.59 | 1 |
| Luxembourg | 0.63 | 18.31 | -5.29 | 5.08 | 636.82 | 4.71 | 94.60 | 0.71 | 11.45 | 28.26 | 1 |
| Micronesia, Fed. Sts. | 1.15 | 11.25 | . | . | 40.47 | . | . | 1.28 | -4.10 | 6.09 | 1 |
| Mongolia | 0.78 | 11.22 | 1.22 | . | 36.08 | . | . | 0.98 | 30.57 | 13.89 | 2 |
| Netherlands | 0.75 | 16.54 | -5.29 | 4.16 | 169.00 | 5.00 | 5.07 | 0.84 | 5.12 | 19.68 | 9 |
| New Zealand | 0.79 | 17.11 | -6.12 | 0.66 | 80.46 | 3.43 | 98.63 | 0.45 | 3.36 | 58.33 | 6 |
| Norway | 0.90 | 13.82 | -5.52 | 0.00 | 54.14 | 6.29 | 20.83 | 0.35 | 4.71 | 13.24 | 10 |
| Portugal | 0.73 | 16.26 | -5.29 | 23.74 | 113.88 | 7.86 | 16.97 | -0.19 | 3.32 | 14.61 | 8 |
| Singapore | 0.67 | 18.37 | -1.86 | 0.00 | 110.03 | 6.43 | 50.00 | 5.35 | -1.17 | 10.69 | 2 |
| Slovenia | 0.96 | 14.34 | -3.14 | 14.77 | 54.70 | 8.00 | 20.09 | 0.54 | 12.16 | 11.75 | 3 |
| Spain | 0.84 | 16.64 | -5.29 | 0.00 | 130.52 | 5.00 | 9.23 | 1.26 | 9.88 | 15.51 | 65 |
| Sweden | 0.85 | 17.38 | -3.86 | 0.00 | 72.08 | 7.43 | 0.00 | **0.05** | 21.79 | 18.83 | 2 |
| Switzerland | 0.80 | 12.54 | -4.63 | 13.02 | 137.17 | 5.43 | 9.82 | 1.37 | 1.17 | 38.58 | 299 |
| Taiwan | 0.87 | 16.45 | 0.79 | 23.49 | . | 10.00 | 0.00 | 1.48 | . | 18.25 | 35 |
| United Arab Emirates | 0.77 | 15.11 | . | 35.00 | 47.36 | 5.00 | 27.00 | -3.65 | 8.85 | 5.48 | 3 |
| United Kingdom | 0.80 | 16.23 | -3.77 | 0.00 | 123.53 | 3.57 | 49.51 | -0.84 | 5.38 | 18.92 | 29 |
| United States | 1.03 | 11.70 | 0.00 | 0.00 | 72.90 | 8.00 | 14.50 | 3.02 | 3.59 | 9.77 | 8691 |
| Uzbekistan | 0.84 | 11.73 | 31.69 | . | . | . | . | 0.98 | . | 9.93 | 3 |
| Vietnam | 0.73 | 14.03 | 1.86 | . | 66.97 | . | . | 0.81 | 14.99 | 19.46 | 1 |
| ***Developing*** | **0.76** | **11.99** | **0.96** | **36.70** | **48.01** | **7.20** | **15.90** | **0.05** | **10.94** | **8.74** | **1138** |
| Albania | 1.12 | 13.08 | -6.23 | 54.00 | 69.12 | 6.00 | 46.00 | 2.09 | 31.39 | 18.20 | 1 |
| Algeria | 0.69 | 13.40 | . | 93.30 | 56.46 | 5.43 | 6.54 | 2.61 | 13.94 | 10.85 | 6 |
| Angola | 0.77 | 11.83 | 41.77 | 31.46 | 18.89 | . | 43.18 | 1.97 | 29.35 | 5.11 | 2 |
| Argentina | 0.69 | 13.92 | 29.69 | 36.19 | 24.42 | 8.00 | 29.10 | 2.54 | -8.54 | 8.81 | 18 |
| Bahrain | 0.70 | 15.69 | 0.00 | 0.43 | 64.51 | 8.00 | 77.57 | 0.92 | 4.16 | 8.06 | 3 |
| Bangladesh | 0.86 | 13.02 | 4.10 | 46.84 | 52.84 | 9.00 | 9.29 | 0.65 | 3.99 | 7.63 | 8 |
| Belarus | 0.80 | 10.30 | 15.23 | 74.51 | 18.56 | 9.14 | 21.80 | 1.59 | 16.44 | 2.69 | 1 |
| Bosnia and Herzegovina | 0.69 | 12.00 | -5.29 | 7.90 | 43.59 | 8.00 | 79.60 | 3.14 | 8.85 | 8.71 | 2 |
| Brazil | 0.76 | 13.55 | 2.18 | 37.66 | 52.89 | 7.00 | 25.61 | 0.91 | 6.71 | 8.69 | 92 |
| Bulgaria | 0.71 | 12.82 | -5.30 | 10.19 | 52.51 | 7.00 | 73.89 | 0.85 | 26.66 | 12.06 | 1 |
| Cambodia | 0.88 | 12.55 | 0.79 | 0.00 | 20.60 | 6.00 | 0.00 | 2.72 | 17.65 | 8.49 | 1 |
| China | 0.88 | 15.28 | -1.19 | 68.76 | 151.61 | 11.00 | 1.89 | 0.82 | -0.50 | 16.04 | 69 |
| Colombia | 0.90 | 14.67 | 0.48 | 17.01 | 29.79 | 10.00 | 20.04 | 2.34 | 8.88 | 10.27 | 9 |
| Costa Rica | 0.83 | 10.45 | 7.70 | 58.95 | 48.59 | 10.57 | 23.15 | 1.20 | 9.27 | 6.04 | 33 |
| Croatia | 0.86 | 11.73 | -5.87 | 4.30 | 59.14 | 6.00 | 90.17 | 2.66 | 10.07 | 10.48 | 1 |
| Czech Republic | 0.65 | 14.49 | -8.68 | 3.24 | 59.73 | 9.00 | 87.60 | 1.52 | 0.83 | 13.01 | 4 |
| Dominican Republic | 0.66 | 11.07 | 13.85 | 25.00 | 38.61 | 12.00 | . | 1.30 | -3.21 | 10.28 | 16 |
| Ecuador | 0.91 | 12.33 | 0.00 | 14.00 | 20.98 | 10.00 | 7.00 | 1.09 | -1.41 | 10.59 | 10 |
| Egypt, Arab Rep. | 0.91 | 15.84 | 7.77 | 65.56 | 93.64 | 7.00 | 16.90 | 1.04 | -1.79 | 10.87 | 1 |
| El Salvador | 1.01 | 13.27 | 0.00 | 4.09 | 51.23 | 10.43 | 25.69 | 1.18 | -0.42 | 9.98 | 7 |
| Ghana | 0.93 | 11.39 | 8.45 | 15.91 | 30.06 | 8.43 | 51.39 | 1.34 | 2.22 | 9.67 | 3 |
| Guatemala | 0.90 | 14.11 | -0.15 | 3.21 | 41.09 | 8.14 | 9.43 | 1.85 | 5.64 | 12.42 | 2 |
| Honduras | 0.92 | 12.37 | 3.54 | 0.00 | 50.17 | 8.00 | 24.71 | 1.74 | 6.63 | 10.28 | 13 |
| Hungary | 0.68 | 13.48 | -5.71 | 5.14 | 51.02 | 8.43 | 91.91 | 1.74 | 9.94 | 17.58 | 2 |
| India | 0.92 | 15.08 | -1.08 | 74.73 | 63.83 | 8.57 | 7.08 | 1.66 | 7.20 | 17.66 | 55 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Indonesia | 0.97 | 14.85 | 1.67 | 38.48 | 45.45 | 12.00 | 39.70 | 0.74 | 3.76 | 14.71 | 11 |
| Jamaica | 0.94 | 13.93 | 7.16 | 0.00 | 63.91 | 11.00 | 95.20 | 0.87 | 4.31 | 9.26 | 3 |
| Jordan | 0.76 | 13.57 | 0.00 | 0.00 | 126.44 | 6.86 | 40.73 | 0.88 | 3.69 | 9.63 | 5 |
| Kazakhstan | 0.79 | 14.54 | -2.00 | 0.36 | 26.75 | 9.57 | 12.33 | 1.99 | 27.11 | 10.84 | 2 |
| Kenya | 0.85 | 12.93 | -1.67 | 0.63 | 38.95 | 8.14 | 39.02 | 0.92 | -2.76 | 6.15 | 1 |
| Korea, Rep. | 0.81 | 17.13 | -2.52 | 30.90 | 113.92 | 8.14 | 40.72 | 2.03 | 9.92 | 19.40 | 15 |
| Latvia | 0.56 | 13.68 | -2.23 | 3.67 | 38.73 | 5.43 | 59.84 | 1.75 | 24.89 | 11.35 | 1 |
| Macedonia, FYR | 0.89 | 11.88 | . | 1.45 | 36.57 | 6.00 | 51.19 | 0.88 | 10.81 | 5.54 | 6 |
| Malaysia | 0.80 | 16.62 | -1.40 | 0.00 | 130.73 | 8.00 | 20.03 | 5.69 | -3.97 | 13.82 | 8 |
| Mauritius | 0.70 | 13.07 | 2.72 | 1.03 | 94.06 | 9.14 | 42.41 | 0.93 | 4.23 | 7.16 | 2 |
| Mexico | 0.79 | 15.59 | 2.19 | 0.00 | 26.36 | 5.71 | 81.54 | 0.37 | 5.35 | 9.95 | 12 |
| Moldova | 0.83 | 11.12 | -0.15 | 7.77 | 36.95 | 10.14 | 29.37 | 0.29 | 16.74 | 4.96 | 1 |
| Montenegro | 0.75 | 11.65 | -5.29 | . | 27.88 | . | . | -2.13 | 63.15 | 7.76 | 4 |
| Morocco | 0.79 | 15.78 | -3.47 | 32.43 | 85.93 | 7.86 | 21.10 | 1.94 | 2.38 | 6.81 | 2 |
| Mozambique | 0.84 | 10.26 | 8.53 | . | 28.58 | 8.00 | 94.54 | 1.42 | -3.53 | 6.14 | 1 |
| Namibia | 0.85 | 13.86 | 1.80 | . | 37.94 | 7.00 | 70.00 | 1.57 | 2.94 | 13.76 | 1 |
| Nepal | 0.89 | 11.71 | -0.86 | . | 54.44 | . | . | 2.12 | 3.64 | 10.03 | 11 |
| Nicaragua | 1.08 | 12.73 | . | 0.00 | 31.07 | 10.71 | 9.56 | 2.45 | 5.87 | 14.50 | 1 |
| Nigeria | 0.82 | 13.98 | 3.19 | 4.38 | 21.67 | 9.00 | 1.44 | 1.81 | 15.11 | -4.45 | 9 |
| Oman | 0.82 | 14.03 | 0.00 | 0.00 | 33.53 | 8.57 | 6.80 | 2.37 | -0.40 | 6.58 | 2 |
| Panama | 0.90 | 13.30 | 0.00 | 12.01 | 82.17 | 9.00 | 56.09 | 1.87 | -2.33 | 10.63 | 4 |
| Paraguay | 0.77 | 12.06 | 6.61 | 9.15 | 27.05 | 10.00 | 83.47 | 1.28 | -3.51 | 9.04 | 7 |
| Peru | 0.78 | 14.15 | -1.54 | 5.33 | 31.05 | 7.14 | 42.86 | 2.48 | -2.76 | 9.75 | 7 |
| Philippines | 0.93 | 15.41 | 0.91 | 11.57 | 58.14 | 5.00 | 14.29 | 2.21 | -3.32 | 9.43 | 11 |
| Poland | 0.67 | 15.17 | -6.17 | 22.13 | 43.90 | 6.43 | 69.21 | 1.94 | 5.92 | 12.04 | 3 |
| Romania | 0.90 | 14.71 | 2.69 | 41.80 | 31.02 | 8.57 | 47.30 | 1.25 | 25.70 | 8.82 | 2 |
| Russian Federation | 0.69 | 10.16 | -1.24 | 36.79 | 32.16 | 6.00 | 8.59 | -0.82 | 16.28 | 6.27 | 584 |
| South Africa | 0.84 | 16.48 | 1.80 | 0.00 | 67.94 | 6.86 | 17.04 | 1.88 | 3.56 | 18.66 | 4 |
| Sri Lanka | 1.04 | 13.10 | 5.43 | 21.00 | 39.95 | 9.00 | 5.14 | 1.96 | 2.13 | 12.75 | 6 |
| Sudan | 0.73 | 12.58 | -3.32 | 12.00 | 17.92 | 8.00 | 4.00 | 3.10 | 29.29 | 12.65 | 1 |
| Swaziland | 0.75 | 11.96 | 1.80 | 14.20 | 21.19 | 10.00 | 85.80 | 0.82 | 10.86 | 13.04 | 2 |
| Tanzania | 0.82 | 12.93 | 6.59 | 21.00 | 24.83 | 7.00 | 53.00 | 1.93 | 16.86 | 12.43 | 1 |
| Thailand | 0.92 | 16.28 | -1.96 | 23.72 | 112.81 | 9.43 | 5.71 | 2.09 | 1.01 | 18.45 | 11 |
| Trinidad and Tobago | 1.12 | 11.64 | 0.07 | 15.25 | 42.81 | 8.43 | 11.97 | 1.46 | -3.09 | 8.93 | 1 |
| Turkey | 0.88 | 15.56 | 15.05 | 31.82 | 40.27 | 6.00 | 3.47 | -1.70 | 8.44 | 9.03 | 15 |
| Ukraine | 0.80 | 12.65 | -1.05 | 12.00 | 38.61 | 5.00 | 10.50 | 2.42 | 27.23 | 9.74 | 4 |
| Uruguay | 0.55 | 12.74 | 12.18 | 50.38 | 49.65 | 6.86 | 40.64 | 4.89 | -5.02 | 15.30 | 2 |
| Venezuela, RB | 0.89 | 14.04 | 19.46 | 8.15 | 24.42 | 6.00 | 38.74 | 1.68 | 11.38 | 9.17 | 14 |
| Zambia | 0.86 | 12.48 | 4.52 | . | 20.69 | . | . | 2.13 | 4.50 | 10.19 | 3 |
| Zimbabwe | 0.53 | 14.46 | 0.00 | 9.12 | 74.75 | 7.00 | 36.55 | 4.33 | 47.23 | 6.11 | 1 |

Variables are 2001-2007 averages of : NSFR: Ratio that aims to measure the level in which available stable funding cover the required stable funding for a bank to transform short-term liabilities into long-term stable assets.; Size: logarithm of total bank's asset.; CHG__FX (%): Change in exchange rate (%), yearly growth rate of the nominal exchange rate; GOB (%): Government-owned banks (%), percentage of banking system total assets that is held by state-owned banks ; M2 to GDP (%): Money and Quasi money (M2) as percentage of GDP ; ORBA: Bank activities, Index that measures the extent to which a bank can both engage in securities, insurance, and real estate activities and own nonfinancial firms ; FOB: Foreign-owned banks, Percentage of banking system total assets that is held by foreign-owned banks; GLOANDEV (%): Growth loans deviation, measured as the deviation of bank's individual yearly growth rate of loans over the country average growth rate of loans (due to the presence of outliers, they were removed by taking values from the $5^{th}$ percentile to the $95^{th}$ percentile); GLOAN _GDP (%): Growth loans to GDP, measured as the yearly growth rate of credit to private sector over GDP ; LEV: measured as the ratio of total assets to equity. For a complete description of variables and sources see Table C in the Appendix.

Table 2: Descriptive statistics by sub-regions

| | Total | | | Developing: DEV+EME | | | Developed: OECD+OHI | | | Diff. in means |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Sd. | N. Banks | Mean | Sd. | N. Banks | Mean | Sd. | N. Banks | (2)-(1) |
| NSFR | 0.974 | 0.148 | 11,536 | 0.759 | 0.172 | 1,138 | 0.997 | 0.124 | 10,398 | 0.238*** |
| Size | 12.080 | 1.841 | 11,536 | 11.993 | 2.672 | 1,138 | 12.090 | 1.726 | 10,398 | 0.097 |
| CHG__FX (%) | -0.451 | 2.537 | 11,517 | 0.959 | 5.708 | 1,125 | -0.603 | 1.836 | 10,392 | -1.563*** |
| Govt Own Banks (%) | 6.359 | 15.055 | 11,037 | 36.695 | 17.925 | 1,115 | 2.950 | 10.051 | 9,922 | -33.75*** |
| M2 to GDP (%) | 82.262 | 36.822 | 11,033 | 48.009 | 32.322 | 1,132 | 86.178 | 35.242 | 9,901 | 38.17*** |
| ORBA | 7.634 | 1.067 | 11,039 | 7.198 | 1.801 | 1,115 | 7.683 | 0.938 | 9,924 | 0.485*** |
| FOB (%) | 13.941 | 6.674 | 11,013 | 15.896 | 17.024 | 1,105 | 13.723 | 4.092 | 9,908 | -2.172*** |
| G Loans deviation (%) | 0.668 | 9.357 | 10,880 | 0.053 | 13.026 | 936 | 0.726 | 8.934 | 9,944 | |
| G Loans to GDP (%) | 3.831 | 3.881 | 11,497 | 10.944 | 7.950 | 1,138 | 3.049 | 1.900 | 10,359 | -7.895*** |
| LEVERAGE (%) | 11.786 | 17.897 | 11,536 | 8.738 | 17.030 | 1,138 | 12.120 | 17.959 | 10,398 | 3.382*** |

Two sample mean comparison t-test for unequal variances* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Sd and N. Banks denotes, respectively, the standard deviation and the number of banks. We separate the data also in four groups: OECD non-emerging, OHI (other high income, non-OECD), emerging and other developing, following recent classification in Claessens, Stijn and Neeltje van Horen, 2015. Initial regression results indicate that the effects of variables are similar in OECD (non-emerging) and OHI (non-OECD), and in emerging and developing. "OECD" only includes the core OECD countries and "OHI" includes all countries classified as high-income by the World Bank in 2000, not belonging to OECD. Variables are 2001-2007 averages of : NSFR: Ratio that aims to measure the level in which available stable funding cover the required stable funding for a bank to transform short-term liabilities into long-term stable assets.; Size: logarithm of total bank's asset.; CHG__FX (%): Change in exchange rate (%), yearly growth rate of the nominal exchange rate; Govt Own Banks (%): Government-owned banks (%), percentage of banking system total assets that is held by state-owned banks ; M2 to GDP (%): Money and Quasi money (M2) as percentage of GDP ; ORBA: Bank activities, Index that measures the extent to which a bank can both engage in securities, insurance, and real estate activities and own nonfinancial firms ; FOB: Foreign-owned banks, Percentage of banking system total assets that is held by foreign-owned banks; G Loans deviation (%), measured as the deviation of bank's individual yearly growth rate of loans over the country average growth rate of loans (due to the presence of outliers, they were removed by taking values from the $5^{th}$ percentile to the $95^{th}$ percentile); G Loans to GDP (%): Growth loans to GDP, measured as the yearly growth rate of credit to private sector over GDP ; Leverage: measured as the ratio of total assets to equity. For a complete description of variables and sources see Table C in the Appendix.

Table 3: Logit regressions of Status Change over 2008-2015

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| NSFR | -0.392*** | -0.413*** | -0.411*** | -0.418*** |
| | (0.105) | (0.123) | (0.122) | (0.119) |
| Size | -0.00668** | -0.00744** | -0.00780*** | -0.00744** |
| | (0.00268) | (0.00297) | (0.00292) | (0.00297) |
| Change in exchange rate (%) | -0.00672** | -0.00688** | -0.00702** | |
| | (0.00273) | (0.00322) | (0.00302) | |
| Government-owned banks (%) | -0.00459*** | -0.00455*** | -0.00454*** | -0.00456*** |
| | (0.00116) | (0.00133) | (0.00126) | (0.00124) |
| M2 to GDP (%) | -0.00244*** | -0.00255*** | -0.00267*** | -0.00258*** |
| | (0.000370) | (0.000643) | (0.000446) | (0.000415) |
| Bank activities | 0.0396*** | 0.0423*** | 0.0423*** | 0.0418*** |
| | (0.0144) | (0.0154) | (0.0161) | (0.0159) |
| Foreign-owned banks | -0.00313*** | -0.00304** | -0.00307** | -0.00305** |
| | (0.00114) | (0.00132) | (0.00128) | (0.00126) |
| Growth loan deviation (%) | 0.00432*** | | | |
| | (0.00143) | | | |
| Growth loans to GDP | | 0.000287 | | |
| | | (0.00418) | | |
| Leverage | | | 0.000518 | |
| | | | (0.000381) | |
| NSFR* FX change | | | | -0.00910** |
| | | | | (0.00396) |
| N | 10323 | 10958 | 10958 | 10958 |
| chi2 | 343.0 | 245.4 | 232.8 | 291.5 |
| aic | 10199.2 | 11168.7 | 11163.7 | 11166.6 |
| bic | 10264.4 | 11234.4 | 11229.4 | 11225.0 |
| r2_p | 0.0612 | 0.0474 | 0.0478 | 0.0474 |
| N_clust | 81 | 82 | 82 | 82 |

Average marginal effects; standard errors in parentheses. Standard errors adjusted for country clusters (d) for discrete change of dummy variable from 0 to 1. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Explanatory variables: 2001-2007 averages of: NSFR: Ratio that aims to measure the level in which available stable funding cover the required stable funding for a bank to transform short-term liabilities into long-term stable assets.; Size: logarithm of total bank's asset.; Change in exchange rate (%): yearly growth rate of the nominal exchange rate; Government-owned banks (%): Percentage of banking system total assets that is held by state-owned banks; M2 to GDP (%): Money and Quasi money (M2) as percentage of GDP; Bank activities: Index that measures the extent to which a bank can both engage in securities, insurance, and real estate activities and own nonfinancial firms; Foreign-owned banks: Percentage of banking system total assets that is held by foreign-owned banks; Growth loan deviation (%): Measured as the deviation of bank's individual yearly growth rate of loans over the country average growth rate of loans (significant outliers of this indicator were removed by taking values from the 5$^{th}$ percentile to the 95$^{th}$ percentile); Growth loans to GDP: Measured as the yearly growth rate of credit to private sector over GDP; Leverage: Measured as the ratio of total assets to equity. For a complete description of variables and sources see Table C in the Appendix.

Table 4: Logit regressions of Status Change over 2008-2015 excluding US banks

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| NSFR | -0.172*** | -0.180*** | -0.187*** | -0.194*** |
| | (0.0419) | (0.0430) | (0.0432) | (0.0449) |
| Size | -0.00241 | -0.00401 | -0.00479 | -0.00478 |
| | (0.00395) | (0.00414) | (0.00405) | (0.00401) |
| Change in exchange rate (%) | -0.00383** | -0.00329 | -0.00434* | |
| | (0.00193) | (0.00202) | (0.00228) | |
| Government-owned banks (%) | -0.000831 | -0.000806 | -0.000703 | -0.000816 |
| | (0.000595) | (0.000726) | (0.000723) | (0.000731) |
| M2 to GDP (%) | -0.00117*** | -0.00100** | -0.00141*** | -0.00135*** |
| | (0.000399) | (0.000446) | (0.000505) | (0.000495) |
| Bank activities | 0.00960 | 0.0121 | 0.00963 | 0.00959 |
| | (0.00713) | (0.00835) | (0.00848) | (0.00851) |
| Foreign-owned banks | -0.000729 | -0.000349 | -0.000611 | -0.000660 |
| | (0.000535) | (0.000562) | (0.000641) | (0.000651) |
| Growth loan deviation (%) | -0.00108** | | | |
| | (0.000461) | | | |
| Growth loans to GDP | | 0.00309 | | |
| | | (0.00242) | | |
| Leverage | | | 0.000316* | |
| | | | (0.000178) | |
| NSFR* FX change | | | | -0.00485* |
| | | | | (0.00281) |
| N | 2273 | 2494 | 2494 | 2494 |
| chi2 | 183.2 | 212.3 | 177.9 | 154.1 |
| aic | 1349.1 | 1636.1 | 1634.5 | 1639.2 |
| bic | 1400.7 | 1688.5 | 1686.9 | 1685.8 |
| r2_p | 0.127 | 0.138 | 0.138 | 0.135 |
| N_clust | 80 | 81 | 81 | 81 |

Average marginal effects; standard errors in parentheses. Standard errors adjusted for country clusters (d) for discrete change of dummy variable from 0 to 1. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Explanatory variables: 2001-2007 averages of: NSFR: Ratio that aims to measure the level in which available stable funding cover the required stable funding for a bank to transform short-term liabilities into long-term stable assets.; Size: logarithm of total bank's asset.; Change in exchange rate (%): yearly growth rate of the nominal exchange rate; Government-owned banks (%): Percentage of banking system total assets that is held by state-owned banks; M2 to GDP (%): Money and Quasi money (M2) as percentage of GDP; Bank activities: Index that measures the extent to which a bank can both engage in securities, insurance, and real estate activities and own nonfinancial firms; Foreign-owned banks: Percentage of banking system total assets that is held by foreign-owned banks; Growth loan deviation (%): Measured as the deviation of bank's individual yearly growth rate of loans over the country average growth rate of loans (significant outliers of this indicator were removed by taking values from the 5$^{th}$ percentile to the 95$^{th}$ percentile); Growth loans to GDP: Measured as the yearly growth rate of credit to private sector over GDP; Leverage: Measured as the ratio of total assets to equity. For a complete description of variables and sources see Table C in the Appendix.

Table 5: Logit regressions of Status Change over 2008-2015 with Developing dummy

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| NSFR | -0.423*** | -0.438*** | -0.439*** | -0.444*** |
| | (0.0955) | (0.116) | (0.114) | (0.112) |
| developing | -0.111** | -0.143** | -0.129** | -0.122* |
| | (0.0553) | (0.0649) | (0.0639) | (0.0637) |
| Size | -0.00576** | -0.00631** | -0.00684*** | -0.00650** |
| | (0.00245) | (0.00260) | (0.00260) | (0.00264) |
| Change in exchange rate (%) | -0.00563* | -0.00452 | -0.00598* | |
| | (0.00291) | (0.00326) | (0.00320) | |
| Government-owned banks (%) | -0.00264** | -0.00228* | -0.00224* | -0.00238* |
| | (0.00123) | (0.00127) | (0.00125) | (0.00128) |
| M2 to GDP (%) | -0.00294*** | -0.00285*** | -0.00328*** | -0.00315*** |
| | (0.000514) | (0.000688) | (0.000633) | (0.000606) |
| Bank activities | 0.0369** | 0.0418*** | 0.0382** | 0.0376** |
| | (0.0144) | (0.0162) | (0.0162) | (0.0160) |
| Foreign-owned banks | -0.00229** | -0.00173 | -0.00210* | -0.00214* |
| | (0.00103) | (0.00115) | (0.00114) | (0.00114) |
| Growth loan deviation (%) | 0.00424*** | | | |
| | (0.00144) | | | |
| Growth loans to GDP | | 0.00360 | | |
| | | (0.00427) | | |
| Leverage | | | 0.000549 | |
| | | | (0.000351) | |
| NSFR* FX change | | | | -0.00740* |
| | | | | (0.00421) |
| N | 10323 | 10958 | 10958 | 10958 |
| chi2 | 342.3 | 516.3 | 518.3 | 502.0 |
| aic | 10192.4 | 11158.0 | 11154.1 | 11158.2 |
| bic | 10264.8 | 11231.0 | 11227.2 | 11223.9 |
| r2_p | 0.0621 | 0.0485 | 0.0488 | 0.0483 |
| N_clust | 81 | 82 | 82 | 82 |

Average marginal effects; standard errors in parentheses. Standard errors adjusted for country clusters (d) for discrete change of dummy variable from 0 to 1. * p < 0.10, ** p < 0.05, *** p < 0.01. Explanatory variables: 2001-2007 averages of: NSFR: Ratio that aims to measure the level in which available stable funding cover the required stable funding for a bank to transform short-term liabilities into long-term stable assets.; Size: logarithm of total bank's asset.; Change in exchange rate (%): yearly growth rate of the nominal exchange rate; Government-owned banks (%): Percentage of banking system total assets that is held by state-owned banks; M2 to GDP (%): Money and Quasi money (M2) as percentage of GDP; Bank activities: Index that measures the extent to which a bank can both engage in securities, insurance, and real estate activities and own nonfinancial firms; Foreign-owned banks: Percentage of banking system total assets that is held by foreign-owned banks; Growth loan deviation (%): Measured as the deviation of bank's individual yearly growth rate of loans over the country average growth rate of loans (significant outliers of this indicator were removed by taking values from the 5$^{th}$ percentile to the 95$^{th}$ percentile); Growth loans to GDP: Measured as the yearly growth rate of credit to private sector over GDP; Leverage: Measured as the ratio of total assets to equity. For a complete description of variables and sources see Table C in the Appendix.

Table 6: Logit regressions of Status Change over 2008-2015 without NSFR

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Size | -0.00258 | -0.00264 | -0.00318 | -0.00262 |
| | (0.00292) | (0.00367) | (0.00354) | (0.00372) |
| Change in exchange rate (%) | -0.00821*** | -0.00769** | -0.00878*** | -0.00874*** |
| | (0.00267) | (0.00314) | (0.00301) | (0.00302) |
| Government-owned banks (%) | -0.00280*** | -0.00298*** | -0.00265*** | -0.00261*** |
| | (0.000839) | (0.00106) | (0.000914) | (0.000899) |
| M2 to GDP (%) | -0.00272*** | -0.00252*** | -0.00308*** | -0.00297*** |
| | (0.000432) | (0.000592) | (0.000560) | (0.000515) |
| Bank activities | 0.0148 | 0.0205 | 0.0152 | 0.0146 |
| | (0.0116) | (0.0130) | (0.0126) | (0.0124) |
| Foreign-owned banks | -0.00200** | -0.00173* | -0.00202* | -0.00198* |
| | (0.000943) | (0.00102) | (0.00106) | (0.00105) |
| Growth loan deviation (%) | 0.00499*** | | | |
| | (0.00170) | | | |
| Growth loans to GDP | | 0.00405 | | |
| | | (0.00390) | | |
| Leverage | | | 0.000677 | |
| | | | (0.000624) | |
| N | 10323 | 10958 | 10958 | 10958 |
| chi2 | 336.9 | 150.6 | 103.1 | 96.73 |
| aic | 10282.4 | 11288.9 | 11284.3 | 11289.5 |
| bic | 10340.4 | 11347.3 | 11342.7 | 11340.6 |
| r2_p | 0.0534 | 0.0370 | 0.0374 | 0.0368 |
| N_clust | 81 | 82 | 82 | 82 |

Average marginal effects; standard errors in parentheses. Standard errors adjusted for country clusters (d) for discrete change of dummy variable from 0 to 1. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Explanatory variables: 2001-2007 averages of: Size: logarithm of total bank's asset.; Change in exchange rate (%): yearly growth rate of the nominal exchange rate; Government-owned banks (%): Percentage of banking system total assets that is held by state-owned banks; M2 to GDP (%): Money and Quasi money (M2) as percentage of GDP; Bank activities: Index that measures the extent to which a bank can both engage in securities, insurance, and real estate activities and own nonfinancial firms; Foreign-owned banks: Percentage of banking system total assets that is held by foreign-owned banks; Growth loan deviation (%): Measured as the deviation of bank's individual yearly growth rate of loans over the country average growth rate of loans (significant outliers of this indicator were removed by taking values from the 5$^{th}$ percentile to the 95$^{th}$ percentile); Growth loans to GDP: Measured as the yearly growth rate of credit to private sector over GDP; Leverage: Measured as the ratio of total assets to equity. For a complete description of variables and sources see Table C in the Appendix.

Table 7: OLS regressions of 2008-2013 average Z-scores

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| NSFR | 1.131*** | 0.670** | 1.045*** | 0.969*** |
| | (0.245) | (0.262) | (0.280) | (0.255) |
| Size | 0.00204 | -0.0190 | 0.000986 | 0.00110 |
| | (0.0371) | (0.0290) | (0.0334) | (0.0321) |
| Change in exchange rate (%) | -0.0365* | -0.0513*** | -0.0365* | |
| | (0.0203) | (0.0132) | (0.0202) | |
| Government-owned banks (%) | 0.0121*** | 0.0118*** | 0.0118*** | 0.0113** |
| | (0.00442) | (0.00363) | (0.00415) | (0.00434) |
| M2 to GDP (%) | 0.00524*** | -0.000399 | 0.00564*** | 0.00561*** |
| | (0.00195) | (0.00159) | (0.00190) | (0.00189) |
| Bank activities | -0.186*** | -0.191*** | -0.175*** | -0.167*** |
| | (0.0477) | (0.0398) | (0.0481) | (0.0461) |
| Foreign-owned banks | -0.000556 | -0.00522 | -0.000509 | -0.000515 |
| | (0.00501) | (0.00399) | (0.00485) | (0.00479) |
| Growth loan deviation (%) | -0.00757 | | | |
| | (0.00574) | | | |
| Growth loans to GDP | | -0.0685*** | | |
| | | (0.0142) | | |
| Leverage | | | 0.000316 | |
| | | | (0.00451) | |
| NSFR* FX change | | | | -0.0502** |
| | | | | (0.0250) |
| Constant | 3.154*** | 4.796*** | 3.102*** | 3.129*** |
| | (0.750) | (0.699) | (0.579) | (0.594) |
| N | 2545 | 2745 | 2745 | 2745 |
| aic | 7944.6 | 8410.6 | 8549.3 | 8540.7 |
| bic | 7997.2 | 8463.9 | 8602.6 | 8588.1 |
| r2 | 0.265 | 0.295 | 0.258 | 0.260 |
| N_clust | 76 | 78 | 78 | 78 |

Sstandard errors in parentheses. Standard errors adjusted for country clusters (d) for discrete change of dummy variable from 0 to 1. * p < 0.10, ** p < 0.05, *** p < 0.01. Explanatory variables: 2001-2007 averages of: NSFR: Ratio that aims to measure the level in which available stable funding cover the required stable funding for a bank to transform short-term liabilities into long-term stable assets.; Size: logarithm of total bank's asset.; Change in exchange rate (%): yearly growth rate of the nominal exchange rate; Government-owned banks (%): Percentage of banking system total assets that is held by state-owned banks; M2 to GDP (%): Money and Quasi money (M2) as percentage of GDP; Bank activities: Index that measures the extent to which a bank can both engage in securities, insurance, and real estate activities and own nonfinancial firms; Foreign-owned banks: Percentage of banking system total assets that is held by foreign-owned banks; Growth loan deviation (%): Measured as the deviation of bank's individual yearly growth rate of loans over the country average growth rate of loans (significant outliers of this indicator were removed by taking values from the 5$^{th}$ percentile to the 95$^{th}$ percentile); Growth loans to GDP: Measured as the yearly growth rate of credit to private sector over GDP; Leverage: Measured as the ratio of total assets to equity. For a complete description of variables and sources see Table C in the Appendix.

Table 8: OLS regressions of 2008-2013 average Z-scores excluding US banks

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| NSFR | 1.061*** | 0.746* | 0.964** | 0.892** |
| | (0.388) | (0.387) | (0.415) | (0.387) |
| Size | -0.00687 | -0.0260 | -0.00593 | -0.00534 |
| | (0.0394) | (0.0302) | (0.0352) | (0.0338) |
| Change in exchange rate (%) | -0.0362* | -0.0577*** | -0.0360* | |
| | (0.0215) | (0.0162) | (0.0209) | |
| Government-owned banks (%) | 0.0118* | 0.00888* | 0.0117** | 0.0111* |
| | (0.00621) | (0.00484) | (0.00584) | (0.00626) |
| M2 to GDP (%) | 0.00546** | -0.00183 | 0.00587*** | 0.00580*** |
| | (0.00207) | (0.00226) | (0.00204) | (0.00200) |
| Bank activities | -0.181*** | -0.172*** | -0.170*** | -0.161*** |
| | (0.0478) | (0.0362) | (0.0485) | (0.0465) |
| Foreign-owned banks | -0.000401 | -0.00725 | -0.000283 | -0.000383 |
| | (0.00571) | (0.00441) | (0.00550) | (0.00546) |
| Growth loan deviation (%) | -0.00224 | | | |
| | (0.00233) | | | |
| Growth loans to GDP | | -0.0775*** | | |
| | | (0.0170) | | |
| Leverage | | | 0.000458 | |
| | | | (0.00424) | |
| NSFR* FX change | | | | -0.0503* |
| | | | | (0.0270) |
| Constant | 3.277*** | 5.025*** | 3.200*** | 3.223*** |
| | (0.712) | (0.676) | (0.536) | (0.546) |
| N | 2153 | 2340 | 2340 | 2340 |
| aic | 6701.1 | 7093.3 | 7255.5 | 7246.4 |
| bic | 6752.2 | 7145.1 | 7307.3 | 7292.5 |
| r2 | 0.258 | 0.307 | 0.257 | 0.259 |
| N_clust | 75 | 77 | 77 | 77 |

Standard errors in parentheses. Standard errors adjusted for country clusters (d) for discrete change of dummy variable from 0 to 1. * p < 0.10, ** p < 0.05, *** p < 0.01. Explanatory variables: 2001-2007 averages of: NSFR: Ratio that aims to measure the level in which available stable funding cover the required stable funding for a bank to transform short-term liabilities into long-term stable assets.; Size: logarithm of total bank's asset.; Change in exchange rate (%): yearly growth rate of the nominal exchange rate; Government-owned banks (%): Percentage of banking system total assets that is held by state-owned banks; M2 to GDP (%): Money and Quasi money (M2) as percentage of GDP; Bank activities: Index that measures the extent to which a bank can both engage in securities, insurance, and real estate activities and own nonfinancial firms; Foreign-owned banks: Percentage of banking system total assets that is held by foreign-owned banks; Growth loan deviation (%): Measured as the deviation of bank's individual yearly growth rate of loans over the country average growth rate of loans (significant outliers of this indicator were removed by taking values from the 5$^{th}$ percentile to the 95$^{th}$ percentile); Growth loans to GDP: Measured as the yearly growth rate of credit to private sector over GDP; Leverage: Measured as the ratio of total assets to equity. For a complete description of variables and sources see Table C in the Appendix.

Table 9: OLS regressions of 2008-2013 average Z-scores with developing dummy

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| NSFR | 0.920*** | 0.718** | 0.841*** | 0.792*** |
| | (0.250) | (0.296) | (0.301) | (0.281) |
| developing | -0.416 | 0.151 | -0.429 | -0.404 |
| | (0.277) | (0.263) | (0.285) | (0.283) |
| Size | -0.00421 | -0.0177 | -0.00636 | -0.00592 |
| | (0.0347) | (0.0293) | (0.0314) | (0.0301) |
| Change in exchange rate (%) | -0.0293* | -0.0549*** | -0.0290* | |
| | (0.0169) | (0.0150) | (0.0165) | |
| Government-owned banks (%) | 0.0162*** | 0.0102** | 0.0161*** | 0.0155*** |
| | (0.00506) | (0.00484) | (0.00490) | (0.00504) |
| M2 to GDP (%) | 0.00388** | -0.000264 | 0.00417** | 0.00422** |
| | (0.00189) | (0.00161) | (0.00189) | (0.00188) |
| Bank activities | -0.162*** | -0.200*** | -0.152*** | -0.147*** |
| | (0.0461) | (0.0508) | (0.0464) | (0.0460) |
| Foreign-owned banks | 0.00156 | -0.00625 | 0.00154 | 0.00142 |
| | (0.00505) | (0.00449) | (0.00493) | (0.00489) |
| Growth loan deviation (%) | -0.00816 | | | |
| | (0.00582) | | | |
| Growth loans to GDP | | -0.0729*** | | |
| | | (0.0171) | | |
| Leverage | | | 0.0000793 | |
| | | | (0.00435) | |
| NSFR* FX change | | | | -0.0404* |
| | | | | (0.0215) |
| Constant | 3.439*** | 4.791*** | 3.426*** | 3.429*** |
| | (0.675) | (0.696) | (0.545) | (0.558) |
| N | 2545 | 2745 | 2745 | 2745 |
| aic | 7929.4 | 8410.7 | 8531.8 | 8525.6 |
| bic | 7987.8 | 8469.8 | 8591.0 | 8578.8 |
| r2 | 0.270 | 0.295 | 0.263 | 0.264 |
| N_clust | 76 | 78 | 78 | 78 |

Standard errors in parentheses. Standard errors adjusted for country clusters (d) for discrete change of dummy variable from 0 to 1. * p < 0.10, ** p < 0.05, *** p < 0.01. Explanatory variables: 2001-2007 averages of: NSFR: Ratio that aims to measure the level in which available stable funding cover the required stable funding for a bank to transform short-term liabilities into long-term stable assets.; Size: logarithm of total bank's asset.; Change in exchange rate (%): yearly growth rate of the nominal exchange rate; Government-owned banks (%): Percentage of banking system total assets that is held by state-owned banks; M2 to GDP (%): Money and Quasi money (M2) as percentage of GDP; Bank activities: Index that measures the extent to which a bank can both engage in securities, insurance, and real estate activities and own nonfinancial firms; Foreign-owned banks: Percentage of banking system total assets that is held by foreign-owned banks; Growth loan deviation (%): Measured as the deviation of bank's individual yearly growth rate of loans over the country average growth rate of loans (significant outliers of this indicator were removed by taking values from the 5$^{th}$ percentile to the 95$^{th}$ percentile); Growth loans to GDP: Measured as the yearly growth rate of credit to private sector over GDP; Leverage: Measured as the ratio of total assets to equity. For a complete description of variables and sources see Table C in the Appendix.

Table 10: Logit regressions of Status Change over 2008-2015 - Banks in developed countries

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| NSFR | -0.492*** | -0.539*** | -0.533*** | -0.512*** |
| | (0.0689) | (0.0703) | (0.0734) | (0.0902) |
| Size | -0.00387** | -0.00480*** | -0.00395*** | -0.00416*** |
| | (0.00168) | (0.00139) | (0.00152) | (0.00148) |
| Change in exchange rate (%) | 0.0421 | 0.0563** | 0.0479* | |
| | (0.0262) | (0.0244) | (0.0274) | |
| Government-owned banks (%) | -0.00753** | -0.00454** | -0.00718** | -0.00726** |
| | (0.00342) | (0.00183) | (0.00344) | (0.00361) |
| M2 to GDP (%) | -0.00398*** | -0.00319*** | -0.00443*** | -0.00403*** |
| | (0.000922) | (0.000957) | (0.000976) | (0.000823) |
| Bank activities | -0.0675 | -0.0612 | -0.0733 | -0.0228 |
| | (0.0701) | (0.0547) | (0.0721) | (0.0381) |
| Foreign-owned banks | -0.0127 | -0.00940** | -0.0125 | -0.0123 |
| | (0.00772) | (0.00446) | (0.00784) | (0.00922) |
| Growth loan deviation (%) | 0.00511*** | | | |
| | (0.000704) | | | |
| Growth loans to GDP | | 0.0203 | | |
| | | (0.0154) | | |
| Leverage | | | 0.000599 | |
| | | | (0.000494) | |
| NSFR*Var. FX | | | | 0.0299 |
| | | | | (0.0186) |
| N | 9445 | 9867 | 9867 | 9867 |
| chi2 | 20017.7 | 4554.1 | 1861.7 | 1302.9 |
| aic | 9253.9 | 9969.6 | 9969.9 | 9977.7 |
| bic | 9318.2 | 10034.4 | 10034.7 | 10035.3 |
| r2_p | 0.0742 | 0.0566 | 0.0566 | 0.0556 |
| N_clust | 25 | 25 | 25 | 25 |

Average marginal effects; standard errors in parentheses. Standard errors adjusted for country clusters (d) for discrete change of dummy variable from 0 to 1. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Explanatory variables: 2001-2007 averages of: NSFR: Ratio that aims to measure the level in which available stable funding cover the required stable funding for a bank to transform short-term liabilities into long-term stable assets.; Size: logarithm of total bank's asset.; Change in exchange rate (%): yearly growth rate of the nominal exchange rate; Government-owned banks (%): Percentage of banking system total assets that is held by state-owned banks; M2 to GDP (%): Money and Quasi money (M2) as percentage of GDP; Bank activities: Index that measures the extent to which a bank can both engage in securities, insurance, and real estate activities and own nonfinancial firms; Foreign-owned banks: Percentage of banking system total assets that is held by foreign-owned banks; Growth loan deviation (%): Measured as the deviation of bank's individual yearly growth rate of loans over the country average growth rate of loans (significant outliers of this indicator were removed by taking values from the $5^{th}$ percentile to the $95^{th}$ percentile); Growth loans to GDP: Measured as the yearly growth rate of credit to private sector over GDP; Leverage: Measured as the ratio of total assets to equity. For a complete description of variables and sources see Table C in the Appendix.

Table 11: Logit regressions of Status Change over 2008-2015 - Banks in developing countries

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| NSFR | -0.158*** | -0.207*** | -0.196*** | -0.198*** |
| | (0.0424) | (0.0329) | (0.0362) | (0.0407) |
| Size | -0.0142* | -0.0197** | -0.0182** | -0.0178** |
| | (0.00791) | (0.00808) | (0.00740) | (0.00738) |
| Change in exchange rate (%) | -0.00644*** | -0.00876*** | -0.00660** | |
| | (0.00209) | (0.00265) | (0.00265) | |
| Government-owned banks (%) | 0.000346 | 0.00109 | 0.000746 | 0.000723 |
| | (0.000748) | (0.00102) | (0.000958) | (0.000911) |
| M2 to GDP (%) | 0.000170 | -0.0000114 | 0.000335 | 0.000371 |
| | (0.000561) | (0.000662) | (0.000643) | (0.000627) |
| Bank activities | -0.0180* | -0.0312** | -0.0252** | -0.0251** |
| | (0.00998) | (0.0131) | (0.0122) | (0.0119) |
| Foreign-owned banks | 0.000614 | 0.000892 | 0.00108 | 0.00108 |
| | (0.000872) | (0.00105) | (0.00107) | (0.00106) |
| Growth loan deviation (%) | -0.00204*** | | | |
| | (0.000465) | | | |
| Growth loans to GDP | | -0.00464 | | |
| | | (0.00299) | | |
| Leverage | | | 0.000579 | |
| | | | (0.00102) | |
| NSFR*Var. FX | | | | -0.00842*** |
| | | | | (0.00324) |
| N | 878 | 1091 | 1091 | 1091 |
| chi2 | 210.7 | 269.2 | 293.0 | 239.8 |
| aic | 840.8 | 1117.5 | 1119.0 | 1117.4 |
| bic | 883.8 | 1162.5 | 1164.0 | 1157.3 |
| r2_p | 0.0497 | 0.0498 | 0.0486 | 0.0482 |
| N_clust | 56 | 57 | 57 | 57 |

Average marginal effects; standard errors in parentheses. Standard errors adjusted for country clusters (d) for discrete change of dummy variable from 0 to 1. * p < 0.10, ** p < 0.05, *** p < 0.01. Explanatory variables: 2001-2007 averages of: NSFR: Ratio that aims to measure the level in which available stable funding cover the required stable funding for a bank to transform short-term liabilities into long-term stable assets.; Size: logarithm of total bank's asset.; Change in exchange rate (%): yearly growth rate of the nominal exchange rate; Government-owned banks (%): Percentage of banking system total assets that is held by state-owned banks; M2 to GDP (%): Money and Quasi money (M2) as percentage of GDP; Bank activities: Index that measures the extent to which a bank can both engage in securities, insurance, and real estate activities and own nonfinancial firms; Foreign-owned banks: Percentage of banking system total assets that is held by foreign-owned banks; Growth loan deviation (%): Measured as the deviation of bank's individual yearly growth rate of loans over the country average growth rate of loans (significant outliers of this indicator were removed by taking values from the 5th percentile to the 95th percentile); Growth loans to GDP: Measured as the yearly growth rate of credit to private sector over GDP; Leverage: Measured as the ratio of total assets to equity. For a complete description of variables and sources see Table C in the Appendix.

Table 12: Quantile regressions of 2008-2013 average Z-scores with Growth loan deviation

| | OLS | (1) Q(25) | (2) Q(50) | (3) Q(75) |
|---|---|---|---|---|
| NSFR | 1.131*** | 0.915*** | 1.022** | 1.032*** |
| | (0.245) | (0.269) | (0.419) | (0.320) |
| Size | 0.00204 | 0.0292 | -0.00865 | -0.0198 |
| | (0.0371) | (0.0396) | (0.0392) | (0.0347) |
| Change in exchange rate (%) | -0.0365* | -0.0456 | -0.0274 | -0.0341** |
| | (0.0203) | (0.0472) | (0.0249) | (0.0163) |
| Government-owned banks (%) | 0.0121*** | 0.0157*** | 0.00718 | 0.00572 |
| | (0.00442) | (0.00472) | (0.00564) | (0.00414) |
| M2 to GDP (%) | 0.00524*** | 0.00382** | 0.00630** | 0.00703*** |
| | (0.00195) | (0.00187) | (0.00248) | (0.00255) |
| Bank activities | -0.186*** | -0.181*** | -0.150** | -0.168*** |
| | (0.0477) | (0.0524) | (0.0631) | (0.0468) |
| Foreign-owned banks | -0.000556 | 0.000710 | 0.00111 | 0.000795 |
| | (0.00501) | (0.00556) | (0.00647) | (0.00416) |
| Growth loan deviation (%) | -0.00757 | -0.00592 | -0.00987 | -0.00927 |
| | (0.00574) | (0.00576) | (0.00631) | (0.00942) |
| Constant | 3.154*** | 2.236*** | 3.210*** | 4.128*** |
| | (0.750) | (0.599) | (0.700) | (0.841) |
| N | 2545 | 2545 | 2545 | 2545 |

We use the least-absolute-deviations (LAD) estimator with robust intra-cluster correction proposed by Parente and Santos Silva (2016). Standard errors in parentheses. Standard errors adjusted for country clusters. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Explanatory variables: 2001-2007 averages of: NSFR: Ratio that aims to measure the level in which available stable funding cover the required stable funding for a bank to transform short-term liabilities into long-term stable assets.; Size: logarithm of total bank's asset.; Change in exchange rate (%): yearly growth rate of the nominal exchange rate; Government-owned banks (%): Percentage of banking system total assets that is held by state-owned banks; M2 to GDP (%): Money and Quasi money (M2) as percentage of GDP; Bank activities: Index that measures the extent to which a bank can both engage in securities, insurance, and real estate activities and own nonfinancial firms; Foreign-owned banks: Percentage of banking system total assets that is held by foreign-owned banks; Growth loan deviation (%): Measured as the deviation of bank's individual yearly growth rate of loans over the country average growth rate of loans (significant outliers of this indicator were removed by taking values from the 5th percentile to the 95th percentile). For a complete description of variables and sources see Table C in the Appendix.

Table 13: Quantile regressions of 2008-2013 average Z-scores with Growth loans to GDP

| | (1) OLS | (2) Q(25) | (3) Q(50) | (4) Q(75) |
|---|---|---|---|---|
| NSFR | 0.670** | 0.658** | 0.649** | 0.620** |
| | (0.262) | (0.291) | (0.269) | (0.251) |
| Size | -0.0190 | 0.0132 | -0.0343 | -0.0375 |
| | (0.0290) | (0.0315) | (0.0319) | (0.0241) |
| Change in exchange rate (%) | -0.0513*** | -0.0465*** | -0.0397*** | -0.0417*** |
| | (0.0132) | (0.0121) | (0.0153) | (0.0113) |
| Government-owned banks (%) | 0.0118*** | 0.0158*** | 0.00775* | 0.00553* |
| | (0.00363) | (0.00368) | (0.00422) | (0.00299) |
| M2 to GDP (%) | -0.000399 | -0.00245** | 0.000549 | 0.00315 |
| | (0.00159) | (0.00107) | (0.00254) | (0.00211) |
| Bank activities | -0.191*** | -0.214*** | -0.173*** | -0.161*** |
| | (0.0398) | (0.0420) | (0.0556) | (0.0425) |
| Foreign-owned banks | -0.00522 | -0.00489 | -0.00649 | -0.00283 |
| | (0.00399) | (0.00417) | (0.00619) | (0.00317) |
| Growth loans to GDP | -0.0685*** | -0.0704*** | -0.0659*** | -0.0541*** |
| | (0.0142) | (0.0113) | (0.0199) | (0.0151) |
| Constant | 4.796*** | 3.935*** | 4.975*** | 5.337*** |
| | (0.699) | (0.631) | (0.906) | (0.536) |
| N | 2745 | 2745 | 2745 | 2745 |

We use the least-absolute-deviations (LAD) estimator with robust intra-cluster correction proposed by Parente and Santos Silva (2016). Standard errors in parentheses. Standard errors adjusted for country clusters. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Explanatory variables: 2001-2007 averages of: NSFR: Ratio that aims to measure the level in which available stable funding cover the required stable funding for a bank to transform short-term liabilities into long-term stable assets.; Size: logarithm of total bank's asset.; Change in exchange rate (%): yearly growth rate of the nominal exchange rate; Government-owned banks (%): Percentage of banking system total assets that is held by state-owned banks; M2 to GDP (%): Money and Quasi money (M2) as percentage of GDP; Bank activities: Index that measures the extent to which a bank can both engage in securities, insurance, and real estate activities and own nonfinancial firms; Foreign-owned banks: Percentage of banking system total assets that is held by foreign-owned banks; Growth loans to GDP: Measured as the yearly growth rate of credit to private sector over GDP. For a complete description of variables and sources see Table C in the Appendix.

Table 14: Quantile regressions of 2008-2013 average Z-scores with Leverage

| | (1) OLS | (2) Q(25) | (3) Q(50) | (4) Q(75) |
|---|---|---|---|---|
| NSFR | 1.045*** | 0.895** | 1.002** | 0.894*** |
| | (0.280) | (0.354) | (0.412) | (0.336) |
| Size | 0.000986 | 0.0330 | -0.0105 | -0.0275 |
| | (0.0334) | (0.0382) | (0.0358) | (0.0274) |
| Change in exchange rate (%) | -0.0365* | -0.0394 | -0.0237 | -0.0301* |
| | (0.0202) | (0.0423) | (0.0217) | (0.0174) |
| Government-owned banks (%) | 0.0118*** | 0.0158*** | 0.00744 | 0.00416 |
| | (0.00415) | (0.00447) | (0.00506) | (0.00458) |
| M2 to GDP (%) | 0.00564*** | 0.00401** | 0.00627*** | 0.00804*** |
| | (0.00190) | (0.00202) | (0.00234) | (0.00263) |
| Bank activities | -0.175*** | -0.179*** | -0.144** | -0.154*** |
| | (0.0481) | (0.0484) | (0.0653) | (0.0527) |
| Foreign-owned banks | -0.000509 | 0.0000249 | -0.0000311 | 0.000573 |
| | (0.00485) | (0.00567) | (0.00657) | (0.00364) |
| Leverage | 0.000316 | 0.000684 | 0.00363 | -0.000276 |
| | (0.00451) | (0.00755) | (0.00509) | (0.000978) |
| Constant | 3.102*** | 2.146*** | 3.138*** | 4.178*** |
| | (0.579) | (0.465) | (0.552) | (0.552) |
| N | 2745 | 2745 | 2745 | 2745 |

We use the least-absolute-deviations (LAD) estimator with robust intra-cluster correction proposed by Parente and Santos Silva (2016). Standard errors in parentheses. Standard errors adjusted for country clusters. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Explanatory variables: 2001-2007 averages of: NSFR: Ratio that aims to measure the level in which available stable funding cover the required stable funding for a bank to transform short-term liabilities into long-term stable assets.; Size: logarithm of total bank's asset.; Change in exchange rate (%): yearly growth rate of the nominal exchange rate; Government-owned banks (%): Percentage of banking system total assets that is held by state-owned banks; M2 to GDP (%): Money and Quasi money (M2) as percentage of GDP; Bank activities: Index that measures the extent to which a bank can both engage in securities, insurance, and real estate activities and own nonfinancial firms; Foreign-owned banks: Percentage of banking system total assets that is held by foreign-owned banks; Leverage: Measured as the ratio of total assets to equity. For a complete description of variables and sources see Table C in the Appendix.

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Table 15: Quantile regression specification test

15.a) All countries

| | Q(25) | Q(50) | Q(75) |
|---|---|---|---|
| Model with Growth loan deviation | 21.584*** | 28.092*** | 23.260*** |
| Model with Growth loans to GDP | 17.357*** | 21.341*** | 18.393*** |
| Model with Leverage | 21.606*** | 26.738*** | 25.239*** |
| Model with NSFR*Var. FX | 20.535*** | 27.698*** | 25.607*** |

Parente and Santos Silva (2016) test for intra-cluster correlation. Standard errors adjusted for country clusters. Ho: No intra-cluster correlation. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

15.b) Developed countries

| | Q(25) | Q(50) | Q(75) |
|---|---|---|---|
| Model with Growth loan deviation | 14.583*** | 16.914*** | 9.139*** |
| Model with Growth loans to GDP | 9.142*** | 15.592*** | 8.851*** |
| Model with Leverage | 12.970*** | 15.813*** | 11.245*** |
| Model with NSFR*Var. FX | 14.664*** | 18.702*** | 9.462*** |

Parente and Santos Silva (2016) test for intra-cluster correlation. Standard errors adjusted for country clusters. Ho: No intra-cluster correlation. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

15.c) Developing countries

| | Q(25) | Q(50) | Q(75) |
|---|---|---|---|
| Model with Growth loan deviation | 6.078*** | 5.599*** | 2.029** |
| Model with Growth loans to GDP | 5.587*** | 4.871*** | 2.797*** |
| Model with Leverage | 5.444*** | 5.149*** | 2.325** |
| Model with NSFR*Var. FX | 6.074*** | 5.517*** | 2.492** |

Parente and Santos Silva (2016) test for intra-cluster correlation. Standard errors adjusted for country clusters. Ho: No intra-cluster correlation. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.0$

## Figures

**Figure 1:** Alternative measures of required and available stable funding, based on data publicly available

| Assets | RSF | RSF1 | RSF2 | Liabilities + Equity | ASF | ASF1 |
|---|---|---|---|---|---|---|
| 1. Total Earning Assets | | | | 1. Total Deposits, Money Market and Short Term Funding | | |
| 1.A Loans | 85% | 85% | 85% | 1.A Total Customer Deposits | | 80% |
| 1.A.1 Total Customer Loans | | | | 1.A.1 Customer Deposits - Current | 90% | |
| Mortgage Loans | | | | 1.A.2 Customer Deposits - Savings | 95% | |
| Other Mortgage Loans | | | | 1.A.3 Customer Deposits - Term | 95% | |
| Other Consumer/Retail Loans | | | | 1.B Deposits from Banks | 0% | 0% |
| Corporate & Commercial Loans | | | | 1.C Other Deposits and Short-term Borrowing | 25% | 25% |
| Other Loans | | | | 2. Other Interest Bearing Liabilities | | |
| 1.A.1 Reserves for Impaired Loans/NPLs | | | | 2.A Derivatives | 0% | 0% |
| 1.B Other Earning Assets (OEA) | | | | 2.B Trading Liabilities | 0% | 0% |
| 1.B.1 Loans and Advances to Banks | 0% | 0% | 0% | 2.C Total Long Term Funding | 100% | 100% |
| 1.B.3 Total Securities | | | 50% | 2.C.1 Long Term Funding | | |
| Other Securities | 50% | 50% | | Senior Debt | | |
| At equity investments | 50% | 50% | | Subordinated Borrowing | | |
| Trading Securities | 50% | 15% | | Other Funding | | |
| Remaining Securities | 50% | 50% | | 2.C.2 Pref. Shares and Hybrid Capital | 0% | 0% |
| Memo: Government securities | 5% | | | 3. Non-Interest Bearing Liabilities | 0% | 0% |
| 1.B.4 Remaining OEA | | | 0% | 4. Loan Loss Reserves | 0% | 0% |
| 2. Fixed Assets | 100% | | 100% | 5. Other Reserves | 0% | 0% |
| 3. Non-Earning Assets | 100% | | 100% | 6. Equity | 100% | 100% |

**Figure 2:** Kernel density of alternative ratios of net stable funding.

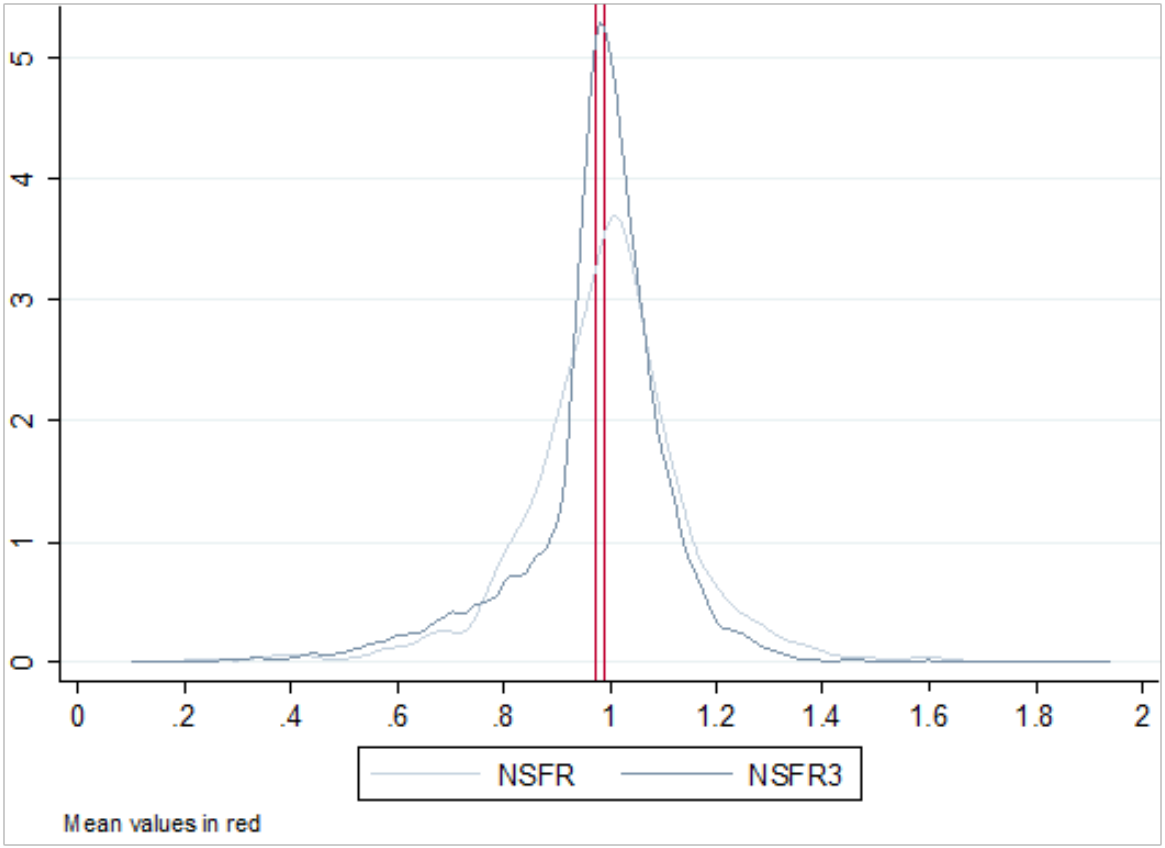
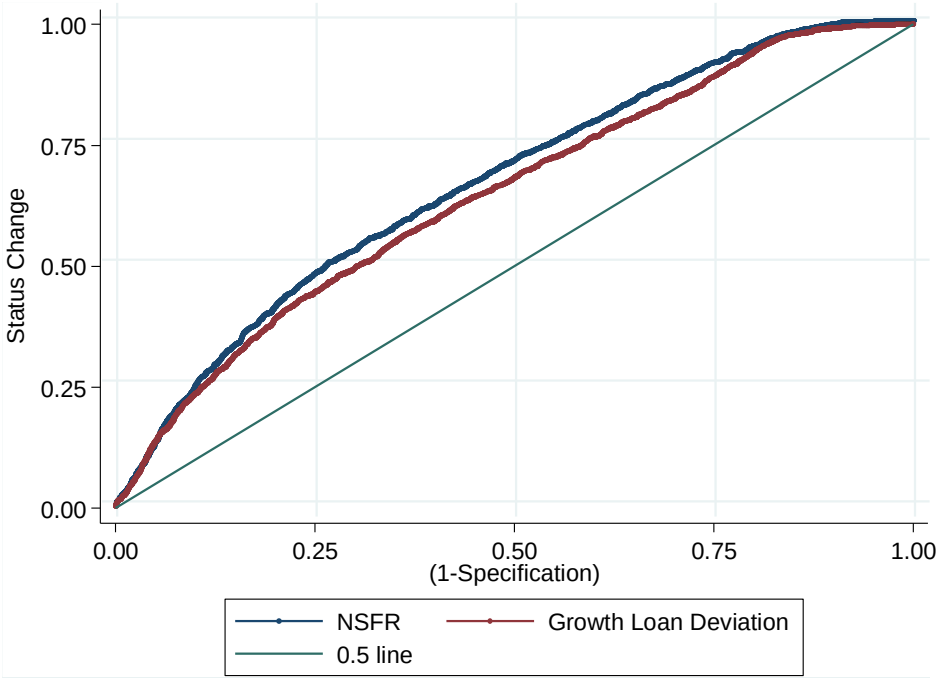


**Figure 3:** Test AUROC of predictive ability - NSFR over Growth Loan Deviation

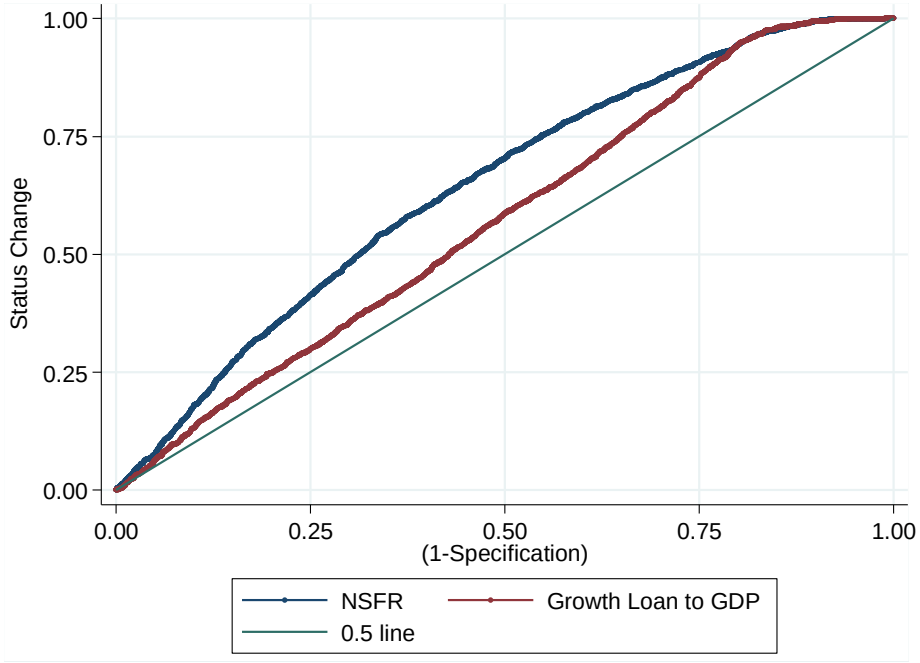



| Test Chi-square of AUROC equality | ROC | | Asymptotic Normal | | |
|---|---|---|---|---|---|
| | Obs | Area | Std. Err. | [95% Conf. Interval] | |
| ROC1. With NSFR / Including Growth Loan Deviation (%) | 10323 | 0.6642 | 0.0063 | 0.65190 | 0.66643 |
| ROC2. Without NSFR / Including Growth Loan Deviation (%) | 10323 | 0.6454 | 0.0064 | 0.63289 | 0.65801 |

Ho: Area under ROC1 = Area under ROC2

chi2= 29.49; Prob>chi2= 0.0000

**Figure 4:** Test AUROC of predictive ability - NSFR over Growth Loan to GDP

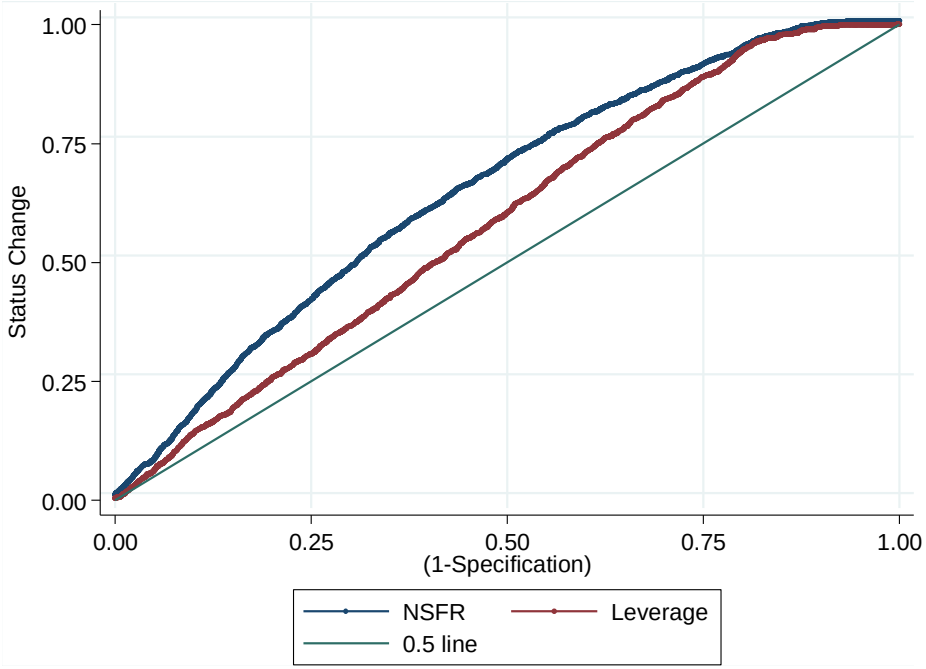



| Test Chi-square of AUROC equality | ROC | | Asymptotic Normal | | |
|---|---|---|---|---|---|
| | Obs | Area | Std. Err. | [95% Conf. Interval] | |
| ROC1. With NSFR / Including Growth Loan to GDP (%) | 10958 | 0.6427 | 0.0059 | 0.63106 | 0.65435 |
| ROC2. Without NSFR / Including Growth Loan to GDP (%) | 10958 | 0.5721 | 0.0061 | 0.56011 | 0.58412 |

Ho: Area under ROC1 = Area under ROC2

chi2= 106.05; Prob>chi2= 0.0000

**Figure 5:** Test AUROC of predictive ability - NSFR over Leverage




| Test Chi-square of AUROC equality | ROC | | Asymptotic Normal | | |
|---|---|---|---|---|---|
| | Obs | Area | Std. Err. | [95% Conf. Interval] | |
| ROC1. With NSFR / Including Leverage (%) | 10958 | 0.6431 | 0.0059 | 0.63147 | 0.65473 |
| ROC2. Without NSFR / Including Leverage (%) | 10958 | 0.5843 | 0.0060 | 0.57248 | 0.59619 |

Ho: Area under ROC1 = Area under ROC2

chi2= 106.05; Prob>chi2= 0.0000

**Figure 6:** Z-score density

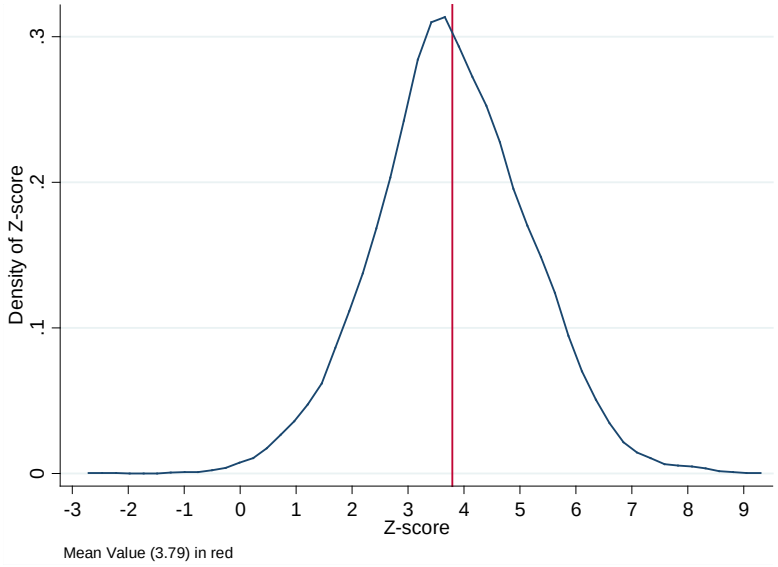
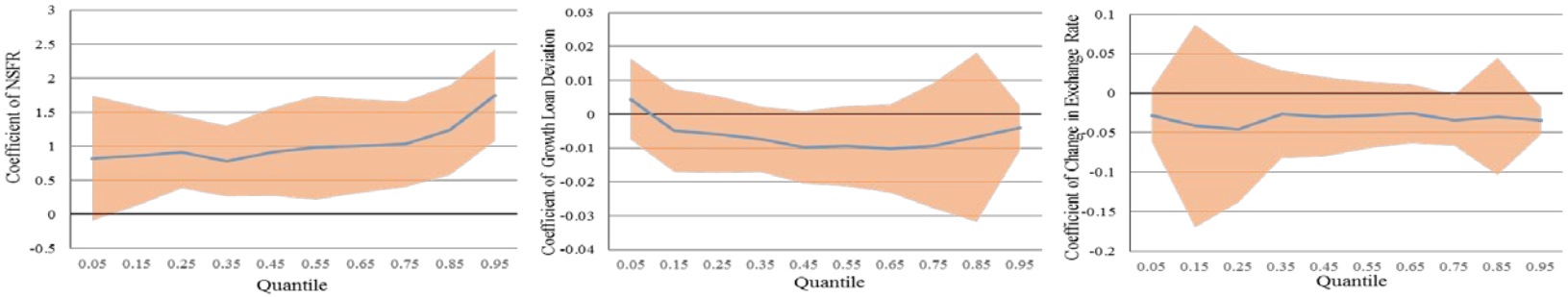
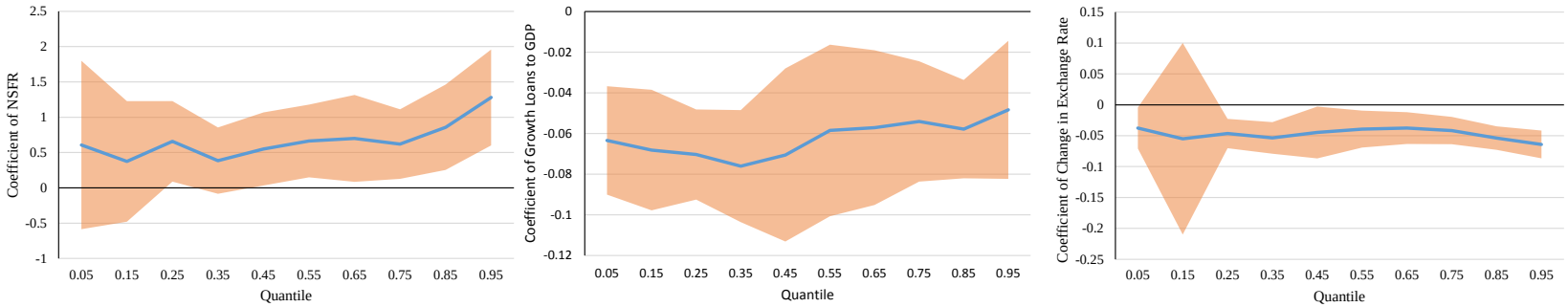


**Figure 7:** Quantile regression coefficients and 95% confidence intervals

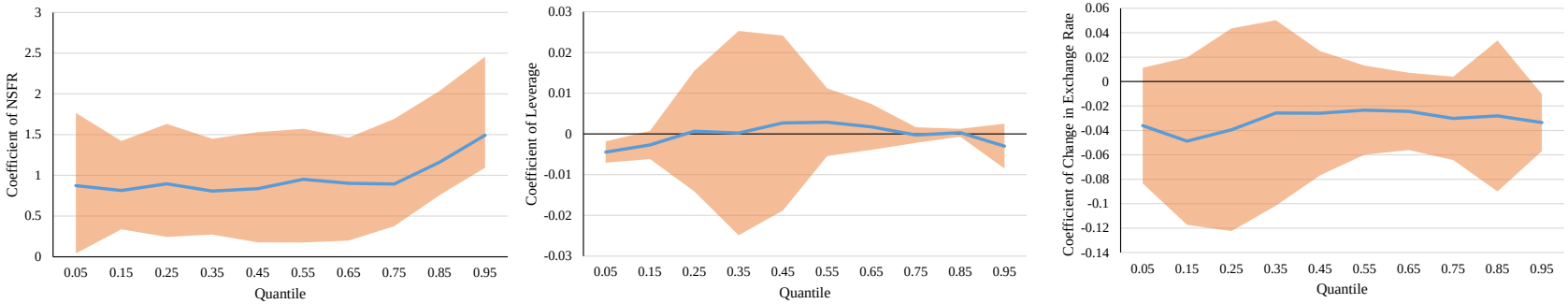
*Quantile coefficients with Growth Loan Deviation*




*Quantile coefficients with Growth Loans to GDP*




*Quantile coefficients with Leverage*



## Appendix

**Table A:** Alternative definitions for status change from December 2006 to June 2015.

| | Dummy variables for banks that held a positive NSFR in December 2016 | | | |
|---|---|---|---|---|
| Status held as of June 2015 | **STATCH1 (Baseline)** | STATCH2 | STATCH3 | STATCH4 |
| Active | **0** | 0 | 0 | 0 |
| Active (receivership) | **1** | 0 | 0 | 0 |
| Active, no longer with accounts | **1** | 1 | 0 | 0 |
| Bankruptcy | **1** | 1 | 1 | 0 |
| Dissolved | **1** | 1 | 1 | 1 |
| Dissolved (merged) | **1** | 1 | 1 | 0 |
| In liquidation | **1** | 1 | 1 | 0 |
| Inactive (no precision) | **1** | 1 | 1 | 0 |

**Table B:** Correlation coefficients for regression variables:

| | Stat Ch 2015 | Z-score | NSFR | Size | CHG_FX | GOB | M2 to GDP (%) | ORBA | FOB (%) | G Loans Dev (%) | NSFR* CHG_FX | G Loans to GDP (%) | LEV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Status Change 2015 | 1.0000 | | | | | | | | | | | | |
| Z-score | -0.4024 | 1.0000 | | | | | | | | | | | |
| NSFR | -0.0760 | 0.0683* | 1.0000 | | | | | | | | | | |
| Size | -0.0865 | 0.0258 | -0.1791* | 1.0000 | | | | | | | | | |
| CHG__FX (%) | 0.0549 | -0.3151* | 0.2023* | -0.1230* | 1.0000 | | | | | | | | |
| GOB (%) | -0.0584 | 0.1644* | -0.5000* | 0.1395* | -0.2324* | 1.0000 | | | | | | | |
| M2 to GDP (%) | -0.2214 | 0.3847* | -0.1047* | 0.4528* | -0.4533* | 0.2194* | 1.0000 | | | | | | |
| ORBA | 0.0574 | -0.2737* | 0.4749* | -0.1149* | 0.5830* | -0.4372* | -0.4240* | 1.0000 | | | | | |
| FOB (%) | 0.0387 | -0.2210* | 0.0336* | 0.0052 | 0.2732* | -0.2986* | -0.3186* | 0.1688* | 1.0000 | | | | |
| Growth Loans Dev (%) | -0.0377 | -0.0728* | 0.1027* | -0.0659* | 0.0140 | -0.0219* | -0.0165* | 0.0311* | 0.0070 | 1.0000 | | | |
| NSFR*CHG_FX | 0.0641 | -0.3360* | 0.1754* | -0.1198* | 0.9838* | -0.2556* | -0.4607* | 0.5829* | 0.2836* | 0.0053 | 1.0000 | | |
| G Loans to GDP (%) | 0.1701 | -0.3284* | -0.2726* | -0.2661* | 0.0725* | 0.2325* | -0.6220* | -0.1078* | 0.0543* | -0.0016 | 0.1044* | 1.0000 | |
| LEVERAGE (%) | -0.1090 | 0.1269* | -0.1023* | 0.1879* | -0.1401* | 0.0682* | 0.2592* | -0.1420* | -0.0645* | -0.0067 | -0.1412* | -0.1533* | 1.0000 |

Polychoric correlations between Status Change 2015 and the rest (in bold), and Pearson's pairwise correlations elsewhere. *p<0.10 (significance levels are not available for polychoric correlations). Variable definitions in Table C of the Appendix. NSFR: Ratio that aims to measure the level in which available stable funding cover the required stable funding for a bank to transform short-term liabilities into long-term stable assets.; Size: logarithm of total bank's asset.; CHG__FX (%): Change in exchange rate (%), yearly growth rate of the nominal exchange rate; GOB (%): Government-owned banks (%), percentage of banking system total assets that is held by state-owned banks ; M2 to GDP (%): Money and Quasi money (M2) as percentage of GDP ; ORBA: Bank activities, Index that measures the extent to which a bank can both engage in securities, insurance, and real estate activities and own nonfinancial firms ; FOB: Foreign-owned banks, Percentage of banking system total assets that is held by foreign-owned banks; G Loans Dev (%): Growth loan deviation, measured as the deviation of bank's individual yearly growth rate of loans over the country average growth rate of loans (due to the presence of outliers, they were removed by taking values from the $5^{th}$ percentile to the $95^{th}$ percentile); GLOAN _GDP (%): Growth loans to GDP, measured as the yearly growth rate of credit to private sector over GDP ; LEV: measured as the ratio of total assets to equity. For a complete description of variables and sources see Table C in the Appendix.

**Table C:** Variables definition and sources

| Variable | Description | Source |
|---|---|---|
| ***Dependent variables*** | | |
| Status change 2015 (STATCH) | Dummy variable that takes one if the bank held a positive NSFR at December 2006 and is no longer active at June 2016. | Bankscope and own calculations |
| Z-score (ZSCORE) | It is measured as the number of standard deviations that bank return on average assets (ROAA) has to be drop to extinguish all equity of the bank. | Bankscope and own calculations |
| ***Bank-level variables*** | | |
| Net Stable Funding Ratio (NSFR) | Ratio that aims to measure the level in which available stable funding cover the required stable funding for a bank to transform short-term liabilities into long-term assets | Bankscope.and own calculations. |
| Bank size (Size) | Logarithm of total bank's asset. It is calculated in a similar way to Basel's NSFR | Bankscope.and own calculations. |
| Leverage ratio (LEV) | Measured as the ratio of equity to total assets. | Bankscope.and own calculations. |
| Growth loan deviation (%) | Measured as the deviation of bank's individual yearly growth rate of loans over the country average growth rate of loans. In those observations where yearly data of loans were unavailable, we estimated the annual rate using geometric interpolation between the two closest years, prior and after those periods. Additionally, outliers were removed by taking values from the 5th percentile to the 95th percentile. | Bankscope.and own calculations. |
| ***Country-level variables*** | | |
| Money and quasi Money (MCM) | Money and Quasi money (M2) as percentage of GDP. | World Bank. |
| Growth Loans to GDP (GLOAN_GDP) | Measured as the yearly growth rate of credit to private sector over GDP. | World Bank. |
| Overall Restrictions on Bank Activities (ORBA) | Index that measures the extent to which a bank can both engage in securities, insurance, and real estate activities and own nonfinancial firms. It can potentially range from 4 to 16, with higher numbers indicating greater restrictiveness. | WB database "The Regulation of Banks around the World", surveys I, II, III and IV. Barth et al. (2001, 2004, 2006, 2012). |
| Government-owned banks (GOB) | Percentage of banking system total assets that is held by state-owned banks | WB database "The Regulation of Banks around the World", surveys I, II, III and IV. Barth et al. (2001, 2004, 2006, 2012). |
| Foreign-owned banks (FOB) | Percentage of banking system total assets that is held by foreign-owned banks | WB database "The Regulation of Banks around the World", surveys I, II, III and IV. Barth et al. (2001, 2004, 2006, 2012). |
| Change of the exchange rate (CHG_FX) | Yearly growth rate of the nominal exchange rate | Penn World Table (PWT) |

Notes: The construction of the regulatory variables is explained in detail by Barth, Caprio and Levine (2004).