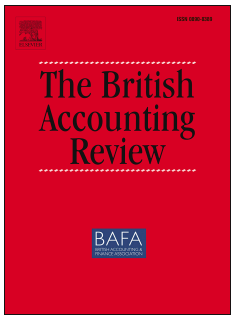


# Capital and Liquidity Ratios and Financial Distress. Evidence from the European Banking Industry

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Laura Chiaramonte* and Barbara Casu#

**Abstract**

Using a large bank-level dataset, we test the relevance of both structural liquidity and capital ratios as defined in Basel III on banks' probability of failure. To include all relevant episodes of bank failure and distress (F&D) occurring in the EU-28 member states over the past decade, we develop a broad indicator that includes information not only on bankruptcies, liquidations, under receivership and dissolved banks, but also accounts for state interventions, mergers in distress and EBA stress test results. Estimates from several versions of the logistic probability model indicate that the likelihood of failure and distress decreases with increased liquidity holdings, while capital ratios are significant only for large banks. Our results provide support for Basel III's initiatives on structural liquidity and for the increased regulatory focus on large and systemically important banks.

**Keywords:** bank capital, structural liquidity, Basel III, bank failure and distress, financial crises

**JEL Classification:** *G*01, *G*21

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# Capital and Liquidity Ratios and Financial Distress.

# Evidence from the European Banking Industry


## Abstract

Using a large bank-level dataset, we test the relevance of both structural liquidity and capital ratios as defined in Basel III on banks' probability of failure. To include all relevant episodes of bank failure and distress (F&D) occurring in the EU-28 member states over the past decade, we develop a broad indicator that includes information not only on bankruptcies, liquidations, under receivership and dissolved banks, but also accounts for state interventions, mergers in distress and EBA stress test results. Estimates from several versions of the logistic probability model indicate that the likelihood of failure and distress decreases with increased liquidity holdings, while capital ratios are significant only for large banks. Our results provide support for Basel III's initiatives on structural liquidity and for the increased regulatory focus on large and systemically important banks.



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## 1. Introduction

The global financial crisis lead to a broad consensus that capital and liquidity holdings are equally important to promote the safety and soundness of banks. This has prompted a revision of the existing regulatory framework, which resulted in the introduction of liquidity standards in the Basel III capital adequacy framework. While capital regulation aims to limit banks' insolvency risk by increasing their loss-absorbing capacity, liquidity regulation aims to minimise banks' maturity mismatch, to limit funding risk and market liquidity risk. Although theoretically more liquid and better-capitalised banks should also be safer banks, in practice these requirements might trigger changes in risk management, decrease bank profitability and ultimately increase bank risk taking propensity. While there is a substantial literature on the effectiveness of capital measures in predicting bank distress, little is known about the impact of the new liquidity measures. In addition, empirical evidence on how the combination of mandatory capital and liquidity ratios actually impacts on bank stability is limited.

This paper contributes to the emerging strand of the literature on the potential impact of the introduction of minimum liquidity ratios (King, 2013; Dietrich *et al.*, 2014; Hong *et al.*, 2014) and investigates the effectiveness of the Basel III bank capital and liquidity measures in reducing bank failures and distress. In particular, we consider the relationship between the newly proposed measure of structural liquidity, the Net Stable Funding Ratio (NSFR), and subsequent bank probability of default. We also contribute to the broader literature on bank liquidity management, which builds on the works of Kashyap *et al.,* (2002); Gatev and Strahan (2006); Gatev *et al.,* (2009) and has recently considered whether banks advantage as liquidity providers has failed during the financial crisis (Acharya and Mora, 2015).

Focusing on a sample of banks headquartered in the EU-28 member states over the period 2004-2013, we aim to answer the following questions: (i) are higher structural liquidity ratios decreasing banks' subsequent probability of default? (ii) are structural liquidity and capital ratios

complementary in promoting bank stability? and (iii) is the relationship between liquidity and capital ratios and banks' probability of failure different for large banks?

To answer these questions, we first examine the relationship between the Basel III capital and liquidity ratios and episodes of bank failure and distress. Our NSFR is computed following both the final version of October 2014 and the original document of December 2010, in order to assess the impact of changes in regulatory definitions. As proxy of capital, we use alternatively a non-risk-weighted indicator, i.e. the ratio of equity to total assets (as a proxy of the leverage ratio), and two risk-based measures, i.e. Tier1 capital ratio and Total regulatory capital ratio.

Given that outright bank failures in the EU have been extremely low, we develop a broad indicator of bank failure to include all relevant episodes of distress occurring in EU member states over the past decade. Following Betz *et al.* (2014), we collect information not only on bankruptcies, liquidations, under receivership and dissolved episodes, but we also take into account state interventions and mergers in distress. We subsequently analyse whether the link between capital and liquidity indicators and the probability of failure and distress differs for large banks by focusing on the 123 banks observed by European Banking Authority (EBA) in the EU-wide 2014 stress testing exercise. In this instance, our definition of failed and distressed banks takes also into account EBA information for banks that did not overcome stress tests.

Following the exiting literature (see Poghosyan and Čihák, 2011; Distinguin *et al.*, 2013; DeYoung and Torna, 2013), to evaluate the relationship between Basel III liquidity and capital measures and bank failures and distress, we use several versions of the logistic probability model.

This paper makes several contributions to the related literature. To the best of our knowledge, it is the first study to estimate bank structural liquidity ratios by employing the final version of the NSFR (October 2014). In addition, we compare the ratios obtained following the 2014 specification to those obtained following the initial 2010 specification. This allows us to validate the effectiveness of the new rules proposed by the Basel Committee on Banking Supervision (BCBS) and therefore to provide evidence to support the regulatory effort. Our second contribution relates to

the geographical coverage of sample banks. This is one of a handful of studies that focuses exclusively on episodes of failure and distress among EU banks (see Poghosyan and Čihák, 2011; and Betz *et al.*, 2014). This most likely reflects the fact that the number of outright bank failures in EU countries is relatively low and some EU countries experienced no bank failures. Indeed, the large majority of studies on the determinants of bank failures focus on the US, both because of numerous episodes of bank failures and because of the detailed information available for US banks (see Lane *et al.*, 1986; Cole and Gunther, 1995; Calomiris and Mason, 2000; Estrella *et al.*, 2000; Wheelock and Wilson, 2000; and Hong *et al.*, 2014).

Departing from previous studies, our definition of failed and distressed banks also takes into account state interventions, mergers in distress and the EBA stress tests results. This enables us to consider all troubled EU banks, not only those that failed. Finally, the data covers a timeframe that allows us to investigate bank funding structure and capital dynamics in the run up to, during and after the global financial and eurozone crises, providing the first evidence on the impact of crises on sources of distress for individual banks.

The main results of the empirical analysis can be summarised as follows. We find that capital and liquidity ratios play a complementary role in ensuring bank soundness, but only for the largest banking groups. When considering the full sample, our results indicate that, among the target variables, only the NSFR is a significant determinant of banking sector fragility in the EU. This result is consistent with the view that during the global financial crisis the key source of bank instability was excessive maturity transformation (see Gobat *et al.*, 2014). Indeed, banks that ran into difficulty almost always had low NSFR, although their capital requirements were well above the statutory minimum (see BCBS, 2014). Moreover, we show that only the new final version of the NSFR (October 2014) has predictive power, whereas the original version (December 2010) does not. This finding implies that the recent changes on the calibration of the NSFR are effective in terms of improving bank stability. Finally, considering only large banks, we find that both Basel III liquidity and capital standards are significant in reducing bank probability of default. Hence, the

results support the Basel III regulations on structural liquidity and capital, but only for the largest banking groups. This is in line with the major emphasis placed by the BCBS on global systemically important banks (G-SIBs).

The findings of the analysis are of particular interest to both academics and policy makers as they contribute to the current debate on the effectiveness of the combined role of liquidity and capital cushions in promoting bank stability, especially for the largest banks.

The remainder of the paper is organised as follows. Section 2 summarises the bank capital and liquidity rules of Basel III and Section 3 reviews the relevant literature. Section 4 describes the sample and discusses the methodology and our identification of failure and distress events. It also presents our variables of interest and the controls used in the empirical analysis. Section 5 and 6 present the empirical results and the robustness tests. Section 7 concludes and offers some policy implications.

## 2. Basel III capital and liquidity requirements and bank stability

The Basel Committee on Banking Supervision (BCBS), in the December 2010 final document (the so-called Basel III accord), set the introduction of liquidity standards for banks and added a leverage ratio to the revised risk-weighted capital buffers, introduced in Basel II.[1]

The capital standards and new capital buffers will require banks to hold more and higher quality capital than under Basel II. The enhanced capital ratios prescribed by the BCBS relate to the ratio of a firm's eligible regulatory capital divided by a regulatory prescribed calculation of risk-weighted asset. In addition to strengthened capital requirements, the Basel III framework introduced a non-risk-weighted leverage ratio (capital to asset ratio), which has been designed to supplement risk-based minimum capital requirements (i.e. Tier1 Capital Ratio and Total Regulatory Capital Ratio)

[1] Being a new and complex set of rules, a full analysis of the regulatory changes proposed under the Basel III framework is outside the scope of this paper.

to ensure that adequate funding is maintained in case of crisis. This is a supplemental 3% non-risk based leverage ratio, which serves as a backstop to the measures outlined above.

Furthermore, the BCBS (2010) developed two quantitative measures for liquidity: the Liquidity Coverage Ratio (LCR), which aims to ensure that banks have enough liquid assets to withstand liquidity stress in the short term, and the Net Stable Funding Ratio (NSFR), which aims to encourage banks to hold more stable and longer term funding sources against their liquid assets, thereby reducing maturity transformation risk. The two liquidity ratios are required to be above 100 per cent. The Basel III liquidity standards have undergone substantial revisions since they were first issued in December 2010. With respect to the NSFR, the overall aim of these changes was to ensure that the indicator reflected a bank's structural liquidity risk rather than it being calculated for stress testing purposes only. These changes include greater differentiation in terms of maturity, to allow for the prompt identification of banks with excessive maturity mismatches and more fragile funding structures (BCBS, 2014).

More specifically, the NSFR is the ratio between the amount of Available Stable Funding (ASF) relative to the amount of Required Stable Funding (RSF):

$$NFSR = \frac{ASF}{RSF} \tag{1}$$

The ASF comprises weighted liabilities reflecting their contractual maturity and is defined as the portion of capital and liabilities expected to be a reliable source of funding over a one-year time horizon. The RSF of a specific bank is a function of the liquidity characteristics and residual maturities of the various assets held by that institution as well as those of its off-balance sheet (OBS) exposures (BCBS, 2014). The ASF and RSF are calibrated to reflect the presumed degree of stability of a bank's liabilities and liquidity of a bank's assets. The weights for assets and liabilities range from 0% to 100%; these are primarily the result of internationally agreed definitions and calibrations.

For example, the NSFR is generally calibrated such that longer-term liabilities are assumed to be more stable than short-term liabilities and that short-term retail deposits are more stable than wholesale funding of the same maturity from other counterparties. While the level of detail necessary to estimate the NSFR is not publicly available, we can approximate the ratio consistently with the BCBS guidelines (see Equation 2). Table A.1 in the Appendix illustrates the calibrations we used, following both the 2010 and the 2014 documents, and the relevant balance sheet items considered for the estimation of the NSFR.[2]

$$NSFR = \frac{Equity + Total\ LT\ Funding + \left(\begin{matrix}Customer\ Deposits\\ Savings\ Term\end{matrix}\right) * 0.95 + \left(\begin{matrix}Customer\ Deposits\\ Current\end{matrix}\right) * 0.9 + \left(\begin{matrix}Other\ Deposits\ and\\ ST\ Borrowing\end{matrix}\right) * 0.5}{Other\ Assets + \left(\begin{matrix}Government\\ Securities\end{matrix} + \begin{matrix}OBS\\ Items\end{matrix}\right) * 0.05 + \left(\begin{matrix}Other\\ Securities\end{matrix} + \begin{matrix}Loans\ and\\ Advances\ to\ Banks\end{matrix}\right) * 0.5 + \left(\begin{matrix}Mortgage\\ Loans\end{matrix}\right) * 0.65 + \left(\begin{matrix}Retail\ and\\ Corportate\ Loans\end{matrix}\right) * 0.85} \quad (2)$$

Banks can achieve the required NSFR ratios either by implementing strategies aimed at increasing ASF or decreasing RSF or, most likely, a combination of both (see King, 2013, for a discussion of the complementary or alternative strategies aimed at increasing the NSFR). These strategies are likely to impact banks' liquidity management function, given the stronger emphasis on holdings of liquid assets, in particular of government securities. Allen *et al*. (2012) discuss the potential economic impact of the Basel III regulatory changes, especially in terms of the possible restructuring of banks' balance sheets towards more liquid assets and consequent impact on the availability of credit. Covas and Driscoll (2014) develop a general equilibrium to study the macroeconomic impact of introducing a minimum liquidity standard for banks on top of existing capital adequacy requirements. They suggest that the introduction of a minimum liquidity requirement would lead to a decline in loans by about 3 percent and an increase in securities over 6 percent. As the introduction liquidity regulation could prevent banks from fully exploiting their profit opportunities, they would reduce the supply of bank loans and increases the cost of funds.

[2] The weights in Equation 2 relate to the 2014 NSFR specification. For more details on the construction of the NSFR see Section 4.4.4 and Appendix 1.

This, in turn, would lead to decreased aggregate output and decreased consumption. In contrast, Dietrich *et al*. (2014)'s empirical evidence indicates that the introduction of the NSFR is likely to have little impact on bank performance, measured by the return on assets, return on equity and net interest margin.

Despite the potential costs, the primary aims of the new regulations is to ensure banks' stability. While both capital and liquidity holdings are important for the safety and soundness of banks, little is known about the way the newly introduced liquidity standards interact with capital buffers. Liquidity and solvency are closely interrelated, however, they are not perfect substitutes. All else being equal, better-capitalised banks require less liquidity. Higher capitalisation might increase depositors and investors' confidence and therefore allow banks easier (and cheaper) access to short term funding. However, a strong capital position is not sufficient to address liquidity risk and banks still need to hold liquidity buffers, regardless of their capital positions. As the global financial crisis has shown, even well capitalised banks may have difficulties in accessing short term funding during turbulent financial conditions. On the other hand, higher liquidity buffers can compensate for lower capital when a bank is facing difficulties. There are a number of channels through which liquidity standards can interact with capital measures (Farag *et al*., 2013; ECB, 2014). Banks can increase the NSFR by decreasing the amount of risky and illiquid assets and replace them with liquid assets, leading to an improvement in capital ratios. In addition, the cost of increasing the NSFR should decrease as capital ratios improve, highlighting synergies between the two indicators (ECB, 2014).

In sum, while capital and liquidity are equally important in ensuring bank stability, the interactions among them are still unclear. In addition, both banks and regulators will seek an optimal combination of capital and liquidity that minimises the risk of financial distress while limiting the costs of holding excessive buffers which could be detrimental to banks' financial intermediation function.

## 3. Literature Review

Capital ratios have long been a valuable regulatory tool for assessing the safety and soundness of banks. In particular, as US regulators use CAMELS ratings to assess bank conditions, a number of studies have used proxies for capital adequacy, asset quality, management quality, earnings, liquidity, and sensitivity as predictors of bank failures. The earlier studies (Cole and Gunther, 1995; Estrella *et al.*, 2000; Wheelock and Wilson, 2000; DeYoung, 2003) use data on US financial institutions during the savings and loan crisis (S&Ls) of the 1980s and early 1990s. More recently, a number of studies have applied the same framework to the analysis bank failures during the global financial crisis (Cole and White, 2012; DeYoung and Torna, 2013; Altunbas *et al.*, 2015). These studies consistently identify a robust set of bank failure predictors, including aggressive loan growth and excessive reliance on short-term market funding. In addition, low quality assets (high levels of non-performing loans), low profitability and low capitalisation are linked to the accumulation of risk. The extant literature suggests that better capitalised banks fared better during the global financial crisis. Demirgüç-Kunt *et al.* (2013) find that during the crisis, a stronger capital position was associated with better stock market performance, most markedly for larger banks. They also find the relationship to be stronger when capital is measured by the leverage ratio rather than the risk-adjusted capital ratio. Similar results were reported by Beltratti and Stultz (2012). However, the relationship between capital and risk might be non linear, as both very low and very high levels of capital induce banks to take on more risk (Altunbas *et al.*, 2015). In practice, higher levels of capital may reflect regulators' efforts to encourage riskier banks to hold higher buffers. Delis and Staikouras (2011) find some evidence of a positive relationship between higher levels of bank capital and risk. Mayes and Stremmel (2014), focusing on FDIC-insured US banks from 1992 to 2012, compare risk-based and non-risked-weighted measures of capital. They find that the non-risked-weighted capital measure, the leverage ratio, explains bank distress and failures best and with considerable accuracy.

A handful of recent studies focus on the ability of the new Basel III capital ratios or of the new liquidity standards to reduce bank failures. The study closer to ours is Vazquez and Federico

(2015). They study the connection between structural liquidity and leverage in bank balance sheets in the run-up to the global financial crisis, and the likelihood of subsequent failure. Focusing on a sample of US and European banks over the period 2001-2009, they show the complementary nature of these two ratios. Banks with weaker structural liquidity and higher leverage ratios in the pre-crisis period were more likely to fail afterward. Vazquez and Federico (2015) also find evidence of systematic differences across bank types. Smaller banks were more susceptible to failure because of liquidity problems, while the large cross-border banking groups typically failed because of insufficient capital buffers. Hong *et al.* (2014) consider a sample of US commercial banks over the period 2001-2011 to examine potential links between Basel III liquidity risk measures and bank failures. They find that both the NSFR and LCR have limited effects on bank failures.

This brief review of the literature demonstrates that empirical work on the connection between Basel III liquidity and capital buffers and banks' subsequent probability of failure is still developing. We build on the existing literature and investigate whether higher capital and liquidity holdings contribute to decreasing banks' probability of failure.

## 4. Data and Methodology

### *4.1 Data*

This study focuses on all banks, both active and non-active, headquartered in the EU-28 member states. This allows us to include banks that failed or were acquired during the sample period (2004 – 2013). The 10-year time span enables us to take into account the numerous distress episodes that characterised many EU banks during the global financial crisis and subsequent eurozone crisis. Our empirical analysis is carried out using annual consolidated bank statements from the *Bureau Van Dijk*'s BankScope database.[3] The analysis focuses only on those EU banks with available data to compute our variables of interest (the Basel III capital and liquidity ratios).[4] Overall our sample

[3] Most of the information available on distress episodes (our dependent variable) is relative to banking groups. This is also consistent with the application of the Basel III liquidity rules at the highest level of consolidation.

[4] The estimation of the Basel III capital and liquidity ratios is data demanding in terms of the granularity of the balance sheet items necessary for the calibration of the ratios. A number of banks does not report to BankScope with the required level of detail, simply because these measures were not mandatory before the new regulation proposed by the

includes 513 banks, with 1,982 bank-year observations in total. Table A.2 in the Appendix presents the distribution of banks by country and the representativeness of the sample. We compare aggregate total assets of our sample banks over the time period of investigation with the aggregate total assets of the whole banking system. In line with Distinguin *et al.* (2013), the final sample constitutes over 56 per cent of the EU banking sector assets over the sample period. The representativeness of the sample increases in more recent years (74% of the total EU banking sector assets in 2013, see Table A.2), due to the improved reporting of more granular information for the relevant balance sheet items post crisis, in line with the new regulatory requirements.

Next, we focus on the 123 EU banks observed by EBA in the EU-wide stress testing 2014.[5] The EBA stress test is designed to provide supervisors, market participants and institutions with consistent data to "contrast and compare EU-banks' resilience under adverse market conditions". This subsample allows us to investigate whether the relationship between the Basel III capital and liquidity standards and subsequent bank failure is different for the EU largest banks. This is in line with the major emphasis placed by the BCBS on global systemically important banks. All large banks have information available and therefore we can include all the EBA banks in our analysis. Table A.2 in the Appendix illustrates the distribution of large banks by country.

*4.2 Empirical Methodology*

To study the relation between bank failure and Basel III liquidity and capital measures, we use a pooled logit model.[6] The model has the following log-likelihood function:

BCBS (2010). Missing values in the relevant accounting variables are present for banks in all categories, size, specialisation, ownership, etc.

[5] The 2014 stress test exercise included 123 banking groups across the EU (Austria, Belgium, Cyprus, Germany, Denmark, Spain, Finland, France, Greece, Hungary, Ireland, Italy, Luxembourg, Latvia, Malta, Netherlands, Poland, Portugal, Sweden, Slovenia, United Kingdom) and including Norway with a total of EUR 28,000BN of assets covering more than 70 per cent of total EU banking assets (see EBA, 2014). The list of EU banks subjected to the 2014 stress test exercise is available at www.eba.europa.eu.

[6] Pooled logit models have been widely used in the literature. See, among others, Kumar *et al.*, 2003; Fuertes and Kalotychou, 2007; Davis and Karim, 2008; Poghosyan and Čihak, 2011; LoDuca and Peltonen, 2013; Sarlin and Peltonen, 2013; and Betz *et al.*, 2014. See Fuertes and Kalotychou (2006) and Davis and Karim (2008) for a discussion on the appropriateness of a pooled approach. As a robustness check, we also run our estimations using a probit specification. We obtain qualitatively similar results.

$$LogL = \sum_{t=1}^{T}\sum_{i=1}^{N}\{Y_{it}\, log[F(\beta' X_{it-1})] + (1 - Y_{it}) log[1 - F(\beta' X_{it-1})]\} \quad (3)$$

where $Y_{it}$ is a binary variable that takes value of 1 when a bank *i* fails or experiences financial distressed in time period *t* and 0 otherwise. Following Poghosyan and Čihak (2011), we estimate the probability of default (PD) as a function of lagged explanatory variables $X_{it\text{-}1}$. $F(\beta' X_{it\text{-}1})$ is the cumulative probability distribution function evaluated at $\beta' X_{it\text{-}1}$. We assume that the probability distribution function is logistic. $\beta$ is a vector of coefficients to be estimated.

*4.3 Identifying Failed and Distressed Banks (F&D)*

Our identification process starts with the *Bureau Van Dijk*'s BankScope database. BankScope assigns a status to a bank that can take the following forms: (*i*) active; (*ii*) under receivership; (*iii*) bankruptcy; (*iv*) dissolved; (*v*) dissolved by merger; (*vi*) in liquidation.[7]

We classify a bank as failed and distressed (F&D) if it satisfies at least one of the following three conditions during our sample period (2004-2013).[8] The first condition is that a formerly active bank changes its status to under receivership, bankruptcy, dissolved, or in liquidation. The second condition regards banks that change their status to 'dissolved by merger', with one important caveat. Unlike the majority of related studies (Poghosyan and Čihák, 2011; Vazquez and Federico, 2015), we do not automatically include banks dissolved by merger in the F&D banks' definition.

[7] BankScope defines: 'under receivership' those banks that remain active, though they are in administration or receivership; 'bankruptcy' those banks that no longer exist because they have ceased their activities since they are in the process of bankruptcy; 'dissolved' those banks that no longer exist as a legal entity; 'dissolved by merger' those banks that no longer exist as a legal entity because they have been included in a merger; 'in liquidation' those banks that no longer exist because they have ceased their activities, since they are in the process of liquidation. In BankScope there are also the three following type of bank status: 'active, no longer with accounts on BankScope' that are banks still active, though their accounts are no longer updated on BankScope following an acquisition by another bank with accounts on BankScope integrating the accounts of its subsidiary in its consolidated accounts; 'dissolved by demerger', that are banks no longer exist as a legal entity. The reason for this is a demerger, the bank has been split; and 'inactive', these are banks no longer active and the precise reason for inactivity is unknown. In our analysis we don't consider these latter banks, as they do not return the necessary information.

[8] To check the robustness of our identification of F&D, we use a complementary methodology that allows us to identify technical failure banks. Following, Cole and White (2012) we count as a technical failure any bank reporting the sum of equity plus loan loss reserves as less than half of the value of its non-performing assets. We find that Cole and White's methodology gives the same results as those obtained using BankScope's information.

This is because mergers and acquisitions (M&As) might have been carried out for strategic reasons rather than for rescuing troubled banks (Arena, 2008). For this reason, following Betz *et al.* (2014), banks with status 'dissolved by merger' are classified as F&D banks only if they have a coverage ratio (defined as the ratio of total equity and loan loss reserve minus non-performing loans to total assets, CR) smaller than 0 during the twelve months prior to the M&A. Finally, a bank is classified as F&D if it receives state aid during the period considered. State aid can take different forms such as: nationalisation, recapitalisation, guarantee lines, loans, etc. Data on state aid are collected from the database provided by Mediobanca (2013). [9]

For our subsample of large banks, the definition of our dependent variable (F&D banks) also takes into account the EBA information for those banks that did not overcome the 2014 stress testing exercise.

Panel A of Table 1 illustrates the sample composition by bank status (active banks versus F&D) for the EU-28 member states during the period 2004–2013. We identify 292 F&D events for 106 banks.[10] The number of F&D banks in EU countries over the sample period is relatively low and some EU countries had no episodes of bank failures or distress.[11] In particular, Panel A of Table 1 shows that the highest number of cases of distress episodes (compared to the total number of banks in each country) occurred in Denmark and Greece, followed by Ireland, Belgium, Italy and Spain. This result is to some extent expected because Greece, Ireland, Italy and Spain had the most vulnerable banking sectors during the sovereign debt crisis. The Danish banking system was also severely affected by the crisis due to a strong presence of subsidiaries in Ireland (for example, Danske Bank). Concerning Belgium, two large banks, Fortis and Dexia experienced severe troubles. Other countries that experienced a relatively high number of bank failure and distress events are the

[9] Mediobanca is an Italian investment bank whose research department actively collects and publishes data on the banking industry. For each European country considered, the Mediobanca database includes details of all rescue operations. The Mediobanca database is based on official sources: the accounts of individual institutions, the official documents of the European Commission or of the national central banks.

[10] The number of banks is smaller than the number of F&D events, since some banks experienced multiple distress events over time.

[11] Due to the small number of failed EU banks over the period 2004-2013, it is not possible to consider failed and distressed banks separately.

United Kingdom, Austria and Portugal. The banking systems of France, Germany and the Netherlands show the lowest ratio of F&D banks on total banks. The low percentage of distressed banks in Germany is consistent with the evidence provided by Dam and Kotter (2012). Most of the banks that failed the EBA 2014 stress tests had already been identified as F&D in the previous step (see Table 1, column II). However, the EBA information allows us to add 12 F&D episodes. Particularly relevant for example is the case of Cyprus, where only applying the EBA screening we identify 3 banks as F&D.

Regarding the temporal distribution of F&D events, Panel B of Table 1 indicates that the majority of bank distress events in the EU took place mainly during the financial crises (96 per cent of all cases of bank failure and distress). This pattern is analogous to what happened in the US, where more than 500 commercial banks under FDIC supervision went bankrupt between 2008 and 2013 compared to less than 50 between 2001 and 2007. [12]

[Insert Table 1]

*4.4 Capital and liquidity indicators*

Our target variables are the Basel III capital and structural liquidity standards. To measure bank capital, we compute a non-risk-weighted leverage ratio, equal to equity to total assets (ETA), and two risk-based measures: Tier1 capital ratio (defined as the ratio of Tier1 capital to risk weighted assets - TIER1RATIO), and total regulatory capital ratio (defined as the ratio of Tier1 and Tier2 capital to risk weighted assets - TRCR). These proxies are broadly used in literature (see Betz *et al.*, 2014; Mayes and Stremmel, 2014; Vazquez and Federico, 2015). Due to multicollinearity between the capital explanatory variables (ETA, TIER1RATIO and TRCR), we perform the logistic estimations using the three capital ratios alternatively. We expect an increase of ETA (i.e. lower leverage), TIER1RATIO or TRCR to correspond to a decrease of F&D probability.

[12] See http://www.fdic.gov/bank/individual/failed/banklist.html.

As for the structural liquidity ratio, we use the NSFR. Because of the evolving nature of the Basel III liquidity standards, we calculate two versions: NSFR2014, based on the final version of October 2014, and NSFR2010, based on the original document of December 2010. Table A.1 in the Appendix summarises the weights and calibrations for each asset and liability items in both NSFR versions. Table A.1 also shows the key changes from the NSFR published in December 2010. Since BankScope does not cover all the detailed information specified in Basel III, we assess the NSFR using the following assumption. Given that we can not split the loan portfolios according to their residual maturity, which under Basel III entails different weights, corporate and retail loans are treated relatively conservatively (see Gobat *et al.*, 2014), with all these types of loans assumed to have a maturity of more than 1 year and hence a RSF weight of 85 per cent.[13] We expect a negative relationship between our structural liquidity measure and the probability of bank failure and distress, whereby a higher NSFR is associated with lower liquidity risk and hence greater bank stability. Table A.3 in the Appendix describes our target variables and their hypothesised relationships with the dependent binary variable (F&D).

*4.5 Other determinants of bank failure and distress*

In line with the extant literature, we also control for a set of variables traditionally considered predictors of bank failure. Recent studies investigating the determinants of bank failure, mainly focusing on US banks, have reported a high predictive power for the traditional CAMELS indicators (Betz *et al.*, 2104). We therefore start by considering the remaining CAMELS indicators. The first covariate is the ratio of non-performing loans to gross loans (NPL_GL) as a proxy for asset quality. A higher ratio of NPL_GL indicates lower quality of the bank loan portfolio. Hence, an increase in NPL_GL should lead to an increase in the probability of bank failure and distress.

[13] Basel III establishes a RSF weight of 50 per cent for corporate and retail loans with a residual maturity of less than one year, and a RSF weight of 85 per cent for those with a residual maturity of one year or more.

Next, we include the cost-to-income ratio (CIR) as a proxy for bank operational efficiency. Since low values of CIR indicate better managerial quality, the relationship between CIR and the probability of bank failure and distress is expected to be positive.

Furthermore, to measure bank earnings we consider the return on average assets (ROAA).[14] We expect a negative sign for the relation between ROAA and F&D probability, since an increase in profitability should reduce the likelihood of a failure and distress event.

In addition to the CAMELS covariates, we also incorporate a set of other control variables. We include a proxy for bank diversification and following Stiroh (2004) we measure it by the ratio of non-interest income to net operating revenue (DIV). We expect a negative relation between DIV and the F&D probability, because diversification should lead to risk reduction and therefore lower the likelihood of failure and distress. On the other hand, increased reliance on non-interest income might be an indicator of a riskier business model.

Furthermore, we consider the natural logarithm of a bank's total assets to proxy for bank size (SIZE). The sign linking SIZE to the probability of bank failure and distress is uncertain. The relationship can be interpreted negatively when asset growth leads to efficiency gains (scale and scope efficiency), which should result in higher bank stability. On the other hand, the relationship may become positive if large banks follow diversification strategies that increase their risk exposure (Allen and Jagtiani, 2000) and higher volatility of earnings (DeYoung and Roland, 2001; DeJonghe, 2010; Demirguc-Kunt and Huizinga, 2010) while relying on the implicit guarantee associated with the too-big-to-fail argument.

In addition to bank-specific controls, we include macroeconomic variables and a measure of market concentration (Männasoo and Mayes, 2009; Betz *et al.*, 2014). We include the annual percentage change of gross domestic product (GDPC) and the annual inflation rate (INFC). We expected that low GDP growth and high inflation increase bank vulnerability. Hence, we hypothesise a negative sign for GDPC and a positive sign for INFC.

[14] As a robustness test, we also consider the Return on Average Equity (ROAE) and we obtained very similar results in the regressions.

To measure the degree of banking system concentration, we consider the Herfindahl-Hirschman index (hereafter HHI). The HHI is calculated as the sum of the squared market share value (in term of total assets) of all banks in the country. The theoretical relationship linking HHI to bank survival is uncertain. Some studies focus on bank liabilities and predict a negative relationship between market concentration and banks' risk of failure (see Allen and Gale, 2000, 2004; Carletti, 2008; Beck *et al.*, 2013). Other focus on the loan market and suggest a positive association between market concentration and bank risk taking (see Boyd and De Nicolò, 2005). Finally, we include a eurozone dummy variable (dummy_EuroZone), which takes the value of 1 if a bank belongs to the euro area and 0 otherwise. We expect a positive sign given that the eurozone area includes the countries most affected by the sovereign debt crisis. Table A.3 in the appendix describes the explanatory variables outlined above and their hypothesised relationships with the dependent binary variable of bank failure and distress.

*4.6 Descriptive Statistics*

For each sample bank, we compute our capital and liquidity ratios as described in Section 4.4. Table 2 reports the descriptive statistics relating to our variables of interest for the F&D and active banks in each year.[15] With reference to the capital variables (see Panel A), we find that ETA average values of F&D banks are always lower than those of the healthy banks. On the other hand, TIER1RATIO and TRCR average values of troubled banks are similar to those of sound banks.

Focusing on our structural liquidity indicator, we find that, in all period observed, F&D banks show NSFR average values significantly lower than those of active banks, especially during the more recent years (see Panel B of Table 2). Moreover, the NSFR average values of F&D banks are consistently below the Basel III threshold of 100 per cent over the period 2004-2013. Conversely, the NSFR average values of active banks are significantly above the minimum required, with a tendency to increase in more recent years. Overall, Table 2 indicates that many banks, despite

[15] To mitigate the effect of outliers, we winsorize observations in the outside 1 per cent of each tail of both target variables.

meeting the existing capital requirements, experienced difficulties because they did not prudently manage their liquidity. In addition, we find that, as expected, the values of NSFR computed following the revised 2014 methodology are slightly higher than those of those obtained following the original 2010 document. This outcome confirms the findings of Gobat *et al.* (2014), according to whom the key factor contributing to the recent improvements in NSFR has been the change in the ASF factor for deposits.

[Insert Table 2]

Table 3 reports the descriptive statistics for our variables of interest by countries. Table 3 shows that there are significant differences among EU member states, especially for the NSFR (see Panel B). Whereas active banks from most of the EU-28 member states meet (or are close to) the prudential requirements for structural liquidity, F&D banks show low average values over the period 2004-2013, particularly in Ireland, Belgium, France and Germany, followed by Austria, Denmark and United Kingdom. Average NSFR values are below the regulatory requirements for active banks in France, Ireland and Estonia. This evidence is consistent with the results reported by King (2013) and Gobat *et al.* (2014).

[Insert Table 3]

Table 4 reports the descriptive statistics of the other determinants of bank failure by bank status (active vs. F&D). As expected, F&D banks, during the period 2004-2013, have lower average values of profitability, asset quality, operational efficiency and income diversification compared to active banks. Only the bank size of active and F&D banks is comparable.

[Insert Table 4]

Finally, Table 5 presents the correlation matrix for our main variables of interest (capital and liquidity ratios) and the other explanatory factors. Although many of the pairwise correlation coefficients are statistically significant, the correlation magnitudes are in general low.

[Insert Table 5]

## 5. Main results

### *5.1 The baseline model*

Table 6 shows the results of the logistic estimations for the full sample over the period 2004 - 2013. Following the literature and supervisory practice, we run the model on our variables of interest (the Basel III capital and liquidity ratios) as well as the other determinants of bank failure and distress. In all the regressions we include a time dummy and the euro-zone dummy variable.

Among our target variables, we find that only the NSFR is a significant determinant of banking sector fragility in the EU. The results confirm the hypothesised sign. The negative relationship indicates that an increase in NSFR would correspond to a decrease of F&D probability. This result confirms that the key determinant of bank failures and distress during the sample period was excessive maturity transformation. Our capital variables (ETA, TIER1RATIO and TRCR) are never significant. Indeed, banks that ran into difficulty almost always had low NSFR and capital requirements well above the statutory minimum. This finding on the structural liquidity measure is in contrast with that of Hong *et al.* (2014), who find that the NSFR has a limited effect on US bank failures. This might be partially due to the fact that US banking has been subject to liquidity rules for some time (DeYoung and Jang, 2015) whereas the large majority of European banks did not fulfil the NSFR requirements during the financial crisis period (Dietrich *et al.*, 2014). Overall, considering the whole sample, our results are not supportive of the view that Basel III bank capital and liquidity rules play a complementary role in fostering bank stability.

While this paper focuses on the relationship between Basel III capital and liquidity rules and bank failures and distress, it is important to note that F&D probability is also related to other bank

activities. More specifically, Table 6 shows that F&D probability is inversely related to the level of bank diversification (DIV) and positively related to asset quality (NPL_GL) and bank size (SIZE). Overall, we show that asset quality, income diversification and bank size are important determinants of F&D banks next to structural liquidity. The only CAMELS covariates never significant in our model specifications are ROAA and CIR. The latter result is in line with those of Poghosyan and Čihák (2011), who shows that low costs do not indicate a better ability to prevent bank distress.

With reference to macroeconomic factors (GDPC and INFC), Table 6 shows that both GDPC and INFC are significant determinants of probability of failures and distress. We find that a higher rate of GDP growth and a decrease in the rate of inflationary change are associated with a more stable macroeconomic environment and a relatively lower likelihood of bank failure and distress. This outcome is line with Betz *et al.* (2014), who find that low real GDP growth and high inflation increase bank vulnerability. Thus, our results provide support for the implementation of macro-prudential regulations as a complement to the traditional micro-prudential approach.

Additionally, we assess the impact of market concentration on the likelihood of F&D banks and find a negative and significant impact HHI on bank stability. In line with the "concentration-stability" view, this suggests that more concentrated banking markets are characterised by a lower likelihood of F&D banks. This result is in contrast with that of Poghosyan and Čihák (2011), who find a positive and significant impact of EU market concentration on the probability of distress. However, they show that the impact of market concentration becomes insignificant when macroeconomic variables are also entered in the model specification.

[Insert Table 6]

*5.2 The EBA large banks*

We now turn our attention to the subsample of 123 large banks, which have been subjected to the EBA 2014 stress test exercise. In this model, the identification of F&D banks also include as distressed banks those financial institutions that failed the stress tests in 2013. We re-estimate our baseline model on our variables of interest (the Basel III capital and liquidity ratios) as well as the other determinants of bank failure and distress, including time dummy and the euro-zone dummy variable. The results are presented in Table 7. We find that, for the largest EU banks, both Basel III liquidity and capital standards are significant determinants of bank failure and distress. More specifically, Table 7 shows that large banks more susceptible to failure or distress are those with weak structural liquidity and insufficient capital buffers.

[Insert Table 7]

*5.3 The complementary log-log model*

Next, we assess the strength of our results with respect to the estimation methods. Following Männasoo and Mayes (2009), we carry out our estimations using the complementary log-log model (cloglog) for both the full sample and for the sample of EBA large banks. The results are shown in Table 8. Complementary log-log models are frequently used when the probability of an event is very small or very large. In fact, cloglog belongs to the discrete time functional specifications applied when survival occurs in continuous time, but spell lengths are observed only in intervals, as it is the case for bank distress recorded on annual basis in our sample.[16] The findings confirm both the significant role of high values of NSFR in reducing bank fragility and the fact that capital ratios are a key determinant of bank stability only for large banks.

[Insert Table 8]

[16] Guo (1993) observes that time-varying covariates offer an opportunity to examine the relation between the distress probability and the changing conditions under which the distress happens.

## 6. Robustness Tests

To test the robustness of our main results, particularly with reference to the behaviour of both target variables, we perform a number of further regressions. Firstly, we test the logistic regressions using an alternative existing structural measure of maturity transformation risk. We compute the ratio of net loans to deposits and short-term funding (NL_DSTF) for the full sample during the period 2004 - 2013. Table 9 shows that NL_DSTF is never significant. This result indicates that the NSFR is a better prudential tool than NL_DSTF. The capital ratios are insignificant.

[Insert Table 9]

Next, we consider the *Liquidity Coverage Ratio* (LCR), the second regulatory innovation of Basel III in terms of liquidity standards. The *LCR* is designed to ensure that sufficient *high quality liquid assets* (HQLA) are available for one-month survival in case of a stress scenario. HQLA are defined as cash or assets that can be converted into cash at little or no loss of value in private markets to meet a bank liquidity needs for a 30 calendar day liquidity stress scenario (BCBS, 2010). The LCR has two components: (a) the value of the stock of HQLA and (b) the total net outflows and it is expressed as:

$$LCR = \frac{Stock\ of\ HQLA}{Total\ Net\ Outflows\ over\ the\ next\ 30\ calendar\ days} \geq 100\% \qquad (4)$$

Neither the numerator nor the denominator can be evaluated using publicly available balance sheet information and an approximation requires several assumptions. Bearing in mind this caveat, we consider a proxy of the LCR estimated as liquid assets to deposits and short-term funding. The results are reported in Table 10. We find that the LCR has no predictive power when considered as an alternative liquidity ratio. Our results are consistent with the findings of Hong *et al*., (2014). We concur with their explanation: the LCR is designed to ensure that a solvent bank survives a short

term liquidity shock but in case of solvency problems this buffer can do little to mitigate the problem. However, when considered in conjunction with the NSFR (as per regulatory requirements), the LCR becomes significative (but only when considering ETA as proxy for capital). This result lends support to our choice to focus on the NSFR: we argue that a good management of structural liquidity can lessen the negative effect of illiquidity in the short-term.

[Insert Table 10]

To avoid potential distortions driven by the inclusion of those countries that are not affected by F&D events, we estimate the logistic regressions considering only those countries with both active and F&D banks.[17] The findings illustrated in Table 10 confirm the positive effect of a higher NSFR on bank stability and confirms the insignificant role of capital ratios.

[Insert Table 11]

In addition, in Table 12 we analyse whether capital and liquidity ratios are good predictors of F&D two or three years prior to the event. We find that the capital ratios are never significant.[18] In addition, we show that only new final version of the NSFR (October 2014) has predictive power and remains stable within three-year forward window. This finding supports the recent changes put forward by the BCBS and shows that the new calibration of the NSFR is an effective tool in terms of improving bank stability.

[Insert Table 12]

[17] Austria, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain and United Kingdom are those EU countries that in our analysis have both active and F&D banks.

[18] In Table 11 we show only the results with the capital ratio proxied by ETA. However, we obtain very similar results using TIER1RATIO or TRCR.

Finally, we consider the subprime dummy crisis (D_SubCrisis), that takes the value of 1 for the years 2008-2009 and 0 otherwise, and the sovereign debt dummy crisis (D_SovCrisis), equals to 1 from 2010 onward and 0 otherwise. The latter two dummies variables allow us to take into account the impact of the two crises separately. We hypothesise a positive relationship between the dummies crises and our dependent variable. We always find a positive and significant sign for both D_SubCrisis and D_SovCrisis. Table 13 shows that among the two dummies crisis, D_SovCrisis is the most significant. This result is in line with the fact that the EU banks were affected principally by the sovereign debt crisis.

[Insert Table 13]

**7. Conclusions**

The global financial crisis highlighted the risks of maturity mismatches and unstable funding mix on banks' balance sheets. This has lead to changes in the regulatory and supervisory frameworks governing bank liquidity. In addition, the combined role of structural liquidity and capital cushions under Basel III aims to reduce potential bank distress and promote financial stability.

Despite the prolonged period of financial instability, unlike in the US, outright bank failures have been rare in Europe. To evaluate the impact of Basel III structural liquidity and capital ratios on bank stability, in this paper we utilise a broader definition of failure and distress to include banks under receivership, bankrupt, dissolved, or in liquidation. If a bank was 'dissolved by merger' we classify it as F&D banks only if the merger was driven by distress. Finally, we incorporate information on state aid and, for large banks, information on EBA stress tests. These criteria allow us to test the relationship between structural liquidity and capital ratios as introduced by Basel III on banks' probability of default. The results of the analysis are of particular interest to both academics and policy makers as they contribute to the current debate on the effectiveness of the combined role of Basel III structural liquidity and capital cushions in promoting bank stability,

Contrary to expectations, we find that capital and liquidity ratios play a complementary role in fostering bank stability only for the largest banks. When considering all banks our results indicate

that only the NSFR is a significant determinant of bank failure in Europe. This result is consistent with the view that during the global financial crisis and the subsequent sovereign debt crisis, the key source of bank failures and distress was excessive maturity transformation. Our results indicate that those EU banks that run into difficulties almost always had low structural liquidity. On the other hand, troubled banks' capital requirements were well above the statutory minimum. In addition, we find a stronger predictive power of the final version of the NSFR (October 2014) compared to the earlier (December 2010) version. These findings indicate that the recent changes on the NSFR are effective in terms of improving bank stability and are therefore supportive of regulatory efforts.

When considering only EU large banks, we find that both liquidity and capital standards are significant in reducing bank fragility. Hence, the results provide support for the Basel III regulations on structural liquidity and capital, but the increased capital requirements seem to impact only the largest banking groups. This result is in line with the major emphasis placed by the Basel Committee on the global systemically important banks (G-SIBs).

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## Table 1. Database overview

Panel A illustrates the sample distribution, by bank status, for the full sample of banks headquartered in the 28 EU member states over the period 2004-2013. Columns I and VII (F&D) include banks that satisfy one of the following three conditions during 2004-2013: (1) banks that changed their status from 'active' to either: 'under receivership', 'bankruptcy', 'dissolved', or 'in liquidation'; (2) banks defined by BankScope as 'dissolved by merger' but with a coverage ratio smaller than 0 within 12 months before the M&A (the coverage ratio is defined as: total equity and loan loss reserve minus non-performing loans to total assets); (3) banks that received state aids, as collected by Mediobanca (2013). Columns II and VIII show the number of large banks observed by the EBA in the EU-wide stress testing exercise of 2014 that failed the stress test. This information is taken into consideration in the definition of our dependent variable (F&D banks) only for the subsample of large banks. Columns III and VIII present the distribution of the total F&D observed over the period 2004-2013. Columns IV and IX show 'active banks' and include banks that satisfy one of these following two conditions during 2004-2013: (1) banks classified by BankScope database as 'active' entities; (2) banks defined by BankScope as 'dissolved by merger' but with a coverage ratio equal or higher than 0 within 12 months before the operation. For each EU country, Columns V and X show the sum of active and F&D banks for the full sample. Column VI presents the % of F&D that is computed as the ratio of F&D banks (column I) on total banks (column V).
Panel B shows the F&D banks distribution for each EU country in each year.
* Norway is part of the European Economic Area (EEA) and as such the country is considered by EBA in its stress test exercise. We do not include it in the full sample as not a EU member state. **The year 2013 includes also the EBA stress test information.

Panel A: F&D and Active Banks by Country

| | N. of banks | | | | | | Bank-year observation | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Country | (I) F&D | *(II) F&D EBA stress test* | (III) Total F&D (including EBA stress test) | (IV) Active | (V) Total (I+IV) | (VI) % of F&D | (VII) F&D | (VIII) Total F&D (including EBA stress test) | (IX) Active | (X) Total (VII+IX) |
| Austria | 5 | *3* | 5 | 21 | 26 | 0.19 | 14 | 14 | 103 | 117 |
| Belgium | 4 | *2* | 4 | 7 | 11 | 0.36 | 9 | 9 | 21 | 30 |
| Bulgaria | 0 | - | 0 | 7 | 7 | 0 | 0 | 0 | 30 | 30 |
| Croatia | 0 | - | 0 | 5 | 5 | 0 | 0 | 0 | 19 | 19 |
| Cyprus | 0 | *3* | 3 | 5 | 5 | 0.60 | 0 | 3 | 23 | 23 |
| Czech Republic | 0 | - | 0 | 4 | 4 | 0 | 0 | 0 | 27 | 27 |
| Denmark | 12 | *0* | 12 | 13 | 25 | 0.48 | 35 | 35 | 56 | 91 |
| Estonia | 0 | - | 0 | 2 | 2 | 0 | 0 | 0 | 13 | 13 |
| Finland | 0 | *0* | 0 | 9 | 9 | 0 | 0 | 0 | 52 | 52 |
| France | 8 | *1* | 8 | 46 | 54 | 0.14 | 20 | 20 | 160 | 180 |
| Germany | 7 | *4* | 8 | 44 | 51 | 0.18 | 15 | 16 | 202 | 217 |
| Greece | 10 | *4* | 10 | 11 | 21 | 0.47 | 31 | 31 | 36 | 67 |
| Hungary | 0 | *0* | 0 | 9 | 9 | 0 | 0 | 0 | 43 | 43 |
| Ireland | 2 | *3* | 3 | 3 | 5 | 0.60 | 7 | 8 | 10 | 17 |
| Italy | 25 | *9* | 29 | 47 | 72 | 0.40 | 66 | 70 | 163 | 229 |
| Latvia | 0 | *0* | 0 | 8 | 8 | 0 | 0 | 0 | 21 | 21 |
| Lithuania | 0 | - | 0 | 3 | 3 | 0 | 0 | 0 | 6 | 6 |
| Luxembourg | 0 | *0* | 0 | 7 | 7 | 0 | 0 | 0 | 36 | 36 |
| Malta | 0 | *0* | 0 | 1 | 1 | 0 | 0 | 0 | 8 | 8 |
| Netherlands | 2 | *1* | 2 | 17 | 19 | 0.10 | 4 | 4 | 69 | 73 |
| Norway* | | *0* | 0 | 1 | - | 0 | - | 0 | - | - |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Poland | 0 | *0* | 0 | 13 | 13 | 0 | 0 | 0 | 58 | 58 |
| Portugal | 3 | *2* | 4 | 14 | 17 | 0.23 | 13 | 14 | 59 | 72 |
| Romania | 0 | - | 0 | 9 | 9 | 0 | 0 | 0 | 39 | 39 |
| Slovakia | 0 | - | 0 | 4 | 4 | 0 | 0 | 0 | 31 | 31 |
| Slovenia | 0 | *2* | 2 | 6 | 6 | 0.33 | 0 | 2 | 29 | 29 |
| Spain | 22 | *1* | 22 | 58 | 80 | 0.27 | 59 | 59 | 240 | 299 |
| Sweden | 0 | *0* | 0 | 12 | 12 | 0 | 0 | 0 | 47 | 47 |
| United Kingdom | 6 | *0* | 6 | 22 | 28 | 0.21 | 19 | 19 | 89 | 108 |
| Total | 106 | *35* | 118 | 407 | 513 | 0.23 | 292 | 304 | 1,690 | 1,982 |

Panel B: F&D Banks by Country and Year (bank-year observation)

| Country | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013** |
|---|---|---|---|---|---|---|---|---|---|---|
| Austria | 1 | | | | | 3 | 2 | 2 | 2 | 4 |
| Belgium | | 1 | | | 3 | 1 | | 1 | 1 | 2 |
| Bulgaria | | | | | | | | | | |
| Croatia | | | | | | | | | | |
| Cyprus | | | | | | | | | | 3 |
| Czech Republic | | | | | | | | | | |
| Denmark | | | | | | 2 | 10 | 9 | 8 | 6 |
| Estonia | | | | | | | | | | |
| Finland | | | | | | | | | | |
| France | 1 | 2 | | 1 | 2 | 2 | 3 | 3 | 3 | 3 |
| Germany | 1 | 1 | 1 | | | 2 | 2 | 2 | 3 | 4 |
| Greece | | | | | 1 | 4 | 7 | 6 | 7 | 6 |
| Hungary | | | | | | | | | | |
| Ireland | | | | | 1 | 1 | 1 | 1 | 2 | 2 |
| Italy | | | | 1 | | 3 | 2 | 12 | 26 | 26 |
| Latvia | | | | | | | | | | |
| Lithuania | | | | | | | | | | |
| Luxembourg | | | | | | | | | | |
| Malta | | | | | | | | | | |
| Netherlands | | | | | | | 1 | 1 | | 2 |
| Poland | | | | | | | | | | |
| Portugal | | | | 1 | 2 | 2 | 2 | 2 | 3 | 2 |
| Romania | | | | | | | | | | |
| Slovakia | | | | | | | | | | |
| Slovenia | | | | | | | | | | 2 |
| Spain | | | | 1 | 7 | 8 | 9 | 11 | 12 | 11 |
| Sweden | | | | | | | | | | |
| United Kingdom | | | | | | 2 | 4 | 4 | 4 | 5 |
| Total | 3 | 4 | 1 | 4 | 16 | 30 | 43 | 54 | 71 | 78 |

## Table 2. Target variables by bank status and year

This table reports summary statistics on our target variables (Basel III capital and liquidity ratios) by bank status (active banks versus failed and distressed banks, F&D) and year. Panel A shows the capital buffers (ETA, TIER1RATIO or TRCR) and Panel B shows the structural liquidity ratios (NSFR2014 or NSFR2010) used in our analysis. The target variables are defined in Section 4.4. All variables are winsorised at the 1 per cent of each tail. Our sample of banks covers the 28 EU member states over the period 2004-2013 and includes the 123 large banks subjected to the EBA stress test 2014 exercise.

The columns labelled (F&D) include banks that satisfy one of the following three conditions during 2004-2013: (1) banks that changed their status from 'active' to either: 'under receivership', 'bankruptcy', 'dissolved', or 'in liquidation'; (2) banks defined by BankScope as 'dissolved by merger' but with a coverage ratio smaller than 0 within 12 months before the M&A (the coverage ratio is defined as: total equity and loan loss reserve minus non-performing loans to total assets); (3) banks that received state aids, as collected by Mediobanca (2013). The columns labelled 'active banks' include banks that satisfy one of these following two conditions during 2004-2013: (1) banks classified by BankScope database as 'active' entities; (2) banks defined by BankScope as 'dissolved by merger' but with a coverage ratio equal or higher than 0 within 12 months before the operation.

Panel A: Capital ratios by bank status and year

| | ETA | | | | TIER1RATIO | | | | TRCR | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | F&D banks | | Active banks | | F&D banks | | Active banks | | F&D banks | | Active banks | |
| Year | Mean (dev. std.) | Min. –Max. | Mean (dev. std.) | Min. –Max. | Mean (dev. std.) | Min. –Max. | Mean (dev. std.) | Min. –Max. | Mean (dev. std.) | Min. –Max. | Mean (dev. std.) | Min. –Max. |
| 2004 | 6.441 (4.125) | 1.568-15.469 | 8.807 (6.085) | 2.352-40.489 | 11.879 (7.589) | 6.589-40.259 | 11.988 (7.624) | 6.450-41.205 | 13.549 (7.469) | 9.168-27.659 | 14.334 (8.680) | 7.56-48.98 |
| 2005 | 5.559 (3.569) | 1.258-15.896 | 7.611 (5.116) | 2.042-40.545 | 10.549 (6.012) | 5.493-38.745 | 10.718 (6.264) | 6.39-39.8 | 12.449 (6.231) | 8.556-25.778 | 13.573 (4.279) | 8.92-33.6 |
| 2006 | 5.489 (3.874) | 1.225-14.662 | 7.417 (4.519) | 1.625-35.624 | 8.456 (2.459) | 6.425-16.785 | 9.456 (2.879) | 5.790-23.498 | 11.106 (5.123) | 8.412-23.789 | 13.360 (5.711) | 7.56-46.21 |
| 2007 | 5.351 (3.578) | 1.546-15.351 | 7.377 (5.164) | 1.518-57.12 | 6.7 (1.298) | 3.789-13.489 | 9.034 (2.787) | 5.45-22.6 | 10.1 (1.223) | 8.756-15.648 | 11.927 (2.529) | 7.56-22.6 |
| 2008 | 4.653 (1.600) | 1.238-7.871 | 6.507 (3.189) | 1.238-24.511 | 8.374 (2.213) | 6.6-14.65 | 8.825 (2.242) | 4.9-20 | 11.236 (1.659) | 9.9-16.16 | 11.566 (2.111) | 7.56-19.3 |
| 2009 | 6.422 (2.675) | 2.365-16.199 | 7.482 (4.130) | 1.238-36.614 | 10.443 (3.845) | 6.62-26.6 | 10.643 (3.539) | 4.9-34.49 | 13.092 (3.107) | 9.25-26.2 | 13.412 (3.557) | 7.56-37.95 |
| 2010 | 6.501 (3.384) | 2.079-15.018 | 8.071 (4.902) | 1.238-35.969 | 11.596 (4.146) | 4.9-28.3 | 12.116 (4.964) | 4.9-41 | 13.652 (3.511) | 7.56-28 | 14.633 (5.315) | 7.56-48.98 |
| 2011 | 5.886 (3.295) | 1.238-16.117 | 7.863 (4.554) | 1.915-31.288 | 10.554 (3.724) | 4.9-25.5 | 12.346 (4.945) | 4.9-41 | 13.026 (3.437) | 7.56-27.6 | 14.554 (5.153) | 7.56-48.98 |
| 2012 | 6.014 (3.267) | 1.238-14.551 | 7.896 (4.371) | 1.238-26.678 | 10.915 (4.366) | 4.9-33.5 | 12.822 (4.543) | 4.9-34.67 | 13.527 (3.888) | 7.56-31.9 | 15.186 (4.699) | 7.56-34.7 |
| 2013 | 6.644 (2.708) | 1.238-14.313 | 8.627 (4.317) | 1.238-26.264 | 12.069 (4.122) | 5.63-33.9 | 13.646 (4.398) | 4.9-32.5 | 14.697 (4.075) | 8.17-31.3 | 15.834 (4.369) | 7.56-32.5 |

Panel B: Liquidity ratios by bank status and year

| Year | NSFR2014 | | | | NSFR2010 | | | |
|---|---|---|---|---|---|---|---|---|
| | F&D banks | | Active banks | | F&D banks | | Active banks | |
| | Mean (dev. std.) | Min. –Max. | Mean (dev. std.) | Min. –Max. | Mean (dev. std.) | Min. –Max. | Mean (dev. std.) | Min. –Max. |
| 2004 | 92.962 (44.160) | 22.797-149.183 | 97.809 (37.899) | 25.833-211.276 | 84.256 (22.758) | 35.448-148.599 | 104.279 (63.543) | 29.111-418.534 |
| 2005 | 96.789 (35.668) | 40.536-174.067 | 100.869 (31.253) | 29.856-228.357 | 90.336 (31.190) | 31.141-153.950 | 98.535 (34.921) | 33.569-259.839 |
| 2006 | 92.567 (66.752) | 22.525-150.235 | 97.956 (22.866) | 43.648-165.279 | 94.961 (35.465) | 16.589-168.659 | 94.788 (29.404) | 35.856-242.994 |
| 2007 | 90.785 (15.658) | 36.458-121.478 | 99.624 (22.864) | 35.638-183.112 | 80.172 (23.459) | 26.789-101.589 | 93.535 (24.238) | 35.154-162.823 |
| 2008 | 86.705 (24.566) | 29.002-109.513 | 97.866 (27.284) | 25.372-229.909 | 80.729 (23.853) | 27.809-102.655 | 89.854 (26.596) | 18.492-195.794 |
| 2009 | 95.364 (19.235) | 59.087-159.821 | 99.246 (28.801) | 18.710-214.195 | 85.938 (21.153) | 43.979-154.651 | 91.383 (31.263) | 15.816-283.794 |
| 2010 | 96.631 (20.863) | 58.935-162.611 | 101.215 (28.079) | 18.503-212.777 | 87.009 (23.644) | 46.385-150.581 | 92.036 (29.806) | 12.868-274.233 |
| 2011 | 87.934 (13.768) | 47.226-121.090 | 104.010 (29.779) | 17.686-238.313 | 79.395 (15.026) | 43.918-116.598 | 94.867 (30.487) | 13.302-227.959 |
| 2012 | 87.184 (16.406) | 36.680-136.708 | 102.976 (30.643) | 18.619-247.268 | 78.094 (14.151) | 38.788-111.402 | 94.289 (32.497) | 10.411-255.264 |
| 2013 | 90.520 (16.995) | 37.050-122.924 | 106.069 (31.026) | 33.092-272.192 | 80.824 (15.876) | 38.415-131.563 | 98.500 (38.773) | 23.286-350.433 |

## Table 3. Target variables by bank status and country

This table reports summary statistics on our target variables (capital and liquidity ratios of Basel III) by bank status (active banks versus failed and distressed banks, F&D) and country. Panel A shows the capital buffers (ETA, TIER1RATIO or TRCR) and Panel B shows the structural liquidity ratios (NSFR2014 or NSFR2010) used in our analysis. The target variables are defined in Section 4.4. All variables are winsorised at the 1 per cent of each tail. Our sample of banks covers the 28 EU member states over the period 2004-2013 and includes the 123 large banks subjected to the EBA stress test 2014 exercise.
The columns labelled (F&D) include banks that satisfy one of the following three conditions during 2004-2013: (1) banks that changed their status from 'active' to either: 'under receivership', 'bankruptcy', 'dissolved', or 'in liquidation'; (2) banks defined by BankScope as 'dissolved by merger' but with a coverage ratio smaller than 0 within 12 months before the M&A (the coverage ratio is defined as: total equity and loan loss reserve minus non-performing loans to total assets); (3) banks that received state aids, as collected by Mediobanca (2013). The columns labelled 'active banks' include banks that satisfy one of these following two conditions during 2004-2013: (1) banks classified by BankScope database as 'active' entities; (2) banks defined by BankScope as 'dissolved by merger' but with a coverage ratio equal or higher than 0 within 12 months before the operation.

Panel A: Capital ratios by bank status and country

| | ETA | | | | TIER1RATIO | | | | TRCR | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | F&D banks | | Active banks | | F&D banks | | Active banks | | F&D banks | | Active banks | |
| Country | Mean (dev. std.) | Min. –Max. | Mean (dev. std.) | Min. –Max. | Mean (dev. std.) | Min. –Max. | Mean (dev. std.) | Min. –Max. | Mean (dev. std.) | Min. –Max. | Mean (dev. std.) | Min. –Max. |
| Austria | 6.559 (1.537) | 3.107-8.339 | 8.690 (5.393) | 3.189-40.489 | 9.782 (2.145) | 6.07-15.3 | 11.760 (6.549) | 6.6-41 | 13.338 (2.103) | 10.27-18.7 | 15.734 (7.419) | 9.3-48.98 |
| Belgium | 4.586 (2.476) | 2.199-11.905 | 5.951 (2.741) | 1.238-10.806 | 12.652 (2.187) | 10.6-15.8 | 14.299 (2.655) | 9.5-16.9 | 15.288 (2.617) | 11.8-19 | 17.750 (3.426) | 10.1-21.6 |
| Bulgaria | | | 13.936 (2.731) | 7.988-18.078 | | | 14.124 (3.208) | 8.1-18.23 | | | 16.440 (3.247) | 12.49-23.88 |
| Croatia | | | 12.525 (3.616) | 4.553-18.215 | | | 18.938 (4.581) | 11.91-24.75 | | | 19.052 (3.931) | 12.77-24.16 |
| Cyprus | | | 8.702 (3.032) | 1.238-14.137 | | | 9.585 (2.124) | 4.9-13.1 | | | 12.588 (3.611) | 7.56-20 |
| Czech Republic | | | 8.874 (1.614) | 6.181-12.778 | | | 12.669 (1.941) | 8.32-15.6 | | | 15.311 (2.755) | 10.7-21.3 |
| Denmark | 6.906 (3.218) | 2.926-17.799 | 10.262 (3.282) | 4.209-16.199 | 16.501 (6.208) | 7.5-33.9 | 13.374 (4.393) | 6.5-27.8 | 17.535 (5.185) | 13.14-31.9 | 15.264 (3.284) | 8.6-21.3 |
| Estonia | | | 10.047 (5.781) | 4.302-21.182 | | | 17.386 (9.764) | 8.6-32.5 | | | 18.705 (7.334) | 10.92-32.5 |
| Finland | | | 6.328 (1.955) | 2.748-10.262 | | | 12.032 (2.337) | 7.5-18 | | | 14.649 (2.160) | 10.6-20.2 |
| France | 4.412 (0.589) | 2.841-5.178 | 7.312 (4.953) | 1.238-24.195 | 11.211 (1.663) | 7.8-13.6 | 10.926 (2.618) | 6.62-22.89 | 13.270 (1.612) | 11.1-16.3 | 12.058 (2.714) | 7.56-22.89 |
| Germany | 3.728 (1.205) | 2.526-6.474 | 5.192 (2.679) | 1.238-22.087 | 12.918 (1.919) | 9.6-16.9 | 10.768 (3.557) | 4.9-21.3 | 16.045 (1.934) | 13.8-19.2 | 13.939 (4.397) | 7.56-30.3 |
| Greece | 5.643 (3.297) | 1.238-13.433 | 10.480 (12.151) | 2.807-57.120 | 10.394 (3.665) | 4.9-18.5 | 10.758 (7.978) | 4.9-39.8 | 11.346 (3.107) | 7.56-19 | 10.740 (1.587) | 7.56-13.5 |
| Hungary | | | 8.744 (3.174) | 2.856-18.645 | | | 9.753 (3.806) | 4.9-17.37 | | | 13.444 (3.498) | 7.56-19.9 |
| Ireland | 4.291 | 2.135-6.242 | 7.201 | 2.995-10.584 | 12.128 | 4.9-18 | 10.598 | 6.6-17.9 | 15.042 | 9.2-20.5 | 12.047 | 9.2-17.9 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1.432) | | (2.572) | | (5.489) | | (3.674) | | (4.963) | | (3.089) | |
| Italy | 6.691 | 2.949-9.539 | 8.655 | 2.011-34.172 | 8.790 | 5.62-13.23 | 9.522 | 5.11-34.1 | 12.055 | 8-18.91 | 12.347 | 7.56-34.1 |
| | (1.590) | | (3.870) | | (1.723) | | (4.651) | | (2.214) | | (4.215) | |
| Latvia | | | 9.850 | 4.872-16.872 | | | - | - | | | 15.159 | 11.12-17.8 |
| | | | (2.762) | | | | | | | | (2.296) | |
| Lithuania | | | 7.527 | 5.644-10.687 | | | 5.530 | 5.530-5.530 | | | 10.553 | 8.64-12.64 |
| | | | (1.760) | | | | (0) | | | | (2.005) | |
| Luxembourg | | | 6.560 | 2.150-16.951 | | | 11.681 | 4.9-22.38 | | | 16.334 | 7.56-26.37 |
| | | | (3.037) | | | | (4.364) | | | | (6.186) | |
| Malta | | | 6.997 | 6.313-7.950 | | | 10.812 | 9.9-11.86 | | | 14.381 | 11.5-16.51 |
| | | | (0.504) | | | | (0.943) | | | | (2.079) | |
| Netherlands | 3.637 | 2.822-4.890 | 10.246 | 1.639-36.614 | 14.15 | 13-15.3 | 12.786 | 7.4-33.6 | 18.5 | 16.8-20.2 | 15.141 | 10.5-33.6 |
| | (0.900) | | (7.753) | | (1.626) | | (4.695) | | (2.404) | | (4.551) | |
| Poland | | | 10.341 | 3.429-17.306 | | | 12.221 | 5.62-18.8 | | | 13.676 | 8.81-18.83 |
| | | | (3.506) | | | | (3.561) | | | | (2.562) | |
| Portugal | 6.509 | 4.427-9.240 | 7.392 | 1.915-17.968 | 9.841 | 6.6-16.2 | 9.778 | 5.45-14.2 | 12.145 | 10.1-16.2 | 11.768 | 8.95-15.2 |
| | (1.568) | | (3.250) | | (2.752) | | (2.065) | | (1.736) | | (1.567) | |
| Romania | | | 11.102 | 7.034-20.047 | | | 13.863 | 9.76-20.99 | | | 15.444 | 10.9-24.38 |
| | | | (3.007) | | | | (3.110) | | | | (3.401) | |
| Slovakia | | | 9.372 | 6.281-12.775 | | | 12.268 | 9.4-16.01 | | | 13.077 | 9.05-24.12 |
| | | | (1.721) | | | | (1.897) | | | | (3.304) | |
| Slovenia | | | 7.623 | 1..238- | | | 9.018 | 4.9-18.06 | | | 10.929 | 7.56-18.06 |
| | | | (1.909) | 11.640 | | | (3.116) | | | | (2.282) | |
| Spain | 4.136 | 1.238-10.233 | 6.898 | 1.238-26.809 | 9.792 | 4.9-15.2 | 9.543 | 4.9-22.4 | 12.096 | 7.56-16.2 | 12.286 | 7.56-27.1 |
| | (2.044) | | (3.913) | | (2.814) | | (2.656) | | (2.208) | | (2.623) | |
| Sweden | | | 5.935 | 3.272-21.656 | | | 13.429 | 6.19-35.23 | | | 15.803 | 8.87-41.71 |
| | | | (4.333) | | | | (8.563) | | | | (8.998) | |
| United Kingdom | 5.914 | 3.230-15.647 | 5.483 | 1.625-17.065 | 12.073 | 7.9-15.89 | 11.465 | 6.53-20.8 | 16.405 | 12-25.3 | 15.899 | 10.5-26.1 |
| | (4.121) | | (2.718) | | (2.450) | | (3.135) | | (3.187) | | (3.046) | |

Panel B: Liquidity ratios by bank status and country

| | NSFR2014 | | | | NSFR2010 | | | |
|---|---|---|---|---|---|---|---|---|
| | F&D banks | | Active banks | | F&D banks | | Active banks | |
| Country | Mean (dev. std.) | Min. –Max. | Mean (dev. std.) | Min. –Max. | Mean (dev. std.) | Min. –Max. | Mean (dev. std.) | Min. –Max. |
| Austria | 86.183 | 58.919-115.263 | 91.406 | 18.619-228.357 | 79.840 | 48.571-97.905 | 87.722 | 10.411-168.922 |
| | (18.592) | | (32.571) | | (18.197) | | (29.014) | |
| Belgium | 77.321 | 29.002-92.645 | 125.915 | 68.798-160.196 | 66.452 | 27.809-78.091 | 111.599 | 59.767-160.053 |
| | (27.141) | | (31.715) | | (21.634) | | (30.710) | |
| Bulgaria | | | 108.705 | 72.618-141.539 | | | 105.427 | 71.925-135.959 |
| | | | (17.050) | | | | (14.805) | |
| Croatia | | | 114.128 | 75.840-141.041 | | | 116.155 | 69.372-161.143 |
| | | | (20.952) | | | | (25.064) | |
| Cyprus | | | 112.288 | 79.145-167.551 | | | 122.609 | 77.217-354.816 |
| | | | (21.472) | | | | (69.916) | |
| Czech Republic | | | 117.308 | 43.648-145.859 | | | 102.730 | 41.061-133.919 |
| | | | (27.540) | | | | (22.772) | |
| Denmark | 86.819 | 48.533-150.165 | 98.227 | 61.258-142.234 | 75.116 | 33.951-151.370 | 81.185 | 38.415-140.643 |
| | (22.197) | | (20.353) | | (25.539) | | (23.027) | |
| Estonia | | | 81.007 | 31.670-137.343 | | | 94.134 | 31.796-214.644 |
| | | | (31.663) | | | | (54.656) | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Finland | | | 92.871 (26.634) | 45.508-195.293 | | | 80.674 (26.603) | 34.115-166.909 |
| France | 78.760 (11.363) | 55.061-92.748 | 84.611 (34.137) | 28.743-202.607 | 61.299 (11.092) | 39.624-76.173 | 80.416 (45.233) | 18.492-283.794 |
| Germany | 79.615 (9.059) | 59.087-90.565 | 111.774 (39.533) | 18.503-272.192 | 60.545 (6.593) | 43.979-68.154 | 97.041 (33.855) | 17.877-238.860 |
| Greece | 91.477 (24.619) | 47.226-162.611 | 99.363 (21.157) | 50.855-139.307 | 87.632 (23.131) | 45.168-154.651 | 98.128 (19.993) | 48.015-131.130 |
| Hungary | | | 88.919 (16.193) | 39.462-130.401 | | | 84.186 (17.591) | 38.045-124.399 |
| Ireland | 60.861 (25.318) | 17.686-101.085 | 81.609 (14.709) | 60.661-101.560 | 55.536 (24.600) | 13.735-93.929 | 73.931 (12.600) | 53.416-89.649 |
| Italy | 90.350 (12.726) | 42.266-110.579 | 98.371 (15.791) | 44.884-149.261 | 83.552 (9.480) | 62.011-103.578 | 91.719 (14.926) | 38.496-145.425 |
| Latvia | | | 143.460 (37.961) | 63.798-191.991 | | | 164.014 (95.239) | 58.967-418.534 |
| Lithuania | | | 94.152 (8.416) | 85.484-102.292 | | | 86.672 (11.748) | 65.380-96.306 |
| Luxembourg | | | 107.806 (18.182) | 53.969-132.283 | | | 100.417 (27.748) | 53.214-166.784 |
| Malta | | | 127.792 (7.604) | 117.957-139.515 | | | 105.487 (11.915) | 95.401-124.950 |
| Netherlands | 96.842 (23.786) | 70.498-116.743 | 103.306 (35.140) | 25.833-189.942 | 86.001 (22.265) | 61.529-105.061 | 99.990 (43.164) | 26.701-272.130 |
| Poland | | | 120.528 (19.941) | 39.091-151.903 | | | 111.466 (19.565) | 36.517-144.716 |
| Portugal | 97.212 (11.199) | 79.829-122.924 | 100.169 (15.862) | 58.799-130.118 | 89.258 (11.717) | 73.573-116.709 | 93.964 (16.809) | 57.995-132.916 |
| Romania | | | 125.011 (24.391) | 35.293-166.584 | | | 121.604 (25.223) | 33.116-161.729 |
| Slovakia | | | 135.106 (17.028) | 106.271-170.149 | | | 127.298 (20.853) | 89.307-178.290 |
| Slovenia | | | 95.679 (22.396) | 39.181-130.099 | | | 85.958 (20.651) | 37.116-123.619 |
| Spain | 94.254 (18.865) | 36.680-136.708 | 99.968 (12.987) | 46.746-138.068 | 88.376 (15.627) | 53.555-141.909 | 94.829 (17.804) | 55.787-242.994 |
| Sweden | | | 97.451 (19.559) | 36.763-128.628 | | | 90.116 (25.248) | 31.452-169.759 |
| United Kingdom | 86.239 (14.028) | 55.474-106.729 | 92.727 (20.014) | 58.680-147.955 | 76.688 (18.111) | 53.556-131.563 | 80.937 (24.504) | 49.208-161.939 |

## Table 4. Summary statistics of the other determinants of bank F&D by bank status

This table reports summary statistics on the other determinants of bank F&D for the full sample and for the active and F&D banks. These variables are defined in Section 4.5. All variables are winsorised at the 1 per cent of each tail. Our sample of banks covers the 28 EU member states over the period 2004-2013 and includes the 123 large banks subjected to the EBA stress test 2014 exercise.
The columns labelled (F&D) include banks that satisfy one of the following three conditions during 2004-2013: (1) banks that changed their status from 'active' to either: 'under receivership', 'bankruptcy', 'dissolved', or 'in liquidation'; (2) banks defined by BankScope as 'dissolved by merger' but with a coverage ratio smaller than 0 within 12 months before the M&A (the coverage ratio is defined as: total equity and loan loss reserve minus non-performing loans to total assets); (3) banks that received state aids, as collected by Mediobanca (2013). The columns labelled 'active banks' include banks that satisfy one of these following two conditions during 2004-2013: (1) banks classified by BankScope database as 'active' entities; (2) banks defined by BankScope as 'dissolved by merger' but with a coverage ratio equal or higher than 0 within 12 months before the operation.

| Variables | F&D banks | | Active banks | | Full sample | |
|---|---|---|---|---|---|---|
| | Mean (dev. Std.) | Min. - Max. | Mean (dev. Std.) | Min. - Max. | Mean (dev. Std.) | Min. - Max. |
| ROAA | -0.448 (1.763) | -7.348-4.429 | 0.467 (1.422) | -7.348-10.630 | 0.019 (1.523) | -7.348-10.630 |
| CIR | 67.987 (24.150) | 23.614-188.963 | 64.848 (21.229) | 16.641-188.963 | 66.417 (23.498) | 16.614-188.963 |
| NPL_GL | 5.354 (3.870) | 0-18.860 | 2.952 (3.361) | 0-18.860 | 4.153 (3.129) | 0-18.860 |
| DIV | 32.743 (16.641) | -50.098-81.045 | 39.637 (22.461) | -50.098-103.639 | 36.190 (18.798) | -50.098-103.639 |
| SIZE | 10.830 (1.941) | 5.682-14.050 | 9.728 (1.928) | 3.826-14.050 | 10.279 (1.930) | 3.826-14.050 |
| GDPC | | | | | 0.034 (2.505) | -17.669-10.988 |
| INFC | | | | | 2.303 (1.263) | -1.706-11.950 |
| HHI | | | | | 0.147 (0.061) | 0.058-0.682 |

## Table 5. Correlations

This table shows the correlation matrix for the explanatory variables used in the empirical analysis over the sample period. See Sections 4.4 and 4.5 for the description of the explanatory variables. * indicates statistically significance at the 5 per cent level.

| | ETA | TIER1RATIO | TRCR | NSFR2014 | NSFR2010 | ROAA | CIR | NPL_GL | DIV | SIZE | GDPC | INFC | HHI | LCR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ETA | 1.0000 | | | | | | | | | | | | | |
| TIER1RATIO | 0.5416* | 1.0000 | | | | | | | | | | | | |
| TRCR | 0.5330* | 0.9200* | 1.0000 | | | | | | | | | | | |
| NSFR2014 | 0.1424* | 0.1241* | 0.0692* | 1.0000 | | | | | | | | | | |
| NSFR2010 | 0.0372* | 0.1194* | 0.1002* | 0.8215* | 1.0000 | | | | | | | | | |
| ROAA | 0.3739* | 0.1094* | 0.0844* | 0.1857* | 0.0623* | 1.0000 | | | | | | | | |
| CIR | -0.0034 | -0.0047 | 0.0458* | -0.0280 | 0.0864* | -0.3862* | 1.0000 | | | | | | | |
| NPL_GL | 0.0788 | 0.0076 | 0.0304 | -0.1039* | -0.0684* | -0.2487* | 0.0592* | 1.0000 | | | | | | |
| DIV | 0.2583 | 0.0657* | 0.0575* | -0.0230 | -0.0227 | 0.2300* | 0.1008* | -0.0421* | 1.0000 | | | | | |
| SIZE | -0.4095* | -0.3109* | -0.2837* | -0.2588* | -0.1616* | -0.1389* | -0.1774* | -0.0246 | -0.1082* | 1.0000 | | | | |
| GDPC | 0.0300* | -0.0122 | 0.0055 | 0.1240* | 0.0520* | 0.2227* | -0.0628* | -0.1478* | 0.0213 | -0.0949* | 1.0000 | | | |
| INFC | 0.0312* | -0.0058 | -0.0042 | 0.0950* | 0.0697* | 0.0617* | 0.0153 | 0.0236 | -0.0412* | -0.1482* | 0.2496* | 1.0000 | | |
| HHI | 0.0656* | 0.0629* | 0.0945* | 0.0577* | 0.0550* | 0.0307* | 0.0135 | 0.0727* | -0.0348* | -0.1873* | 0.0810* | 0.0941* | 1.0000 | |
| LCR | 0.2810* | 0.1712* | 0.2056* | -0.1816* | 0.0431* | 0.1763* | 0.0833* | -0.0654* | 0.2947* | -0.0160 | 0.0568* | -0.0111 | 0.0193 | 1.0000 |

## Table 6. Logistic estimations results (full sample)

This table presents the results of the estimation of pooled logistic regressions on the full sample (EU 28 member states) over the period 2004-2013. The dependent variable is the failed and distress bank dummy variable (F&D) that takes value of 1 when a bank *i* failed or experiences financial distress in time period *t* and 0 otherwise banks. Capital (ETA, TIER1RATIO or TRCR) and liquidity ratios (NSFR2014 or NSFR2010) are our target variables. As explanatory variables we also include the other CAMELS covariates (ROAA, CIR, NPL_GL, and DIV), the control variables (SIZE, GDPC, INFC and HHI), and the euro zone dummy variable (D_EuroZone). All explanatory variables are lagged by one year, except D_EuroZone. The dependent variable and independent variables are defined in Section 4. All variables are winsorized at the 1% of each tail. Year dummy variables are also included in the model. Robust standard errors are reported in parentheses. The superscripts ***, **, and * denote coefficients statistically different from zero at the 1%, 5%, and 10% levels, respectively, in two-tailed tests.

| Variables | ETA and NSFR2014 | TIER1RATIO and NSFR2014 | TRCR and NSFR2014 | ETA and NSFR2010 | TIER1RATIO and NSFR2010 | TRCR and NSFR2010 |
|---|---|---|---|---|---|---|
| CAPITAL (-1) | -0.025 | -0.029 | -0.029 | -0.024 | -0.029 | -0.030 |
| | (0.035) | (0.027) | (0.023) | (0.035) | (0.027) | (0.023) |
| LIQUIDITY (-1) | -0.006** | -0.006** | -0.006** | -0.006** | -0.006** | -0.007** |
| | (0.002) | (0.003) | (0.002) | (0.035) | (0.003) | (0.002) |
| ROAA (-1) | -0.054 | -0.036 | -0.017 | -0.051 | -0.036 | -0.011 |
| | (0.087) | (0.092) | (0.085) | (0.088) | (0.093) | (0.086) |
| CIR (-1) | 0.0009 | 0.002 | 0.003 | 0.0006 | 0.002 | 0.002 |
| | (0.003) | (0.004) | (0.003) | (0.003) | (0.004) | (0.003) |
| NPL_GL (-1) | 0.045 | 0.054* | 0.045* | 0.047 | 0.056** | 0.047* |
| | (0.029) | (0.029) | (0.027) | (0.029) | (0.029) | (0.027) |
| DIV (-1) | -0.013*** | -0.010*** | -0.011*** | -0.013*** | -0.010*** | -0.011*** |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) |
| SIZE (-1) | 0.216*** | 0.158*** | 0.190*** | 0.209*** | 0.153*** | 0.180*** |
| | (0.047) | (0.044) | (0.044) | (0.047) | (0.045) | (0.045) |
| GDPC (-1) | -0.229*** | -0.265*** | -0.237*** | -0.234*** | -0.268*** | -0.245*** |
| | (0.039) | (0.044) | (0.042) | (0.039) | (0.044) | (0.042) |
| INFC (-1) | 0.003** | 0.025** | 0.032** | 0.0008* | 0.021** | 0.028* |
| | (0.001) | (0.012) | (0.016) | (0.0004) | (0.010) | (0.014) |
| HHI (-1) | -1.576* | -3.187*** | -2.904*** | -1.650* | -3.279*** | -3.044*** |
| | (0.876) | (0.971) | (0.943) | (0.879) | (0.974) | (0.946) |
| D_EuroZone | 0.372** | 0.321 | 0.347* | 0.391** | 0.339 | 0.364* |
| | (0.195) | (0.207) | (0.203) | (0.194) | (0.207) | (0.203) |
| D_years | Yes | Yes | Yes | Yes | Yes | Yes |
| N. of obs. | 1,982 | 1,316 | 1,387 | 1,982 | 1,316 | 1,387 |
| Pseudo R-squared | 0.2037 | 0.1841 | 0.1849 | 0.2041 | 0.1842 | 0.1857 |

## Table 7. Logistic estimations results (EBA large banks)

This table presents the results of the estimation of pooled logistic regressions on the 123 EU banks observed by EBA in the EU-wide stress testing 2014. The sample period is 2004-2013. The dependent variable is the failed and distress bank dummy variable (F&D) that takes value of 1 when a bank *i* failed, experiences financial distress or fails the EBA stress tests in time period *t* and 0 otherwise banks. Capital (ETA, TIER1RATIO or TRCR) and liquidity ratios (NSFR2014 or NSFR2010) are our target variables. As explanatory variables we also include the other CAMELS covariates (ROAA, CIR, NPL_GL, and DIV), the control variables (SIZE, GDPC, INFC and HHI), and the euro zone dummy variable (D_EuroZone). All explanatory variables are lagged by one year, except D_EuroZone. The dependent variable and independent variables are defined in Section 4. All variables are winsorized at the 1% of each tail. Year dummy variables are also included in the model. Robust standard errors are reported in parentheses. The superscripts ***, **, and * denote coefficients statistically different from zero at the 1%, 5%, and 10% levels, respectively, in two-tailed tests.

| Variables | ETA and NSFR2014 | TIER1RATIO and NSFR2014 | TRCR and NSFR2014 | ETA and NSFR2010 | TIER1RATIO and NSFR2010 | TRCR and NSFR2010 |
|---|---|---|---|---|---|---|
| CAPITAL (-1) | -0.232*** | -0.162*** | -0.076* | -0.237*** | -0.164*** | -0.080* |
| | (0.066) | (0.061) | (0.035) | (0.066) | (0.063) | (0.040) |
| LIQUIDITY (-1) | -0.022*** | -0.025*** | -0.025*** | -0.020*** | -0.022*** | -0.023*** |
| | (0.007) | (0.008) | (0.008) | (0.005) | (0.008) | (0.007) |
| ROAA (-1) | 0.108 | -0.004 | -0.028 | 0.119 | -0.001 | -0.023 |
| | (0.202) | (0.200) | (0.180) | (0.207) | (0.208) | (0.187) |
| CIR (-1) | 0.011 | 0.008 | 0.009 | 0.011 | 0.008 | 0.010 |
| | (0.010) | (0.010) | (0.011) | (0.010) | (0.011) | (0.011) |
| NPL_GL (-1) | 0.149*** | 0.141** | 0.126** | 0.149*** | 0.144** | 0.127** |
| | (0.055) | (0.057) | (0.050) | (0.055) | (0.057) | (0.050) |
| DIV (-1) | 0.001 | 0.001 | 0.000 | 0.000 | 0.001 | 0.000 |
| | (0.011) | (0.012) | (0.011) | (0.011) | (0.012) | (0.011) |
| SIZE (-1) | 0.020 | 0.073 | 0.080 | -0.002 | 0.056 | 0.064 |
| | (0.112) | (0.128) | (0.122) | (0.113) | (0.130) | (0.123) |
| GDPC (-1) | -0.165* | -0.092 | -0.125 | -0.178** | -0.106 | -0.140* |
| | (0.087) | (0.087) | (0.085) | (0.086) | (0.086) | (0.084) |
| INFC (-1) | 0.518** | 0.433** | 0.425** | 0.517** | 0.432** | 0.429** |
| | (0.210) | (0.200) | (0.196) | (0.212) | (0.202) | (0.200) |
| HHI (-1) | -9.095*** | -12.100*** | -12.238*** | -9.653*** | -12.341*** | -12.420*** |
| | (2.582) | (3.588) | (3.295) | (2.653) | (3.583) | (3.275) |
| D_EuroZone | 3.338*** | 3.159*** | 3.236*** | 3.430*** | 3.232*** | 3.315*** |
| | (0.580) | (0.595) | (0.579) | (0.606) | (0.613) | (0.601) |
| D_years | Yes | Yes | Yes | Yes | Yes | Yes |
| N. of obs. | 459 | 435 | 441 | 459 | 435 | 441 |
| Pseudo R-squared | 0.3414 | 0.3454 | 0.3321 | 0.3454 | 0.3473 | 0.3342 |

## Table 8. Complementary logistic estimations results

This table presents the results of the estimations of complementary logistic regressions over the period 2004-2013. The results for the full sample are reported in Panel A; the results for the subsample of EBA large banks are reported in Panel B. For the full sample the dependent variable is the failed and distress bank dummy variable (F&D) that takes value of 1 when a bank *i* failed or experiences financial distressed in time period *t* and 0 otherwise banks. For the subsample the dependent variable is the failed and distress bank dummy variable (F&D) that takes value of 1 when a bank *i* failed, experiences financial distress or fails the EBA stress tests in time period *t* and 0 otherwise banks. Capital (ETA, TIER1RATIO or TRCR) and liquidity ratios (NSFR2014 or NSFR2010) are our target variables. As explanatory variables we also include the other CAMELS covariates (ROAA, CIR, NPL_GL, and DIV), the control variables (SIZE, GDPC, INFC and HHI), and the euro zone dummy variable (D_EuroZone). All explanatory variables are lagged by one year, except the dummies variables. The dependent variables and independent variables are defined in Section 4. All variables are winsorized at the 1% of each tail. Year dummy variables are also included in the model. Robust standard errors are reported in parentheses. The superscripts ***, **, and * denote coefficients statistically different from zero at the 1%, 5%, and 10% levels, respectively, in two-tailed tests.

Panel A: Full sample

| Variables | ETA and NSFR2014 | TIER1RATIO and NSFR2014 | TRCR and NSFR2014 | ETA and NSFR2010 | TIER1RATIO and NSFR2010 | TRCR and NSFR2010 |
|---|---|---|---|---|---|---|
| CAPITAL (-1) | -0.036 | -0.037 | -0.032 | -0.036 | -0.037 | -0.033 |
| | (0.030) | (0.025) | (0.020) | (0.030) | (0.025) | (0.020) |
| LIQUIDITY (-1) | -0.004** | -0.004* | -0.005** | -0.004** | -0.004* | -0.005** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) |
| ROAA (-1) | 0.015 | 0.041 | 0.038 | 0.018 | 0.042 | 0.044 |
| | (0.062) | (0.057) | (0.054) | (0.063) | (0.057) | (0.055) |
| CIR (-1) | 0.002 | 0.004 | 0.004* | 0.002 | 0.004 | 0.004 |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) |
| NPL_GL (-1) | 0.031 | 0.030 | 0.029 | 0.032 | 0.032 | 0.030 |
| | (0.025) | (0.023) | (0.021) | (0.025) | (0.023) | (0.021) |
| DIV (-1) | -0.011*** | -0.009*** | -0.009*** | -0.011*** | -0.009*** | -0.010*** |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) |
| SIZE (-1) | 0.190*** | 0.144*** | 0.173*** | 0.186*** | 0.141*** | 0.167*** |
| | (0.041) | (0.038) | (0.037) | (0.041) | (0.039) | (0.038) |
| GDPC (-1) | -0.181*** | -0.211*** | -0.186*** | -0.185*** | -0.214*** | -0.191*** |
| | (0.029) | (0.035) | (0.031) | (0.030) | (0.035) | (0.032) |
| INFC (-1) | 0.021** | 0.016** | 0.016** | 0.023** | 0.015* | 0.015** |
| | (0.010) | (0.008) | (0.008) | (0.011) | (0.007) | (0.007) |
| HHI (-1) | -1.398** | -2.614*** | -2.343*** | -1.438** | -2.666*** | -2.422*** |
| | (0.684) | (0.767) | (0.753) | (0.686) | (0.770) | (0.757) |
| D_EuroZone | 0.354** | 0.274 | 0.311* | 0.366** | 0.285 | 0.321* |
| | (0.174) | (0.178) | (0.177) | (0.173) | (0.177) | (0.177) |
| D_years | Yes | Yes | Yes | Yes | Yes | Yes |
| N. of obs. | 1,982 | 1,316 | 1,387 | 1,982 | 1,316 | 1,387 |

Panel B: EBA large banks

| Variables | ETA and NSFR2014 | T1R and NSFR2014 | TRCR and NSFR2014 | ETA and NSFR2010 | T1R and NSFR2010 | TRCR and NSFR2010 |
|---|---|---|---|---|---|---|
| CAPITAL (-1) | -0.153*** | -0.106** | -0.037* | -0.159*** | -0.108** | -0.039* |
| | (0.041) | (0.047) | (0.019) | (0.042) | (0.048) | (0.019) |
| LIQUIDITY (-1) | -0.014*** | -0.015*** | -0.016*** | -0.014*** | -0.015*** | -0.016*** |
| | (0.004) | (0.005) | (0.005) | (0.004) | (0.005) | (0.005) |
| ROAA (-1) | 0.119 | 0.077 | 0.040 | 0.133 | 0.091 | 0.053 |
| | (0.090) | (0.088) | (0.085) | (0.091) | (0.089) | (0.086) |
| CIR (-1) | 0.003 | 0.003 | 0.004 | 0.003 | 0.003 | 0.004 |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) |
| NPL_GL (-1) | 0.108*** | 0.100** | 0.096** | 0.107*** | 0.101** | 0.096** |
| | (0.039) | (0.041) | (0.038) | (0.039) | (0.041) | (0.038) |
| DIV (-1) | -0.001 | -0.001 | -0.000 | -0.002 | -0.001 | -0.001 |
| | (0.005) | (0.006) | (0.006) | (0.005) | (0.006) | (0.006) |
| SIZE (-1) | 0.055 | 0.085 | 0.081 | 0.032 | 0.067 | 0.060 |
| | (0.075) | (0.081) | (0.078) | (0.076) | (0.083) | (0.080) |
| GDPC (-1) | -0.114** | -0.097* | -0.111* | -0.122** | -0.107* | -0.121** |
| | (0.053) | (0.058) | (0.058) | (0.053) | (0.058) | (0.057) |
| INFC (-1) | 0.351** | 0.275** | 0.277** | 0.354** | 0.275** | 0.281** |
| | (0.138) | (0.133) | (0.134) | (0.139) | (0.135) | (0.137) |
| HHI (-1) | -5.653*** | -6.991*** | -7.419*** | -5.923*** | -7.138*** | -7.568*** |
| | (1.827) | (2.312) | (2.214) | (1.853) | (2.313) | (2.222) |
| D_EuroZone | 2.520*** | 2.370*** | 2.490*** | 2.591*** | 2.430*** | 2.563*** |
| | (0.486) | (0.517) | (0.509) | (0.501) | (0.531) | (0.524) |
| D_year | *Yes* | *Yes* | *Yes* | *Yes* | *Yes* | *Yes* |
| N. of obs. | 459 | 435 | 441 | 459 | 435 | 441 |

## Table 9. Logistic estimations results with an alternative liquidity measure

This table presents the results of the estimation of pooled logistic regressions on the full sample over the period 2004-2013 using an alternative measure of bank liquidity: net loans to deposits and short-term funding (NL_DSTF). The dependent variable is the failed and distress bank dummy variable (F&D) that takes value of 1 when a bank *i* failed or experiences financial distressed in time period *t* and 0 otherwise banks. Capital (ETA, TIER1RATIO or TRCR) and liquidity ratios (NL_DSTF) are our target variables. As explanatory variables we also include the other CAMELS covariates (ROAA, CIR, NPL_GL, and DIV), the control variables (SIZE, GDPC, INFC and HHI), and the Euro Zone dummy variable (D_EuroZone). All explanatory variables are lagged by one year, except D_EuroZone. The dependent variable and independent variables are defined in Section 4. All variables are winsorized at the 1% of each tail. Year dummy variables are also included in the model. Robust standard errors are reported in parentheses. The superscripts ***, **, and * denote coefficients statistically different from zero at the 1%, 5%, and 10% levels, respectively, in two-tailed tests.

| Variables | ETA | TIER1RATIO | TRCR |
|---|---|---|---|
| CAPITAL (-1) | -0.024 | -0.032 | -0.028 |
| | (0.036) | (0.028) | (0.024) |
| NL_DSTF (-1) | 0.0007 | -0.0008 | -0.0004 |
| | (0.001) | (0.001) | (0.001) |
| ROAA (-1) | -0.069 | -0.049 | -0.036 |
| | (0.089) | (0.094) | (0.086) |
| CIR (-1) | 0.001 | 0.002 | 0.003 |
| | (0.003) | (0.004) | (0.003) |
| NPL_GL (-1) | 0.057** | 0.063** | 0.055** |
| | (0.029) | (0.030) | (0.027) |
| DIV (-1) | -0.011*** | -0.009** | -0.010*** |
| | (0.003) | (0.003) | (0.003) |
| SIZE (-1) | 0.241*** | 0.179*** | 0.216*** |
| | (0.046) | (0.043) | (0.042) |
| GDPC (-1) | -0.226*** | -0.269*** | -0.238*** |
| | (0.038) | (0.044) | (0.043) |
| INFC (-1) | -0.004 | -0.040 | -0.045 |
| | (0.064) | (0.080) | (0.076) |
| HHI (-1) | -1.632* | -3.282*** | -2.963*** |
| | (0.884) | (0.209) | (0.960) |
| D_EuroZone | 0.401* | 0.342 | 0.368* |
| | (0.199) | (0.209) | (0.206) |
| D_years | Yes | Yes | Yes |
| N. of obs. | 1,977 | 1,314 | 1,384 |
| Pseudo R-squared | 0.2006 | 0.1819 | 0.1818 |

## Table 10. Logistic estimations results with a proxy for Liquidity Coverage Ratio

This table presents the results of the estimation of pooled logistic regressions on the full sample over the period 2004-2013 using liquid assets to deposits and short-term funding as a proxy for Liquidity Coverage Ratio (LCR). The dependent variable is the failed and distress bank dummy variable (F&D) that takes value of 1 when a bank *i* failed or experiences financial distressed in time period *t* and 0 otherwise banks. Capital (ETA, TIER1RATIO or TRCR) and liquidity ratios (LCR and NSFR2014) are our target variables. As explanatory variables we also include the other CAMELS covariates (ROAA, CIR, NPL_GL, and DIV), the control variables (SIZE, GDPC, INFC and HHI), and the Euro Zone dummy variable (D_EuroZone). All explanatory variables are lagged by one year, except D_EuroZone. The dependent variable and independent variables are defined in Section 4. All variables are winsorized at the 1% of each tail. Year dummy variables are also included in the model. Robust standard errors are reported in parentheses. The superscripts ***, **, and * denote coefficients statistically different from zero at the 1%, 5%, and 10% levels, respectively, in two-tailed tests.

| Variables | ETA | TIER1RATIO | TRCR | ETA | TIER1RATIO | TRCR |
|---|---|---|---|---|---|---|
| CAPITAL (-1) | -0.029 | -0.028 | -0.027 | -0.033 | -0.022 | -0.022 |
| | (0.038) | (0.027) | (0.023) | (0.038) | (0.027) | (0.023) |
| LCR (-1) | -0.005 | -0.001 | -0.002 | -0.008** | -0.004 | -0.004 |
| | (0.003) | (0.003) | (0.003) | (0.004) | (0.004) | (0.004) |
| NSFR2014 (-1) | | | | -0.009*** | -0.009** | -0.009*** |
| | | | | (0.003) | (0.004) | (0.003) |
| ROAA (-1) | -0.058 | -0.053 | -0.037 | -0.029 | -0.036 | -0.013 |
| | (0.093) | (0.094) | (0.086) | (0.093) | (0.093) | (0.086) |
| CIR (-1) | 0.002 | 0.003 | 0.004 | 0.002 | 0.004 | 0.004 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| NPL_GL (-1) | 0.052* | 0.062** | 0.053* | 0.040 | 0.051* | 0.041 |
| | (0.031) | (0.030) | (0.027) | (0.031) | (0.031) | (0.028) |
| DIV (-1) | -0.011*** | -0.009** | -0.010*** | -0.012*** | -0.010** | -0.011*** |
| | (0.003) | (0.004) | (0.004) | (0.003) | (0.004) | (0.004) |
| SIZE (-1) | 0.262*** | 0.186*** | 0.224*** | 0.233*** | 0.166*** | 0.199*** |
| | (0.050) | (0.046) | (0.045) | (0.051) | (0.047) | (0.046) |
| GDPC (-1) | -0.228*** | -0.266*** | -0.237*** | -0.228*** | -0.261*** | -0.236*** |
| | (0.038) | (0.045) | (0.043) | (0.039) | (0.045) | (0.042) |
| INFC (-1) | -0.021 | -0.040 | -0.048 | -0.019 | -0.032 | -0.043 |
| | (0.064) | (0.079) | (0.075) | (0.063) | (0.078) | (0.074) |
| HHI (-1) | -1.529* | -3.217*** | -2.892*** | -1.557* | -3.241*** | -2.956*** |
| | (0.879) | (0.983) | (0.957) | (0.883) | (0.976) | (0.953) |
| D_EuroZone | 0.325* | 0.318 | 0.337* | 0.287 | 0.289 | 0.311 |
| | (0.195) | (0.209) | (0.204) | (0.194) | (0.209) | (0.204) |
| D_year | Yes | Yes | Yes | Yes | Yes | Yes |
| N. of obs. | 1,980 | 1,316 | 1,387 | 1,980 | 1,316 | 1,387 |
| Pseudo R-squared | 0.203 | 0.1817 | 0.1823 | 0.208 | 0.1851 | 0.1862 |

## Table 11. Logistic estimations results in countries with F&D banks

This table presents the results of the estimation of pooled logistic regressions focusing only on those EU 28 member states that have both active and F&D banks over the period 2004-2013 (Austria, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain and United Kingdom). The dependent variable is the failed and distress bank dummy variable (F&D) that takes value of 1 when a bank *i* failed or experiences financial distressed in time period *t* and 0 otherwise banks. Capital (ETA, TIER1RATIO or TRCR) and liquidity ratios (NSFR2014 or NSFR2010) are our target variables. As explanatory variables we also include the other CAMELS covariates (ROAA, CIR, NPL_GL, and DIV), the control variables (SIZE, GDPC, INFC and HHI), and the Euro Zone dummy variable (D_EuroZone). All explanatory variables are lagged by one year, except D_EuroZone. The dependent variable and independent variables are defined in Section 4. All variables are winsorized at the 1% of each tail. Year dummy variables are also included in the model. Robust standard errors are reported in parentheses. The superscripts ***, **, and * denote coefficients statistically different from zero at the 1%, 5%, and 10% levels, respectively, in two-tailed tests.

| Variables | ETA and NSFR2014 | TIER1RATIO and NSFR2014 | TRCR and NSFR2014 | ETA and NSFR2010 | TIER1RATIO and NSFR2010 | TRCR and NSFR2010 |
|---|---|---|---|---|---|---|
| CAPITAL (-1) | -0.026 | -0.059 | -0.072 | -0.026 | -0.059 | -0.073 |
| | (0.035) | (0.027) | (0.027) | (0.035) | (0.027) | (0.027) |
| LIQUIDITY (-1) | -0.005* | -0.004* | -0.004* | -0.005* | -0.003* | -0.003* |
| | (0.003) | (0.002) | (0.002) | (0.003) | (0.001) | (0.001) |
| ROAA (-1) | -0.093 | 0.002 | 0.017 | -0.092 | 0.002 | 0.017 |
| | (0.096) | (0.107) | (0.102) | (0.097) | (0.107) | (0.103) |
| CIR (-1) | -0.005 | -0.003 | -0.003 | -0.005 | -0.003 | -0.003 |
| | (0.004) | (0.005) | (0.005) | (0.004) | (0.005) | (0.005) |
| NPL_GL (-1) | 0.108*** | 0.148*** | 0.154*** | 0.110*** | 0.150*** | 0.156*** |
| | (0.037) | (0.042) | (0.042) | (0.037) | (0.042) | (0.042) |
| DIV (-1) | -0.007* | -0.002 | -0.002 | -0.007* | -0.002 | -0.002 |
| | (0.004) | (0.005) | (0.005) | (0.004) | (0.005) | (0.005) |
| SIZE (-1) | 0.167*** | 0.184*** | 0.186*** | 0.164*** | 0.185*** | 0.187*** |
| | (0.048) | (0.045) | (0.046) | (0.048) | (0.045) | (0.045) |
| GDPC (-1) | -0.129** | -0.077 | -0.055 | -0.131** | -0.079 | -0.057 |
| | (0.060) | (0.066) | (0.067) | (0.059) | (0.066) | (0.067) |
| INFC (-1) | 0.452*** | 0.447*** | 0.478*** | 0.456*** | 0.444*** | 0.476*** |
| | (0.136) | (0.149) | (0.152) | (0.136) | (0.148) | (0.151) |
| HHI (-1) | 4.941*** | 7.573*** | 7.505*** | 4.919*** | 7.494*** | 7.412*** |
| | (1.556) | (2.037) | (2.023) | (1.558) | (2.021) | (2.006) |
| D_EuroZone | 0.068 | 0.097 | 0.031 | 0.093 | 0.102 | 0.038 |
| | (0.221) | (0.249) | (0.251) | (0.222) | (0.249) | (0.252) |
| D_years | Yes | Yes | Yes | Yes | Yes | Yes |
| N. of obs. | 1,500 | 1,005 | 1,013 | 1,500 | 1,005 | 1,013 |
| Pseudo R-squared | 0.2195 | 0.1941 | 0.1963 | 0.2194 | 0.1938 | 0.1960 |

## Table 12. Logistic estimations results with second and third lag

This table presents the results of the estimation of pooled logistic regressions on the full sample over the period 2004-2013, including the second and the third lag of our target variables. The dependent variable is the failed and distress bank dummy variable (F&D) that takes value of 1 when a bank *i* failed or experiences financial distressed in time period *t* and 0 otherwise banks. Capital (ETA) and liquidity ratios (NSFR2014 or NSFR2010) are our target variables. We show only the results with the capital ratio proxied by ETA. However, we obtain very similar results using TIER1RATIO or TRCR rather than ETA. As explanatory variables we also include the other CAMELS covariates (ROAA, CIR, NPL_GL, and DIV), the control variables (SIZE, GDPC, INFC and HHI), and the Euro Zone dummy variable (D_EuroZone). All explanatory variables are lagged by one year, except the dummies variables. The dependent variable and independent variables are defined in Section 4. All variables are winsorized at the 1% of each tail. Year dummy variables are also included in the model. Robust standard errors are reported in parentheses. The superscripts ***, **, and * denote coefficients statistically different from zero at the 1%, 5%, and 10% levels, respectively, in two-tailed tests.

| Variables | ETA and NSFR2014 | | ETA and NSFR2010 | |
|---|---|---|---|---|
| | (I) | (II) | (I) | (II) |
| CAPITAL (-2) | 0.004 | | 0.006 | |
| | (0.022) | | (0.021) | |
| CAPITAL (-3) | | 0.016 | | 0.018 |
| | | (0.019) | | (0.019) |
| LIQUIDITY (-2) | -0.006*** | | -0.003 | |
| | (0.002) | | (0.002) | |
| LIQUIDITY (-3) | | -0.007*** | | -0.004 |
| | | (0.002) | | (0.002) |
| ROAA (-2) | -0.234** | | -0.249** | |
| | (0.112) | | (0.113) | |
| ROAA (-3) | | -0.391*** | | -0.408*** |
| | | (0.150) | | (0.151) |
| CIR (-2) | 0.001 | | 0.001 | |
| | (0.004) | | (0.004) | |
| CIR (-3) | | -0.0005 | | -0.0009 |
| | | (0.907) | | (0.004) |
| NPL_GL (-2) | 0.031 | | 0.035 | |
| | (0.027) | | (0.027) | |
| NPL_GL (-3) | | 0.031 | | 0.034 |
| | | (0.030) | | (0.029) |
| DIV (-2) | -0.008*** | | -0.008** | |
| | (0.003) | | (0.003) | |
| DIV (-3) | | -0.005** | | -0.005* |
| | | (0.003) | | (0.003) |
| SIZE (-2) | 0.169*** | | 0.179*** | |
| | (0.041) | | (0.042) | |
| SIZE (-3) | | 0.139*** | | 0.144*** |
| | | (0.041) | | (0.041) |
| GDPC (-2) | -0.164*** | | -0.166*** | |
| | (0.037) | | (0.037) | |
| GDPC (-3) | | -0.120*** | | -0.122*** |
| | | (0.039) | | (0.039) |
| INFC (-2) | -0.029 | | -0.029 | |
| | (0.054) | | (0.053) | |
| INFC (-3) | | -0.020 | | -0.019 |
| | | (0.051) | | (0.050) |
| HHI (-2) | 0.550 | | 0.539 | |
| | (0.904) | | (0.908) | |
| HHI (-3) | | 1.533* | | 1.565* |
| | | (0.075) | | (0.886) |
| D_EuroZone | 0.634*** | 0.978*** | 0.643*** | 0.985*** |
| | (0.190) | (0.205) | (0.189) | (0.203) |
| D_years | Yes | Yes | Yes | Yes |
| N. of obs. | 1,706 | 1,449 | 1,706 | 1,449 |
| Pseudo R-squared | 0.1412 | 0.1186 | 0.1387 | 0.1165 |

## Table 13. Logistic estimations results with dummy crisis

This table presents the results of the estimation of pooled logistic regressions on the full sample over the period 2004-2013. The dependent variable is the failed and distress bank dummy variable (F&D) that takes value of 1 when a bank *i* failed or experiences financial distressed in time period *t* and 0 otherwise banks. Capital (ETA, TIER1RATIO or TRCR) and liquidity ratios (NSFR2014 or NSFR2010) are our target variables. As explanatory variables we also include the other CAMELS covariates (ROAA, CIR, NPL_GL, and DIV), the control variables (SIZE, GDPC, INFC and HHI), the Euro Zone dummy variable (D_EuroZone), the Subprime crisis dummy variable (D_SubCrisis) and the Sovereign Debt dummy crisis (D_SovCrisis). All explanatory variables are lagged by one year, except the dummies variables. The dependent variable and independent variables are defined in Section 5. All variables are winsorized at the 1% of each tail. Robust standard errors are reported in parentheses. The superscripts ***, **, and * denote coefficients statistically different from zero at the 1%, 5%, and 10% levels, respectively, in two-tailed tests.

| Variables | ETA and NSFR2014 | T1R and NSFR2014 | TRCR and NSFR2014 | ETA and NSFR2010 | T1R and NSFR2010 | TRCR and NSFR2010 |
|---|---|---|---|---|---|---|
| CAPITAL (-1) | -0.025 | -0.026 | -0.032 | -0.025 | -0.027 | -0.033 |
| | (0.036) | (0.027) | (0.024) | (0.036) | (0.027) | (0.024) |
| LIQUIDITY (-1) | -0.007** | -0.007** | -0.007** | -0.006** | -0.007** | -0.007*** |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) |
| ROAA (-1) | -0.112 | -0.128 | -0.101 | -0.111 | -0.128 | -0.099 |
| | (0.083) | (0.089) | (0.081) | (0.083) | (0.090) | (0.082) |
| CIR (-1) | 0.001 | 0.002 | 0.003 | 0.000 | 0.002 | 0.002 |
| | (0.003) | (0.004) | (0.004) | (0.003) | (0.004) | (0.004) |
| NPL_GL (-1) | 0.051* | 0.055* | 0.042 | 0.053* | 0.057* | 0.044* |
| | (0.029) | (0.029) | (0.027) | (0.029) | (0.029) | (0.027) |
| DIV (-1) | -0.013*** | -0.011*** | -0.012*** | -0.013*** | -0.011*** | -0.012*** |
| | (0.003) | (0.004) | (0.004) | (0.003) | (0.004) | (0.004) |
| SIZE (-1) | 0.227*** | 0.172*** | 0.200*** | 0.223*** | 0.167*** | 0.193*** |
| | (0.047) | (0.044) | (0.044) | (0.047) | (0.045) | (0.044) |
| GDPC (-1) | -0.089*** | -0.093*** | -0.086*** | -0.091*** | -0.095*** | -0.090*** |
| | (0.023) | (0.027) | (0.026) | (0.023) | (0.027) | (0.026) |
| INFC (-1) | 0.142*** | 0.181*** | 0.165*** | 0.146*** | 0.184*** | 0.170*** |
| | (0.050) | (0.058) | (0.057) | (0.050) | (0.058) | (0.057) |
| HHI (-1) | -0.943 | -2.444*** | -2.267** | -0.991 | -2.519*** | -2.364*** |
| | (0.832) | (0.890) | (0.885) | (0.834) | (0.893) | (0.887) |
| D_EuroZone | 0.584*** | 0.594*** | 0.602*** | 0.604*** | 0.613*** | 0.622*** |
| | (0.191) | (0.200) | (0.198) | (0.190) | (0.200) | (0.198) |
| D_SubCrisis | 1.338*** | 2.364*** | 2.403*** | 1.318*** | 2.343*** | 2.379*** |
| | (0.349) | (0.615) | (0.615) | (0.350) | (0.615) | (0.615) |
| D_SovCrisis | 2.090*** | 3.362*** | 3.428*** | 2.059*** | 3.331*** | 3.396*** |
| | (0.328) | (0.601) | (0.601) | (0.330) | (0.601) | (0.601) |
| N. of obs. | 1,982 | 1,472 | 1,566 | 1,982 | 1,472 | 1,566 |
| Pseudo R-squared | 0.1887 | 0.2058 | 0.2096 | 0.1887 | 0.2057 | 0.2100 |

# Appendix

## Table A.1. NSFR calculation

This table summarises the weights for each asset and liability items used to compute the last version of the NSFR of October 2014 and the previous version of December 2010. NSFR is computed as the ratio of Available Stable Funding (ASF) to Required Stable Funding (RSF). In bold are highlighted the differences between the two versions of NSFR. We calculate NSFR using the publicly data available in BankScope.

| *ASF factor 2014* | *BankScope Liability & Equity Items* | *ASF factor 2010* | *BankScope Liability & Equity Items* |
|---|---|---|---|
| 100% | Total equity<br>Total long-term funding | 100% | Total equity<br>Total long-term funding |
| **95%** | Customer deposits savings<br>Customer deposits term | **90%** | Customer deposits savings<br>Customer deposits term |
| **90%** | Customer deposits current | **80%** | Customer deposits current |
| 50% | Other deposits and short-term borrowings | 50% | Other deposits and short-term borrowings |
| 0% | Deposits from banks | 0% | Deposits from banks |
| *RSF factor 2014* | *BankScope Asset Items* | *RSF factor 2010* | *BankScope Asset Items* |
| 0% | Cash and due from banks | **0%** | Cash and due from banks<br>**Loans and advance to banks** |
| 5% | Government Securities | 5% | Government Securities |
| **50%** | Other securities (= Total Securities – government securities – at-equity investments in associates)<br>**Loans and advance to banks** | 50% | Other securities (= Total Securities – government securities – at-equity investments in associates) |
| 65% | Residential mortgage loans | 65% | Residential mortgage loans |
| 85% | Net loans<br>– residential mortgage loans | 85% | Net loans<br>– residential mortgage loans |
| 100% | Reserve for impaired loans/NPLs<br>Non-earning assets (=total assets – total earning assets – cash and due from banks)<br>Fixed assets<br>Other earning assets<br>Insurance assets<br>Investments in property<br>At-equity investments in associates | 100% | Reserve for impaired loans/NPLs<br>Non-earning assets (=total assets – total earning assets – cash and due from banks)<br>Fixed assets<br>Other earning assets<br>Insurance assets<br>Investments in property<br>At-equity investments in associates |
| 5% | Off-balance sheet items | 5% | Off-balance sheet items |

## Table A.2. The representativeness of the sample

This table illustrates the distribution of the full sample by country and its representativeness both over the period 2004-2013 and in 2013. We compare aggregate total assets of banks included in our sample with aggregate total assets of the whole banking system. Column I shows the total number of banks by country, over the sample period. Column II shows the number of large banks observed by the EBA in the EU-wide stress testing 2014, by country. The full sample covers the 28 EU member states and includes the 123 large banks subjected to the EBA stress test 2014 exercise. * Norway is part of the European Economic Area (EEA) and as such the country is considered by EBA in its stress test exercise. We do not include it in the full sample as not a EU member state.

| | I | II | III | |
|---|---|---|---|---|
| Country | N. of banks 2004-2013 | N. of large banks (EBA stress test) | Total assets of banks in the full sample / total assets of the whole banking system (%) | |
| | | | 2004-2013 | 2013 |
| Austria | 26 | 6 | 36.62 | 60.24 |
| Belgium | 11 | 5 | 42.01 | 70.13 |
| Bulgaria | 7 | 0 | 71.33 | 83.25 |
| Croatia | 5 | 0 | 55.90 | 75.06 |
| Cyprus | 5 | 3 | 43.99 | 83.24 |
| Czech Republic | 4 | 0 | 66.53 | 85.15 |
| Denmark | 25 | 4 | 36.14 | 57.23 |
| Estonia | 2 | 0 | 68.77 | 75.38 |
| Finland | 9 | 1 | 88.47 | 98.75 |
| France | 54 | 11 | 59.41 | 76.31 |
| Germany | 51 | 24 | 59.39 | 67.87 |
| Greece | 21 | 4 | 70.51 | 98.36 |
| Hungary | 9 | 1 | 55.24 | 76.04 |
| Ireland | 5 | 3 | 37.80 | 66.12 |
| Italy | 72 | 15 | 79.49 | 90.68 |
| Latvia | 8 | 1 | 12.95 | 38.48 |
| Lithuania | 3 | 0 | 32.76 | - |
| Luxembourg | 7 | 2 | 61.81 | 72.86 |
| Malta | 1 | 1 | 39.09 | 45.93 |
| Netherlands | 19 | 6 | 43.74 | 87.42 |
| Norway* | | 1 | | |
| Poland | 13 | 6 | 62.23 | 68.13 |
| Portugal | 17 | 3 | 82.84 | 91.46 |
| Romania | 9 | 0 | 53.38 | 72.11 |
| Slovakia | 4 | 0 | 75.63 | 73.32 |
| Slovenia | 6 | 3 | 43.78 | 60.34 |
| Spain | 80 | 15 | 82.79 | 90.20 |
| Sweden | 12 | 4 | 64.75 | 65.88 |
| United Kingdom | 28 | 4 | 54.23 | 67.88 |
| Total | 513 | 123 | 56.48 | 73.99 |

Table A.3. Variable Definitions

This table reports variable definitions. Data used to compute the variables based on accounting data are from BankScope database. The macroeconomic factors (GDPC and INFC) are collected by the World Economic Outlook database of the International Monetary Fund.

| Variable | Definition | Expected sign |
|---|---|---|
| *Target variables:* | | |
| ETA | The ratio of equity to total assets. | NEGATIVE |
| TIER1RATIO | The ratio of tier1 capital to risk weighted assets. | NEGATIVE |
| TRCR | The ratio of tier1 and tier 2 capital to risk weighted assets. | NEGATIVE |
| NSFR2014 | The ratio of available stable funding to required stable funding as defined by the new final Basel III version of October 2014. | NEGATIVE |
| NSFR2010 | The ratio of available stable funding to required stable funding as defined by the original Basel III document of December 2010. | NEGATIVE |
| *The other determinants of bank F&D:* | | |
| ROAA | The ratio of net income to average total assets. | NEGATIVE |
| CIR | The ratio of overheads to the sum of net interest income (defined as the difference between gross interest & dividend income and total interest expense) and other operating income. | POSITIVE |
| NPL_GL | The ratio of non-performing loans to gross loans. | POSITIVE |
| DIV | The ratio of non-interest income to net operating revenue. Non-interest income is equal to the sum of net gains (losses) on trading and derivatives, net gains (losses) on other securities, net gains (losses) on assets at fair value through income statement, net insurance income, net fee and commissions and other operating income. Net operating revenue is equal to the sum of total non-interest income and net interest income. | NEGATIVE |
| SIZE | The natural logarithm of total assets. | POSITIVE/NEGATIVE |
| GDPC | The annual percentage change of GDP. | NEGATIVE |
| INFC | The annual percentage change of inflation. | POSITIVE |
| HHI | The sum of the squared market share value (in term of total assets) of all banks in the country. | POSITIVE/NEGATIVE |
| D_EuroZone | Equals 1 for banks belonging to the euro area, 0 otherwise | POSITIVE |