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EMPIRICAL ESSAYS ON BANK LIQUIDITY CREATION AND MATURITY TRANSFORMATION RISK:

IMPLICATIONS FOR PRUDENTIAL REGULATION

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"New worlds to discover are no longer of geography, the planet is now identified. They are where the power of science, technology and triumphant economies operate".

"Les nouveaux mondes à découvrir ne relèvent plus de la géographie, la planète est maintenant recensée. Ils se font là où opère la puissance de la science, de la technique et de l'économie conquérante".

—Georges Balandier

"The right questions are not satisfied with easy answers".

"Les bonnes questions ne se satisfont pas de réponses faciles".

—Paul Samuelson

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CONTENTS IN BRIEF

INTRODUCTION

Many consider liquidity transformation one of the preeminent functions of banks and an essential component for the functioning of an economy. Analyses of banks' role in creating liquidity and thereby spurring economic growth have a long tradition, dating back to Adam Smith (1776)[1]. Modern incarnations of the idea that liquidity creation is central to banking appear most prominently in the formal analyses of Bryant (1980) and Diamond and Dybvig (1983). These theories argue that banks create liquidity by accepting short-term, liquid deposits and making longer-term, illiquid loans. Banks hold illiquid assets and provide cash and demand deposits to the rest of the economy. The authors model liquidity transformation performed by banks in its simplest conception as a result of maturity transformation. The Diamond and Dybvig (1983) model provides an explanation for the existence of banks as follows: Economic agents might face unexpected liquidity needs. Banks exist because they provide better liquidity insurance than financial markets. Indeed, banks provide funds to borrowers over a given time period. Meanwhile, depositors can withdraw their funds on demand at par value. Through their function as liquidity insurers, banks are exposed to the risk of run on deposits and could experience lack of liquidity. These difficulties can worsen if banks cannot sell their assets or cannot access external sources of funding. Consequently, there are two dimensions of bank liquidity closely linked with "*market liquidity*" (Decker, 2000). The first is "*asset liquidity*", which corresponds to the ability of a bank to immediately sell or securitize a nonmonetary asset without facing large losses (Valla et al., 2006). Alternatively, the bank can pledge them as collateral in a secured borrowing. The second dimension is "*funding liquidity*", the ability of a bank to access external sources of funding

1 Adam Smith (book II, chapter II, 1776) emphasizes the importance of banks' liquidity creation. In addition, he shows how it helped commerce in Scotland in the 18th century. He notes that "the trade and industry of Scotland have increased very considerably during this period and that the banks have contributed a good deal to this increase".

through interbank financing, by issuing commercial papers or covered bonds or attracting more deposits. A bank can also use off-balance sheet commitments from other financial institutions to obtain external liquidity.

Although these two approaches are distinct, they are closely related. Indeed, a leveraged institution that is not willing or able to sell its assets on time needs to ensure appropriate funding liquidity. Likewise, an institution that is not able to obtain the necessary funding might want to sell or pledge assets, which is considerably more difficult for illiquid assets. The mutual interaction between the liquidity of funding and the liquidity of assets tends to reinforce one another—that is, unexpected withdrawals from customers are likely to exceed the available amount of cash. Such unbalances are exacerbated following a fall in the liquidity of bank assets (i.e., "*asset liquidity risk*") or possible funding roll-offs (i.e., "*funding liquidity risk*"). Hence, bank "*maturity transformation risk*" arises from the mutual interaction of "*asset liquidity risk*" and "*funding liquidity risk*". Maturity transformation risk is the risk a bank takes of being unable to meet unexpected withdrawals from customers with its liquid assets. Maturity transformation risk and available liquidity vary according to the circumstances and how long they prevail. Consequently, several approaches of bank maturity transformation risk can be defined according to three dimensions (Matz and Neu, 2007). The first is the "*mismatch or structural liquidity risk*". It refers to the maturity transformation risk that exists in the structure of on- and off-balance sheets, which stems from pure maturity transformation and the asymmetry of commitments between both sides. The second dimension is the "*contingent liquidity risk*". Liquidity risk is considered a contingent risk, because it can be generated by primary factors[2]. Every risk factor is likely to imply liquidity needs and might create a distortion in the balance sheet structure[3] than can increase bank maturity transformation risk. The third dimension corresponds to "*market liquidity risk*". It refers to the risk a bank takes of facing higher than expected losses from selling assets at discounted value when financial markets become less liquid. Consequently, the cash value of banks' assets might be too low to meet unexpected customer withdrawals. It also refers to banks' risk of being unable to meet unexpected withdrawals from customers, as they cannot continuously obtain funding on the interbank market and roll over or issue commercial papers and covered bonds. From these definitions, bank liquidity and exposure to maturity

2 Primary factors can be endogenous (e.g., the underestimation of liquidity requirements, the underestimation of available liquidity, the inefficient management of credit or operational risks) or exogenous (e.g., every potential source of systemic problems: payment system disruption, capital markets' downturn, credit crunch).

3 For example, future events might require larger (i.e., more than forecasted) amounts of cash incurred by unusual deviation in the timing of cash flows (also called "*term liquidity risk*"), unexpected drawdowns of loan commitments, and unexpected withdrawals from customers (also called "*call liquidity risk*").

transformation risk have idiosyncratic and systemic components (Decker, 2000). A bank cannot survive unless debtholders are confident that it is still able to meet its engagements. Thus, the extent of bank exposure to maturity transformation risk is highly dependent on counterparty perception of its financial soundness.

The traditional function of liquidity provision and banks' exposure to depositor runs are the paramount justifications of banking regulation and of deposit insurance systems. Furthermore, strong interbank relationships worsen the impact of the failure of a given bank on the stability of the financial system (i.e., systemic risk), another justification for banking regulation. Although the "free banking theory" argues that the functioning of the financial system will be improved without regulation, supervision and any lender of last resort, there is a large consensus on the necessity to implement such regulations. Llewellyn (1999) emphasizes the need to regulate banks to strengthen the stability of individual banks, the stability of the financial system as a whole and consumers' protection. To minimize the risk of run on deposits and to protect depositors, most countries have implemented explicit deposit insurance systems. Moreover, the lender of last resort provides funding to banks that cannot access external funding any longer. Although these mechanisms mitigate runs on deposits and systemic risk, they also encourage banks to take on greater moral hazard. Indeed, if the deposit insurance premium is undervalued, banks are encouraged to take greater risks. In addition, the implicit guarantee the lender of last resort provides in case of bank financial distress might encourage banks to increase their risk exposure. Finally, the guarantee of deposits might discourage depositors to monitor banks carefully and sanction excessive risk exposure.

From Basel I capital standards…

To limit these adverse effects on banks' risk-taking behavior, in 1988, the Basel Committee on Banking Regulation and Supervision suggested implementing capital adequacy rules. Banks are required to maintain a given level of capital in relation to their risk weighted assets. The calculation of these solvency standards requires a precise definition of bank capital. Banks must meet the following two regulatory requirements: The ratio of Tier 1 and Tier 2 capital[4] to risk weighted assets must equal or exceed 8%, and the ratio of Tier 1 capital to risk weighted assets must equal or exceed 4%.

4 Tier 1 capital includes common shareholders' equity, qualified preferred stocks and minority interests less goodwill and other adjustments. Tier 2 capital includes perpetual preferred ineligible for Tier 1, perpetual debts and mandatory convertible securities, qualifying senior and subordinated debts and limited life preferred stocks.

Although implementing this regulatory framework has strengthened bank financial soundness, it has been widely criticized. To measure the risk of bank assets, the measure considers only credit risk. However, since the end of 1980s, banks have extensively enhanced their market activities. In 1996, capital requirements were set according to the extent of bank exposure to market risk. Nevertheless, some other problems remain. For example, the risk weights assigned to each type of asset encourage regulatory arbitrage. The risk buckets[5] are too large and enable banks to restructure their investments within a given risk bucket. For a given capital adequacy requirement and risk bucket, banks invest in the riskier assets of the bucket. Because exposures to credit risk of the several portfolios are considered separately, they are simply added; the concept of diversification is not considered.

These accords are focused on solvency standards and minimize several other aspects. Regarding liquidity supervision, in 1992, the Basel Committee on Banking Regulation and Supervision developed sound practices for assessing and managing bank liquidity by considering three major dimensions (Bank of International Settlements [BIS], 1992). The framework includes guidelines on the way to measure and manage net funding requirements with a maturity laddering indicator[6]. It also involves the management of bank access to financial markets[7] and contingency planning[8]. The purpose is to provide useful guidance that banks might consider to implement their liquidity management framework.

… To Basel II capital standards

To address these critics, the Basel Committee announced consultative proposals to strengthen the resilience of the banking sector in 1999. The efforts of the Basel Committee on Banking Supervision to revise the standards governing the capital adequacy requirements (i.e., by better assessing the risk of assets with internal valuation models and external audit

5 There are four risk buckets and thus four weights according the type of the issuer: 0% for government debt securities from Organisation for Economic Co-operation and Development (OECD) member countries, 20% for debt securities issued by banks or municipalities and local agencies from OECD countries, 50% for mortgage lending and 100% for the other types of claims.

6 A maturity ladder should be used to compare a bank's future cash inflows with its future cash outflows over a series of specified time periods. Cash inflows arise from maturing assets, saleable nonmaturing assets and established credit lines that can be tapped. Cash outflows include liabilities falling due and contingent liabilities, especially committed lines of credit that can be drawn down.

7 Some liquidity management techniques are viewed as important for not only their influence on the assumptions used in constructing the maturity ladder, but also their direct contribution to enhancing a bank's liquidity. Thus, it is important for a bank to review its efforts periodically to maintain the diversification of liabilities, to establish relationships with liability-holders and to develop asset-sales markets.

8 A bank's ability to withstand a net funding requirement in a bank specific or general market liquidity crisis can also depend on the caliber of its formal contingency plans. Effective contingency plans should address two major questions: (1) Does management have a strategy for handling a crisis? And (2) does management have procedures in place for accessing cash in emergency? The degree to which a bank has addressed these questions realistically provides management with additional insight as to how a bank may fare in a crisis.

controls) achieved a critical milestone with the publication of an agreed-on text in 2006, known as the Basel II accords. The purpose is to improve the definition of capital adequacy requirements by better assessing the risk of assets with internal valuation models and external audit controls. This regulatory framework encompasses the greater complexity of banking activities and acknowledges that capital adequacy rules depend on bank exposure to credit, market and operational risks. In addition to solvency standards, these new accords focus on the importance of supervisory review and market discipline through greater public disclosures. They rely on three pillars: minimum capital requirements, supervisory oversight and market discipline.

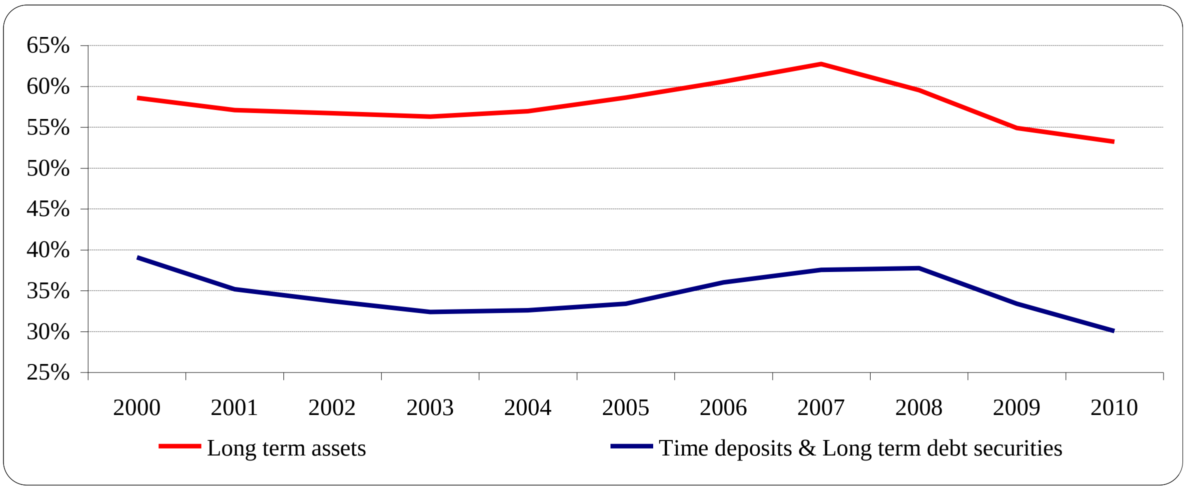
Although in the first pillar, the new definition of capital adequacy rules enables regulators to better assess the risk of bank assets, the use of internal risk valuation models with possibly accommodative hypotheses on bank risk exposure can lead to underestimated risk. In addition, in the second pillar, supervisors must monitor bank risk exposure, evaluate bank internal risk valuation models and assess the correct adequacy between capital and the risk of bank assets. Thus, there is a stronger relationship between banks and supervisors, specifically for the implementation of internal risk valuation models. However, this involvement of supervisors could be criticized as leading to regulatory capture (Benink and Wihlborg, 2002): Supervisors identify themselves with banks and can be too permissive; this lack of stringency can be costly in the case of bank failure.

The banking regulatory framework has been improved from Basel I to Basel II accords, but these accords are focused on solvency standards and still minimize the role of liquidity and bank exposure to maturity transformation risk. Over time, banks have decreased their reliance on core deposits and increased their reliance on wholesale funding. Recent technological and financial innovations have provided banks with new ways of funding their activities and managing their liquidity. These developments have posed new challenges for liquidity management. Consequently, in 2000, the Basel Committee on Banking Regulation and Supervision superseded the 1992 paper on liquidity with updated guidelines (BIS, 2000). The guidelines are organized around a set of 14 principles falling in the following key areas: (1) developing a structure for managing liquidity, (2) measuring and monitoring net funding requirements by considering the maturity laddering indicator, (3) managing market access, (4) contingency planning, (5) foreign currency liquidity management, (6) internal controls for liquidity risk management, (7) role of public disclosure in improving liquidity and (8) role of supervisors.

Basel III new capital and liquidity standards

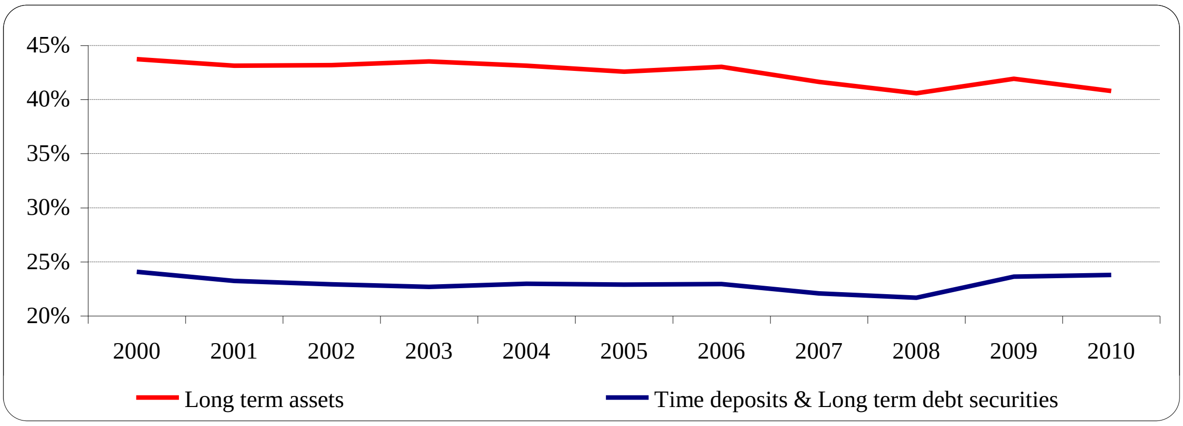
Recent financial crises have relaunched the debate on banking regulation, specifically on bank liquidity and exposure to maturity transformation risk. Liquidity shortages were clearly involved in recent historical events following the Asian crisis at the end of the 1990s and the subprime crisis, which began in mid-2007. High levels of liquidity support were required to sustain the financial system, and even with such extensive support, a large number of banks failed, were forced into mergers or required resolution. Such events indicate that many banks have experienced difficulties in managing their liquidity and have faced maturity transformation risk. For example, it is commonly admitted that U.S. and European banks have been considerably affected by the subprime crisis. The balance sheet structure of commercial banks in the United States and the Euro zone indicates a mismatch between the importance of long-term assets and long-term debts. For U.S. banks, over the 2000–2010 period, the average share of long-term assets in total assets was 58%, and the average share of time deposits and long-term debt securities in total liabilities was 35% (see Figure 1). Over the same period, European banks' average share of long-term assets in total assets was 42.5%, and the average share of time deposits and long-term debt securities in total liabilities was 23% (see Figure 2).

Figure 1. Long-term assets and liabilities of U.S. commercial banks from 2000 to 2010



Source: Federal Deposit Insurance Company (2000–2010). All variables are expressed in percent of total assets. Long-term assets include commercial loans, mortgage loans, long-term securities and other long-term investments. Time deposits and long-term debts securities include all deposits and all debts securities with a maturity over one year.

Figure 2. Long-term assets and liabilities of commercial banks in the Euro Zone from 2000 to 2010



Source: European Central Bank (2000–2010). All variables are expressed in percent of total assets. Long-term assets include commercial loans, mortgage loans, long-term securities and other long-term investments. Time deposits and long-term debts securities include all deposits and all debts securities with a maturity over one year.

Following the subprime crisis, the Basel Committee on Banking Regulation and Supervision developed a package of proposals to strengthen global capital and liquidity regulations with the purpose of promoting a more resilient banking sector (BIS, 2009a, 2009b)[9]. This new regulatory framework is known as the Basel III accords. These accords include additional capital adequacy rules[10] and the implementation of two liquidity ratios concomitant to capital standards. Focusing on liquidity regulation, the "*liquidity coverage ratio*" identifies the amount of unencumbered, high-quality liquid assets an institution holds that can be used to offset the net cash outflows it would encounter under an acute short-term stress scenario specified by supervisors (i.e., over a one-month time horizon). The specified scenario entails both institution-specific and systemic shocks built on actual circumstances experienced in the global financial crisis. The scenario entails (1) a significant downgrade of the institution's public credit rating, (2) a partial loss of deposits, (3) a loss of unsecured wholesale funding, (4) a significant increase in secured funding haircuts[11] and (5) an increase

9 For further details about these new regulatory standards, see BIS (2009a, b). The Basel Committee on Banking Regulation and Supervision asked professionals and researchers for their suggestions about the definition and the way to implement such a regulation. Appendix A includes my comments on the consultative document titled "International framework for liquidity risk measurement, standards and monitoring," which is focused on the key topic of this thesis. I sent my comments to BIS on April 16, 2010. In December 2010, these proposals were fully calibrated and agreed upon and revised in June 2011 (Basel III accords).
10 Regarding the new capital adequacy rules, the required level of Tier 1 capital is set to 6% instead of 4%, and the required common shareholders' equity increases from 2% to 4.5%. In addition, a further 2.5% in common shareholders' equity is required as a conservation buffer. Furthermore, an additional variable amount of countercyclical capital buffer is required. It should vary between 0% and 2.5%. Finally, total capital requirements increased from 8% to 10.5%, including the conservation buffer.
11 The "*haircut*" corresponds to the reduction of value to securities used as collateral in a margin loan. That is, when one places securities as collateral, the brokerage making the loan treats them as being worth less than they actually are, so as to give itself a cushion in case its market price decreases.

in derivative collateral calls and substantial calls on contractual and noncontractual off-balance-sheet exposures (including committed credit and liquidity facilities). Second, the "*net stable funding ratio*" measures the amount of long-term, stable sources of funding an institution employs relative to the liquidity profiles of the assets funded and the potential for contingent calls on funding liquidity arising from off-balance-sheet commitments and obligations. The standard requires a minimum amount of funding that is expected to be stable over a one-year time horizon based on liquidity risk factors assigned to assets and off-balance-sheet liquidity exposures. The net stable funding ratio is intended to promote long-term structural funding of banks' balance sheets, off-balance sheet exposures and capital markets activities.

Expected benefits/drawbacks of implementing such liquidity standards

Such a regulation of bank liquidity seems necessary to strengthen the banking regulatory framework. Even with strong solvency requirements, many banks experienced difficulties during the subprime crisis. They suffered from lack of liquidity and required large liquidity supports from governments and lenders of last resort. Consequently, focusing only on solvency standards does not seem to be sufficient to ensure bank stability, and liquidity can also play a crucial role. The regulation of bank liquidity enlarges the panel of risks included in the scope of regulation and harmonizes liquidity regulation standards across countries by considering international standards.

The changes in the banking industry, following financial globalization and the development of financial innovation, have posed considerable challenges for bank liquidity management. The use of market funding, the loan securitization (i.e., the originate-to-distribute model) and the development of off-balance sheet commitments enable banks to access additional sources of liquidity. Although banks manage their liquidity by accessing several sources of liquidity through their market activities, they are exposed to the instability of financial markets (European Central Bank, [ECB] 2002). The subprime crisis illustrated how quickly and severely illiquidity can crystallize. On the asset side of bank balance sheets, assets considered liquid became illiquid when markets collapsed. On the liability side of bank balance sheets, funding available under normal time conditions ceased during the crisis. In the literature, liquidity is considered a key factor to explain bank financial distress (Demirgüç-Kunt, 1990; Gonzalez-Hermosillo, 1999). Consequently, these facts stress the necessity to reconsider the broad liquidity profile of banks in a context in which banks and financial markets are increasingly connected. The Basel III accords address this issue: The two liquidity ratios include the information on the cash value of assets and the availability of deposit and market funding to assess the liquidity of assets and liabilities. The main purpose is to minimize the impact of liquidity shocks on the stability of banks and also on the stability of the financial system as a whole for which liquidity is a key component.

These several expected benefits justify the implementation of liquidity requirements concomitant to capital standards. Nevertheless, depending on the scope of their activities, their funding and investment strategies, the Basel III liquidity requirements might raise challenges for banks to reach the balance between the proportions of liquid assets and available stable funding. Implementing such liquidity standards could cause banks to question how to improve the liquidity of bank assets without shrinking loan activities and other investments in long-term assets. In addition, it raises challenges considering the need to improve the stability of bank funding without generating destructive competition for deposits or a wide increase of the proportion of long-term market debts. In addition, possible questions arise about the right trade-off between the costs of implementing additional regulatory standards and the advantages provided by such new regulatory standards. Furthermore, implementing such an additional regulation on bank liquidity instead of only considering capital standards might cause regulators to question to what extent these two regulatory frameworks might be completing one another. Finally, it also could raise questions about the effective benefits of this additional regulation to strengthen the stability of banks.

The objective and contents of the thesis

The objective of this thesis is to analyze the advantages of adding liquidity standards in the current banking regulatory framework to strengthen bank stability. It extends the current banking literature in several directions. Considering the proposals of the Basel Committee implementing liquidity requirements concomitant to capital standards (BIS, 2009a, b), the aim is to contribute to the debate on liquidity regulation implemented in the Basel III regulatory framework. From this perspective, the thesis is focused on the following three main issues addressing them empirically.

It is commonly admitted that liquidity creation and maturity transformation risk are inherent to banking institutions. C**hapter 1** reviews the existing literature on the measures of bank liquidity creation and maturity transformation risk. Stylized facts present the extent of banks' liquidity creation and exposure to maturity transformation risk according to their business model. Indeed, depending on the orientation of their activities, banks are likely to face different scopes of activities, investment and funding strategies. This is likely to impact their balance sheets' structure and the extent of their liquidity creation and their exposure to maturity transformation risk. The purpose of this statistical analysis is to emphasize how the differences in the orientation of bank activities might affect banks' role of liquidity provision and the extent of their exposure to maturity transformation risk.

In addition, this chapter examines the sensitivity of maturity transformation risk to several factors considering banks' business models. The main purpose is to emphasize the strengths and weaknesses of banks according to the orientation of their activities for the management of maturity transformation risk. Using the Basel III liquidity requirements, this study identifies banks likely to face more or fewer difficulties in adjusting their investment and funding strategies to meet the Basel III liquidity standards. Beyond the bank-level indicators and macroeconomic variables identified in previous literature, this study investigates the impact of bank access to additional sources of liquidity, focusing on the importance of potentially securitizable loans and of short-term, potentially unstable market debts. This study recommends that securitisable loans be considered along traditional balance sheet measures of liquidity, such as cash and marketable securities, as a measure of banks' liquidity risk management. From this perspective, the study determines to what extent the potential liquidity of the loan portfolio is likely to mitigate bank exposure to maturity transformation risk. Next, the study examines the impact of holding a higher share of short-term, potentially unstable market funding on bank exposure to maturity transformation risk. Consistently with BIS (2009a), short-term debts can be considered less stable than long-term ones, and short-term deposits might be considered more stable than short-term market debts. Consequently, the more banks are funded by short-term market debts, the higher is the potential instability of their funding. Thus, the study investigates to what extent the potential instability of short-term liabilities is likely to increase bank exposure to maturity transformation risk. Understanding what factors significantly affect bank exposure to maturity transformation risk would help banks to improve their liquidity risk management framework and their stability. Furthermore, this issue is of particular importance for regulatory authorities to set adequate regulatory frameworks and appropriate incentive mechanisms for bank risk taking behavior consistent with the evolutions of the banking industry.

Using a sample of U.S. and European publicly traded commercial banks from 2000 to 2008, the results show that European banks perform higher levels of liquidity creation and face much higher exposure to maturity transformation risk than do U.S. banks. In addition, the findings emphasize that large U.S. banks perform higher levels of liquidity creation and face much higher exposure to maturity transformation risk than do small U.S. banks. Thus, similar results are obtained for large U.S. banks and European banks, which are mainly large banks in the sample. On the whole, it is not banks' business models that explain the differences in liquidity creation and of maturity transformation risk profile but rather banks' size. These findings might be primarily explained as small banks benefit from the relative stability of their large deposit base and face a lower exposure to maturity transformation risk. European and large U.S. banks are more involved in debt markets, and they are more exposed to volatile market funding. Loan securitisation also helps with maturity risk transformation in the United States. The findings raise several challenges for both banks and regulators to improve the profile of banks' maturity transformation risk.

During the subprime crisis, a large number of banks failed or required resolution (BIS, 2009a) following lack of liquidity, even if they received extensive liquidity supports. Following this crisis, the proposals to implement liquidity ratios in addition to capital standards relaunched the debate on the broad role of liquidity in bank financial distress. Thus far, most empirical studies on bank default probability have considered indicators from the CAMELS[12] approach, which are computed from accounting data (Demirgüc-Kunt, 1990; Demyanyk and Hasan, 2009; Demyanyk and Van Hemert, 2009; Gonzalez-Hermosillo, 1999; Torna, 2010). However, the current study questions whether introducing liquidity measures as defined in the Basel III accords could contribute to improve the prediction of bank financial distress. **Chapter 2** examines the advantages of using a liquidity ratio as defined in the Basel III accords in addition to the liquidity indicators from the CAMELS approach to predict bank financial distress. Using a standard logit model, the study determines that the Basel III net stable funding ratio adds predictive value to models relying on liquidity ratios from the CAMELS approach to explain bank default probability. The aim is to contribute to the strand of the empirical literature on the determinants of individual bank failure as well as to the debate on liquidity regulation implemented in the Basel III regulatory framework, as this issue is important to assess the accuracy of improving the definition of liquidity ratios to predict bank financial distress.

12 In November 1979, U.S. regulators introduced the Uniform Financial Rating System, informally known as the CAMEL ratings system, to assess the health of individual banks. The CAMEL approach refers to five components to assess bank financial soundness: capital adequacy, asset quality, management, earnings and liquidity. Since 1997, a sixth component has been added and the CAMEL approach, making it the CAMELS approach: sensitivity to market risk. Following an onsite bank examination, bank examiners assign a score on a scale of 1 (best) to 5 (worst) for each component; they also assign a single summary measure, known as the composite rating.

Using a sample of U.S. and European publicly traded banks during the 2005–2009 period, the results show that the Basel III net stable funding ratio adds predictive value to models relying on liquidity ratios from the CAMELS approach to explain bank default probability. The findings support the need to improve the definition of liquidity to predict bank financial distress. Considering only the traditional liquidity ratios from the CAMELS approach ignores additional information provided by the liquidity ratio as defined in the Basel III accords. These findings emphasize that it is essential to consider a liquidity indicator that includes information on the cash value of assets and on the availability of deposits and market funding.

Although banks could mitigate their exposure to maturity transformation risk through various asset and liability management strategies, the risk of being unable to access external funding or the risk of losses from selling illiquid assets to meet the unexpected withdrawals from customers are inherent to banking organizations, because their function is liquidity provision. Prudential policies place great importance on the role of capital in minimizing the impact of losses and improving banks' ability to access external funding. The relationship between bank capital and liquidity creation has been investigated both theoretically[13] and empirically (Berger and Bouwman, 2009). While theory suggests a causal relationship from capital to liquidity creation, the issue is more complex, and both might be jointly determined. Thus, the more banks create liquidity, the higher is their risk exposure. Consequently, they might strengthen their capital ratio to access external funds at better conditions or to possibly, in extreme cases, better assume the losses from selling illiquid assets to repay the liabilities claimed on demand. There is a large consensus in the literature that capital ratios have exhibited an upward trend since the beginning of the 1990s. Previous research studying the determinants of bank capital buffer (i.e., the amount of capital held in excess of the minimum required by regulators) has neglected the role of liquidity[14]. Along the other factors considered in the literature, the reason banks hold capital buffers might be their exposure to liquidity risk. Therefore, this study questions whether banks maintain or strengthen their capital buffer when they face lower liquidity, hypothesizing that banks could strengthen their

13 The recent contributions on the theories on the relationship between bank capital and liquidity creation refers to the works of Allen and Gale (2004), Diamond and Rajan (2000, 2001a), Gorton and Winton (2000), and Repullo (2004).
14 See the following recent empirical studies on the determinants of bank capital buffer: Alfon et al. (2004), Ayuso et al. (2004), Bikker and Metzemakers (2004), Flannery and Rangan (2008), Fonseca and Gonzalez (2010), Jokipii and Milne (2008, 2011), Lindquist (2004), Nier and Baumann (2006) and Stolz and Wedow (2011).

solvency standards to improve their ability to access external funding. In addition, banks could strengthen capital standards under higher levels of illiquidity to improve their ability to assume losses from selling illiquid assets to meet unexpected withdrawals from customers. If the hypothesis is rejected (i.e., if banks do not adjust and improve their capital standards when facing higher illiquidity), liquidity requirements concomitant to capital standards might be needed to temper the overall riskiness of banks. Therefore, **Chapter 3**, using a simultaneous-equations framework, investigates the relationship between bank capital buffer and liquidity. The aim is to contribute to the debate on liquidity regulation implemented in the Basel III regulatory framework.

Using the same sample of U.S. and European banks as in Chapter 1, Chapter 3’s main findings show that banks do not strengthen their capital buffer when they face higher illiquidity as defined in the Basel III accords or when they create more liquidity as measured by Berger and Bouwman (2009). They do seem to hold lower capital buffers when they create more liquidity (e.g., when they fund larger portions of illiquid assets with liquid liabilities). However, these relationships can vary depending on the liquidity measure used. Using a different definition of stable liabilities specific to U.S. banks based on the concept of core deposits, the results show that, except for very large institutions, banks do build bigger capital buffers when exposed to greater illiquidity. The findings support the need to implement minimum liquidity ratios concomitant to capital ratios, as stressed by the Basel Committee. Nevertheless, the results also shed light on the need to further clarify how to define and measure illiquidity.

CHAPTER 1.

LIQUIDITY CREATION AND MATURITY TRANSFORMATION RISK:

THE IMPLICATIONS OF THE BASEL III LIQUIDITY REQUIREMENTS

This chapter refers to and completes the working paper titled "The sensitivity of banks' maturity transformation risk considering their business models: The implications of the Basel III liquidity requirements" (Roulet, 2011).

ABSTRACT.

Chapter 1 examines how the differences in the orientation of bank activities might affect banks' role of liquidity provision and the extent of their exposure to maturity transformation risk. The study uses the Berger and Bouwman liquidity creation (2009) and the Basel III net stable funding (BIS, 2009a) measures and a sample of U.S. and European publicly traded commercial banks during the 2000–2008 period. On the whole, European banks and large U.S. banks perform higher levels of liquidity creation and face much higher exposure to maturity transformation risk than do small U.S. banks. Typically, the results show that it is not banks' business models that explain the differences in liquidity creation and of maturity transformation risk profile but rather banks' size. This difference in results might be primarily explained as small banks benefit from the relative stability of their large deposit base and face a lower exposure to maturity transformation risk. European banks, which are mainly large banks in the sample, and large U.S. banks are more involved in debt markets, and they are more exposed to volatile market funding. Loan securitisation also helps with maturity risk transformation in the United States. The findings imply that regulators must trade off size and maturity transformation risk exposure.

JEL classification: G21; G28

Keywords: Liquidity Creation; Maturity Transformation Risk; Bank Regulation

1.1. Introduction

According to the theory of financial intermediation, an important role of banks in the economy is to provide liquidity by funding long-term, illiquid assets with short-term, liquid liabilities. By providing liquidity, banks create liquidity, as they hold illiquid assets and provide cash and demand deposits to the rest of the economy. The Diamond and Dybvig (1983) model provides an explanation for the existence of banks: Economic agents might face unexpected liquidity needs. Banks exist because they provide better liquidity insurance than financial markets. However, because banks are liquidity insurers, they face maturity transformation risk and are exposed to the risk of depositor runs. More generally, greater liquidity creation results in greater risk for banks to be unable to meet unexpected withdrawals from customers, as illiquid assets cannot be monetized or cannot be pledged as collateral in a secured borrowing.

A large stream of the theoretical literature involves bank liquidity creation (Bryant, 1980; Diamond and Dybvig, 1983; Holmstrom and Tirole, 1998; Kashyap et al., 2002). Despite of this large body of theoretical literature, only a few studies measure actual liquidity creation performed by banks. Deep and Schaefer (2004) define the "*liquidity transformation gap*" (*LT gap*) as the difference between liquid liabilities and liquid assets (i.e., all assets and liabilities maturing within one year)[15]. This measure shows the amount of transformed liquidity relative to total assets. Berger and Bouwman (2009) define the liquidity of assets and liabilities not only according to their maturity but also by considering their category. The authors assume that some assets are easier to sell than others (e.g., trading assets, securitizable loans) or that some liabilities are more volatile than others, because customers can quickly withdraw them without penalty (e.g., commercial papers, short-term deposits). Thus, assets and liabilities are classified as liquid, semiliquid or illiquid according to their maturity and their category. In addition, their indicator includes on- and off-balance sheet items, as they assume that banks can create liquidity through loan commitments and similar claims to liquid funds. Using such an indicator provides several advantages. First, it is a synthetic measure of bank liquidity creation in that it includes both on- and off-balance sheets as a whole, the liquidity of bank assets and liabilities being based on the duration they are expected to stay within the institution and/or on their expected value when they are sold. In addition, this

15 A positive difference means that the bank invests liquid liabilities into illiquid assets and performs a significant amount of liquidity creation.

indicator is an absolute value of created liquidity (i.e., a U.S. dollar or euro amount of actual liquidity a bank creates).

Other studies focus on the determinants of bank liquidity creation (Berger and Bouwman, 2009; Chen et al., 2010; Choi et al., 2009; Deep and Schaefer, 2004; Pana et al., 2010; Rauch et al., 2009) and consider various determinants such as bank capital, profitability, credit risk, market power, business cycle and monetary policy. All these studies portray liquidity creation as an essential role of banks, but they do not deal with the liquidity pressures that banks might face and the importance of their exposure to bank maturity transformation risk.

Throughout the global financial crisis that began in mid-2007, many banks have experienced difficulties in managing their liquidity and have faced maturity transformation risk. Recognizing that banks must improve their liquidity management, the Basel Committee on Banking Regulation and Supervision developed an international framework for liquidity assessment in banking (BIS, 2009a). Among the several guidelines, the Basel III accords include the implementation of liquidity ratios[16] concomitant to capital standards to strengthen the stability of banks. The Basel Committee focuses on the importance of the balance between the amount of assets that cannot be monetized (i.e., the illiquid assets) and the amount of stable funding (i.e., the funding expected to stay within the institution) for maturity transformation risk management. Nevertheless, according to their business model (i.e., retail or diversified banks), banks face different scopes of activities and investment and funding strategies. This is likely to affect their balance sheets' structure and the extent of their exposure to maturity transformation risk. For example, retail banks, which focus on loan activities and deposits, might benefit from a large base of retail customer deposits to match structural imbalances with long-term loans. In contrast, more diversified banks might be exposed to the volatility of debt markets (i.e., bond and interbank markets) and might face structural imbalances with a small deposit base due to the importance of their life insurance and mutual fund shares activities off the balance sheet (Vallet, 2011). Nevertheless, they might benefit from the liquidity of their trading asset portfolio, marketable assets being

16 Two regulatory standards for liquidity have been introduced. The "*net stable funding ratio*" identifies the amount of long-term, stable sources of funding an institution uses relative to the liquidity profiles of its assets and the potential for contingent calls on funding liquidity arising from off-balance-sheet commitments and obligations. The standard requires a minimum amount of funding that is expected to be stable over a one year-time horizon based on liquidity factors assigned to assets and off-balance-sheet commitments. The Basel Committee has also introduced the "*liquidity coverage ratio*" to promote the short-term resiliency of the liquidity profile of institutions by ensuring that they have sufficient high-quality liquid resources to survive an acute stress scenario lasting for one month. These proposals have been fully calibrated and were agreed upon on December, 2010 and revised on June 2011 (Basel III Accords).

readily saleable on financial markets. Thus, depending on their business model, banks can face different challenges to reach the balance between the proportions of liquid assets and of stable funding to meet the Basel III liquidity standards.

This chapter first reviews the existing literature on the measures of liquidity creation and maturity transformation risk. Next, it presents stylized facts on the extent to which banks create liquidity and their exposure to maturity transformation risk depending on their business model. This chapter explores how the differences in terms of scope of activities, funding and investment strategies are likely to affect banks' role of liquidity provision and the extent of their exposure to maturity transformation risk. The purpose is to emphasize the similarities and differences that might exist across banks with heterogeneous business models.

Then, this chapter investigates the sensitivity of maturity transformation risk to several factors depending on banks' business models. The aim is to emphasize the strengths and weaknesses of banks for liquidity risk management considering the orientation of their activities. The purpose is to identify banks likely to face more or fewer difficulties and indicate how they could adjust their investment and funding strategies to meet the Basel III liquidity standards. Beyond the bank-level indicators and macroeconomic variables identified in previous literature (Berger and Bouwman, 2009; Chen et al., 2010; Choi et al., 2009; Deep and Schaefer, 2004; Fungacova et al., 2010; Pana et al., 2010; Rauch et al., 2009) that could affect bank exposure to maturity transformation risk, this study considers the impact of bank access to additional sources of liquidity, focusing on the importance of (1) potentially securitizable loans and (2) short-term, potentially unstable market debts. Regarding loan securitization, this study considers the use of loan securitization in bank liquidity risk management[17]. Securitizable loans should be considered along traditional balance sheet measures of liquidity, such as cash and marketable securities. From this perspective, this study investigates to what extent the potential liquidity of the loan portfolio is likely to mitigate bank exposure to maturity transformation risk. In addition, it considers the impact of holding a higher share of short-term, potentially unstable market debts on bank exposure to maturity transformation risk. Indeed, short-term debts can be considered less stable than long-

17 In focusing on loan securitization, this study contributes to the line of research exploring how the advancements in securitization have changed the nature of banking and bank risk exposure. Several recent studies have tied securitization to excessive credit supply (Demyanyk and Van Hermert, 2009; Keys et al., 2010; Loutskina and Strahan, 2009; Mian and Sufi, 2009; Rajan et al., 2010); lack of ex post monitoring incentives (Piskorski et al., 2010; Parlour and Plantin, 2008); and deterioration of credit quality (Loutskina and Strahan, 2011; Purnanandam, 2010). In contrast to these studies, which mostly explore the shadow banking system and off-balance-sheet implications of securitization, this study considers the use of loan securitization in bank liquidity risk management.

term ones[18]. Furthermore, and consistent with BIS (2009a), short-term deposits could be considered more stable than short-term market debts[19]. Consequently, the more banks are funded by short-term market debts, the higher is the potential instability of their funding. Thus, this research considers to what extent the potential instability of short-term liabilities is likely to increase bank exposure to maturity transformation risk. Understanding what factors significantly affect bank exposure to maturity transformation risk would help banks to improve their liquidity risk management framework and their stability. This issue is of particular importance for regulatory authorities to set adequate regulatory frameworks and appropriate incentive mechanisms for bank risk-taking behavior consistent with the evolution of the banking industry.

The remainder of this chapter is organized as follows. Section 1.2 presents a literature review on the measures of liquidity creation and maturity transformation risk. Section 1.3 describes the data set and presents stylized facts on banks' liquidity creation and maturity transformation risk considering their business model. Section 1.4 presents a study of the sensitivity of bank maturity transformation risk and the implications for risk management considering the orientation of bank activities. Section 1.5 concludes.

1.2. Literature review on the measures of liquidity creation and maturity transformation risk

1.2.1. The liquidity creation indicator of Berger and Bouwman (2009)

Berger and Bouwman (2009) suggest a methodology to assess the level of liquidity creation a bank perform. To compute this indicator, first, all assets and liabilities are classified as liquid, semiliquid or illiquid according to their maturity and their category. The authors assume that some assets are easier to sell than others (e.g., securitizable loans, trading assets). In addition, they assume that some liabilities are more volatile than others, such as commercial papers and short-term deposits. Second, each asset and liability item is weighted

18 Long-term debts are repayable by contract at their maturity, which must exceed one year. Short-term debts are due within one year or might be claimed at short notice because they can be withdrawn without penalty by customers.

19 Short-term deposits are covered by effective explicit and/or implicit deposit insurance systems that limit depositors' panics and runs on deposits. Short-term bondholders are exposed to bank credit risk, specifically when they hold unsecured short-term market debt securities. However, short-term market debt securities can be secured by collateral. Depending on the quality of the assets pledged as collateral, a possible reduction in funding availability against these assets might occur. Consequently, when the credit quality of a bank is degrading, short-term market funding can become more volatile.

accordingly. Appendix B shows the weights applied to bank balance sheets based on Berger and Bouwman (2009). The result of the calculation is an absolute value of created liquidity (i.e., a U.S. dollar or euro amount of actual liquidity created on the balance sheets). Liquidity creation (*LC*) is then calculated as follows[20]:

LC = 0.5 * illiquid assets + 0 * semiliquid assets – 0.5* liquid assets
+ 0.5 * liquid liabilities + 0 * semiliquid liabilities – 0.5 * illiquid liabilities

All else being equal, a bank creates one dollar of liquidity by investing one dollar of liquid liabilities (e.g., transaction deposits) into one dollar of illiquid assets (e.g., business loans). Similarly, a bank destroys one dollar of liquidity by investing one dollar of illiquid liabilities or equity into one dollar of liquid assets (e.g., short-term government securities). Higher values of liquidity creation indicate higher bank illiquidity, as it invests more liquid liabilities into illiquid assets. In such a case, the bank is more exposed to maturity transformation risk if customers claim their funds on demand while illiquid assets are saleable at fire sale prices.

1.2.2. Maturity transformation risk indicators: the Basel III net stable funding ratio and the core funding ratio

1.2.1.1. The net stable funding ratio

Following the subprime crisis, in recognition of the need for banks to improve their liquidity management, the Basel Committee on Banking Regulation and Supervision developed an international framework for liquidity assessment in banking (BIS, 2009a). Among the several guidelines, the Basel III accords include the implementation of the "*net stable funding ratio*". This ratio is intended to promote resiliency over long-term time horizons by creating additional incentives for banks to fund their activities with more stable

20 Bank liquidity creation is affected by on- and off-balance-sheet positions. This thesis considers the liquidity created by banks or their liquidity profile only from on-balance-sheet positions, as a detailed breakdown of off-balance sheets is not available in standard databases. Holmstrom and Tirole (1998) and Kashyap et al. (2002) consider that banks can also create liquidity off the balance sheet through loan commitments to customers and similar claims to liquid funds. However, banks can hold loan commitments from other financial institutions. These liquidity facilities are likely to negatively affect bank liquidity creation. Consequently, the net effect of off-balance sheet positions on bank liquidity creation and illiquidity is not clear-cut.

sources of funding on an ongoing structural basis[21]. This liquidity measure is the ratio of the available amount of stable funding to the required amount of stable funding. The available amount of stable funding is the total amount of an institution's (1) capital, (2) liabilities with effective maturities of one year or greater, and (3) portion of "stable" nonmaturity deposits and of term deposits with maturities of less than one year that would be expected to stay within the institution. The required amount of stable funding is the amount of a particular asset that could not be monetized through sale or used as collateral in a secured borrowing on an extended basis during a liquidity event lasting one year. To calculate the "*net stable funding ratio*", a specific required stable funding factor is assigned to each particular type of asset and a specific available stable funding factor is assigned to each particular type of liability. Appendix C briefly summarizes the composition of asset and liability categories and related stable funding factors. The higher the required amount of stable funding compared with the available amount of stable funding, the more illiquid a bank is considered[22]. A higher "*net stable funding ratio*" implies that the available amount of stable funding is deviating from the amount of assets that cannot be monetized. In this context, the bank might experience fewer difficulties to meet its current commitments with its current internal liquidity. Thus, the inverse of the "*net stable funding ratio*" indicates to what extent a bank is unable to meet unexpected withdrawals from customers without borrowing money or selling its assets at a loss.

Appendix D shows the breakdown of bank balance sheets[23] as provided by Bloomberg and its weighting with respect to the Basel III framework to calculate the inverse of the net stable funding ratio. On the asset side, the type and maturity of assets is defined consistent with the definition of BIS (2009a) to apply the corresponding weights. On the liability side, only the maturity of liabilities is considered to apply the corresponding weights. Because the

21 The Basel Committee on Banking Regulation and Supervision also introduced the "*liquidity coverage ratio*". This ratio is intended to promote the short-term resiliency of the liquidity profile of banks by ensuring that they have sufficient high-quality liquid resources to survive an acute stress scenario lasting for one month. This thesis focuses on a one-year horizon and does not compute such a ratio, which requires the use of monthly data.

22 Because the regulation on bank liquidity is not yet implemented, this ratio is only an indicator of bank illiquidity as defined in the Basel III accords and does not establish a minimum acceptable amount of stable funding based on the liquidity characteristics of an institution's assets and activities over a one-year time horizon.

23 Bank liquidity is affected by on- and off-balance-sheet positions. This thesis considers the liquidity profile of banks only from on-balance-sheet positions, because a detailed breakdown of off-balance sheets is not available in standard databases. The potential contingent calls on funding liquidity arising from off-balance-sheet commitments and obligations can generate lack of liquidity and thus increase bank illiquidity. However, banks can hold loan commitments from other financial institutions. These liquidity facilities are likely to negatively affect bank illiquidity. Consequently, the net effect of off-balance sheet positions on bank illiquidity is not clear-cut.

data only provide the breakdown of deposits according to their maturity and not according to the type of depositors, the intermediate weight of 0.7 is considered for stable demand deposits and saving deposits (including all deposits with a maturity of less than one year). This study calculates the inverse of the net stable funding ratio (*I_NSFR*) as follows:

$$I\_NSFR = \frac{\text{Required amount of stable funding}}{\text{Available amount of stable funding}} = \frac{\begin{array}{l} 0 * (\text{cash + interbank assets + short-term marketable assets}) \\ + 0.5 * (\text{long-term marketable assets + customer acceptances}) \\ + 0.85 * \text{consumer loans} \\ + 1 * (\text{commercial loans + other loans + other assets + fixed assets}) \end{array}}{\begin{array}{l} 0.7 * (\text{demand deposits + saving deposits}) \\ + 0 * (\text{short-term market debt + other short-term liabilities}) \\ + 1 * (\text{long-term liabilities + equity}) \end{array}}$$

Nevertheless, the Basel Committee considers two other available stable funding factors i.e., for demand and saving deposits. Assuming these two assumptions on the extent of deposits considered stable, the weight of 0.7 for demand and saving deposits is changed. The purpose is to determine how the measurement of maturity transformation risk can be affected by the assumptions on the extent of deposits considered stable. The first weight, 0.5 (*I_NSFR_D05*), is the minimum weight for stable demand and saving deposits, and the second, 0.85 (*I_NSFR_D085*), is the maximum weight set by the Basel Committee on Banking Regulation and Supervision for stable demand and saving deposits. In addition, a third factor, 1, is an extreme case in which all demand and saving deposits are considered stable (*I_NSFR_D1*). Explicit deposit insurance systems and implicit government guarantee of deposits mitigate the risk of run on deposits and strengthen their stability.

A greater value of the inverse of the Basel III net stable funding ratio implies that the required amount of stable funding deviates from the available amount of stable funding. In this context, the bank might experience greater difficulties in meeting its current commitments with its current internal liquidity. Consequently, it might need to immediately obtain unsecured funding or be recapitalized or rescued by national authorities.

1.2.1.2. The importance of core deposits for U.S. banks: the core funding ratio

Under the definition of the net stable funding ratio, it is the stability of funding that matters. Nevertheless, the definition of stable funding might be adjusted considering the existence of core deposits in the United States. Indeed, Harvey and Spong (2001) and Saunders and Cornett (2006) emphasize the importance of core deposits for U.S. banks. Core deposits are defined as the sum of demand deposits, saving deposits and time deposits lower than US$100,000. To a great extent, these deposits are derived from a bank's regular customer base and are therefore typically the most stable and least costly source of funding for banks (Harvey and Spong, 2001). Thus, it might be relevant to adopt an alternative definition for stable deposits by considering core deposits for U.S. banks. Consequently, an alternative liquidity proxy can be computed by modifying the denominator of the inverse of the net stable funding ratio (*I_NSFR*). More precisely, the sum of core deposits and other stable funding is considered a proxy of the available amount of stable funding. This maturity transformation risk proxy is defined as the core funding ratio (*CFR*) and is computed as follows:

$$\text{CFR} = \frac{\text{Required amount of stable funding}}{\text{Core deposits + Stable funding}} = \frac{\begin{array}{l} 0 * (\text{cash + interbank assets + short-term marketable assets}) \\ + 0.5 * (\text{long-term marketable assets + customer acceptances}) \\ + 0.85 * \text{consumer loans} \\ + 1 * (\text{commercial loans + other loans + other assets + fixed assets}) \end{array}}{\begin{array}{l} 1 * \text{core deposits} \\ + 0 * (\text{short-term market debt + other short-term liabilities}) \\ + 1 * (\text{long-term liabilities + equity}) \end{array}}$$

1.3. Stylized facts

1.3.1. Presentation of the sample

The sample consists of U.S. and European[24] publicly traded commercial banks observed over the 2000–2008 period. The focus is on U.S. and European banks because the required data are available on standard databases, which ensures an accurate representation of the sample of banks in each country. Furthermore, the sample includes listed banks because a detailed breakdown of bank balance sheets data is needed to compute the liquidity indicators, which are the main variables of interest. In standard databases, these informations are more frequently and extensively reported for listed banks.

Annual consolidated financial statements were extracted from Bloomberg. 870 listed commercial banks have been identified (645 in the United States and 225 in Europe) with data from 2000 to 2008. To compute the liquidity indicators, the sample is restricted to banks for which the breakdown for loans by category and the breakdown for deposits by maturity were

24 The sample includes banks from the 27 EU member countries, Norway and Switzerland. However, the required data are available only for banks located in the 20 following countries: Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Liechtenstein, Malta, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

available in Bloomberg or in annual reports. The final sample consists of 781 commercial banks (574 in the United States and 207 in Europe). Table 1.1 presents the distribution of banks by country and the representativeness of the sample. The study compares aggregate total assets of banks included in the final sample with aggregate total assets of the whole banking system. Over the 2000–2008 period, the final sample accounts, on average, for 66.4% of the total assets of U.S. commercial banks as reported by the Federal Deposit Insurance Corporation (FDIC) and 60.4% of the total assets of European commercial banks as reported by central banks.

Table 1.1. Distribution of U.S. and European listed commercial banks

	Banks available in Bloomberg	Banks included in the final sample	Total assets of banks in final sample / total assets of the banking system (%)
United States	**645**	**574**	**66.4**
Europe	**225**	**207**	**60.4**
Austria	8	8	57.3
Belgium	4	3	80.3
Cyprus	4	4	69.7
Denmark	44	38	60.6
Finland	2	2	71.2
France	22	22	62.1
Germany	15	14	40.1
Greece	12	12	80.6
Iceland	2	2	66.3
Ireland	3	3	31.3
Italy	24	22	59.6
Liechtenstein	2	2	50.1
Malta	4	4	32.5
Netherlands	2	2	47.6
Norway	23	20	70.3
Portugal	6	6	55.3
Spain	15	15	64.4
Sweden	4	4	72.6
Switzerland	22	18	74.8
United Kingdom	7	6	61.5

Source: Bloomberg, European Central Bank, Bank of England, National Bank of Switzerland, Sveriges Riskbank, Danmarks Nationalbank, Central Bank of Iceland, FDIC and Finance Norway. To deal with the issue of sample representativeness, the study compares aggregate total assets of banks included in the final sample (i.e., U.S. and European publicly traded commercial banks) with aggregate total assets of the whole banking system. From 2000 to 2008, the ratio of aggregate total assets of banks included in the final sample to aggregate total assets of the whole banking system is computed. This table reports the average value of this ratio country by country.

Table 1.2 presents some general descriptive statistics of the final sample including U.S. and European banks. Because the purpose of the statistical analysis is to study the similarities and differences in terms of liquidity creation and maturity transformation risk profiles according bank business model, several key accounting ratios that describe the orientation of bank activities, the nature of their funding and investment strategies are considered. The data show very different profiles of noninterest income for U.S. and European banks. The average share of gross noninterest income to total income of U.S. banks is 22.7% and 41% for European banks. This suggests that U.S. banks are on average focused on retail banking activities. In contrast, European banks are universal banks with more diversified activities[25]. Moreover, U.S. banks hold on average higher shares of total loans in total assets (67.1%) and higher shares of deposits in total debts (85.3%) than European banks (respectively, 64.5% and 53%). However, the differences in average deposits are greater than the differences in average total loans between U.S. and European banks. This emphasizes that European banks are more reliant on market debt than U.S. banks. Focusing on the maturity structure of the liability side of banks' balance sheets, U.S. banks hold, on average, lower shares of total short-term debts in total debts (54.4%) than European banks (59.7%). In addition, U.S. banks hold, on average, higher shares of total short-term deposits in total debts (47.6%) and lower shares of short-term market debts in total debts (6.8%) than European banks (respectively, 36.4% and 23.3%). The data emphasize that European banks are more funded by short-term market debt than U.S. banks. In addition, short-term debt securities account for a large share of short-term debts for European banks in comparison with U.S. banks.

Because of the specific research interest of this study, banks that used different business models are separated: the retail banks and the diversified banks. Following the literature (Stiroh, 2002), a bank is considered retail (diversified) if its ratio of total gross noninterest income to total income is lower (higher) than the median of this ratio. As U.S. and European banks have very different profiles of noninterest income, the median of this ratio is calculated separately for U.S. and European banks. The data show that, in both the United States and Europe, retail banks hold on average higher shares of loans in total assets and of deposits in total debts than do the diversified banks. In the United States, the average share of total loans in total assets is 69.3% for retail banks and 64.9% for diversified banks. The average share of total deposits in total debts is 87.7% for retail banks and 83% for diversified

25 This might be explained as follows: Banking groups in the United States are allowed to perform activities "closely related to banking", such as investment banking and insurance, only if they are considered as "well capitalised" by the Federal Reserve (i.e., if they meet its highest risk-based capital rating). Therefore, most banking groups are focused on banking business, primarily issuing deposits and making loans. In Europe, banking groups are not subject to such requirements and can more easily develop their market activities.

banks. For European banks, the average share of total loans in total assets is 70.4% for retail banks and 58.6% for diversified banks. The average share of total deposits in total debts is 60.3% for retail banks and 47.7% for diversified banks. Moreover, the data show that in both the United States and Europe, retail banks hold on average lower shares of short-term market debts in total debts (respectively, 5.2% and 18.2%) than do diversified banks (respectively, 8.3% and 28.2%).

In addition, depending on its size, a bank's ability to access financial markets is presumably different. Large banks might be more involved in market activities in addition to loan activities. Furthermore, large banks might benefit from a reputational advantage, which could provide them broader access to debt markets. This is likely to affect the structure of banks' balance sheets. Therefore, banks are separated according to their business model and size. Following the literature, a bank is considered large if its total assets exceed US$1 billion. The U.S. bank sample included 129 large diversified banks, 136 small diversified banks, 104 large retail banks and 205 small retail banks. The European bank sample included 86 large diversified banks, 17 small diversified banks, 84 large retail banks and 20 small retail banks. Because the European bank sample includes relatively low numbers of small retail and small diversified banks, descriptive statistics for bank business model and size are only presented for U.S. banks. The data show that, for both retail and diversified banks, large U.S. banks hold on average higher shares of long-term loans and other assets (respectively, 54.7% and 47.1%) than do small U.S. banks (respectively, 49.3% and 44.5%). In addition, large banks are less funded by deposit and are more reliant on short-term market debts than small banks. Indeed, for retail banks, the average share of total deposits to total debts is 83.4% for large banks and 89.4% for small banks, and the average share of total short-term markets debts to total debts is 7.5% for large banks and 4.3% for small banks. For diversified banks, the average share of total deposits to total debts is 79.9% for large banks and 86.9% for small banks, and the average share of total short-term market debts to total debts is 10.9% for large banks and 5.2% for small banks.

Table 1.2. Summary descriptive statistics of sample of U.S. and European listed commercial banks, 2000–2008

	Total assets in US$ billion			Total gross noninterest income / total income			Total loans / total assets			Total long-term loans and other assets / total assets			Total deposits / total debts			Total short-term deposits / total debts			Total short-term market debts / total debts		
	Mean	**Median**	**Std Dev**	**Mean**	**Median**	**Std Dev**	**Mean**	**Median**	**Std Dev**	**Mean**	**Median**	**Std Dev**	**Mean**	**Median**	**Std Dev**	**Mean**	**Median**	**Std Dev**	**Mean**	**Median**	**Std Dev**
All banks																					
U.S. banks	15.4	0.8	114.6	22.7	20.6	11.9	67.1	68.6	11.9	48.4	48.2	17.2	85.3	86.9	9.9	47.6	46.3	15.0	6.8	5.0	6.6
European banks	138.2	10.4	367.9	41.0	39.2	16.3	64.5	67.5	18.9	44.9	44.7	15.1	53.0	53.8	20.3	36.4	35.2	18.2	23.3	21.6	15.3
Test statistic & %level	20.32 ***	35.62 ***	10.30 ***	49.23 ***	42.01 ***	1.88 ***	-6.43 ***	1.96 **	2.51 ***	-7.62 ***	7.28 ***	1.29 ***	-85.19 ***	51.89 ***	4.20 ***	-24.97 ***	22.57 ***	1.48 ***	60.18 ***	43.45 ***	5.40 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.05)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
By specialisation																					
Retail - U.S. banks	1.2	0.5	2.3	14.2	15.0	4.5	69.3	70.7	11.8	50.8	51.0	19.1	87.7	89.1	8.7	47.0	45.3	16.3	5.2	3.8	5.1
Diversified - U.S. banks	28.9	1.3	156.5	31.1	27.8	10.9	64.9	66.7	11.6	45.9	46.3	14.4	83.0	84.4	10.4	48.2	47.0	13.3	8.3	6.6	7.4
Test statistic & %level	8.51 ***	23.78 ***	4774.32 ***	69.33 ***	58.96 ***	5.74 ***	-12.90 ***	13.60 ***	1.04	-9.77 ***	9.19 ***	1.76 ***	-16.87 ***	16.50 ***	1.45 ***	2.78 ***	3.75 ***	1.50 ***	16.69 ***	16.11 ***	2.09 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.33)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Retail - European banks	53.9	4.3	222.0	28.7	30.0	7.8	70.4	71.2	16.1	44.2	43.4	14.2	60.3	61.0	18.3	40.8	41.4	18.4	18.2	14.8	13.8
Diversified - European banks	222.4	20.0	457.4	53.3	49.1	13.1	58.6	62.2	19.7	45.7	46.6	16.0	45.7	44.8	19.6	31.9	29.1	17.0	28.2	28.1	15.0
Test statistic & %level	9.74 ***	15.28 ***	4.24 ***	47.71 ***	36.09 ***	2.84 ***	-13.68 ***	12.79 ***	1.51 ***	2.03 **	2.75 ***	1.27 ***	-15.97 ***	15.60 ***	1.15 **	-10.51 ***	10.62 ***	1.17 **	14.48 ***	14.59 ***	1.18 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.04)	(0.01)	(0.00)	(0.00)	(0.00)	(0.05)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.01)
By specialisation and size for U.S. banks																					
Large - Retail U.S. banks	3.1	2.0	3.6	14.7	15.8	4.6	68.7	70.0	12.5	54.7	56.4	18.9	83.4	84.7	9.1	45.5	43.9	16.0	7.5	6.0	6.3
Small - Retail U.S. banks	0.4	0.4	0.2	14.0	14.7	4.5	69.5	71.0	11.5	49.3	49.2	19.0	89.4	90.6	7.8	47.6	45.9	16.4	4.3	3.1	4.3
Test statistic & %level	7.87 ***	41.37 ***	7433.10 ***	-3.25 ***	3.88 ***	1.06	1.42	1.10	1.19 ***	-6.15 ***	6.16 ***	1.01	15.87 ***	15.20 ***	1.36 ***	2.83 ***	2.08 **	1.04	-13.80 ***	13.13 ***	2.11 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.38)	(0.16)	(0.27)	(0.01)	(0.00)	(0.00)	(0.92)	(0.00)	(0.00)	(0.00)	(0.00)	(0.04)	(0.52)	(0.00)	(0.00)	(0.00)
Large - Diversified U.S. banks	51.4	3.4	206.7	32.7	29.5	11.3	63.3	65.9	12.1	47.1	47.1	14.1	79.9	80.9	10.8	47.4	46.1	12.4	10.9	9.2	8.2
Small - Diversified U.S. banks	0.5	0.5	0.2	29.2	25.9	10.0	66.9	67.9	10.5	44.5	44.2	14.8	86.9	88.0	8.5	49.2	48.4	14.3	5.2	4.0	4.7
Test statistic & %level	30.60 ***	37.46 ***	235.80 ***	-7.75 ***	10.33 ***	1.27 ***	7.59 ***	6.68 ***	1.34 ***	-4.31 ***	4.15 ***	1.10 *	17.03 ***	16.39 ***	1.60 ***	3.23 ***	3.25 ***	1.34 ***	-19.75 ***	19.80 ***	2.97 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.10)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Source: Bloomberg (2000–2008). All variables are expressed in percentage, except *Total assets*. *Total assets* in US$ billion; *Total gross noninterest income / total income:* (interest income from loans + resale agreements + interbank investments + other interest income or losses) / total income; *Total loans / total assets:* (commercial loans + consumer loans + other loans) / total assets; *Total long-term loans and other assets / total assets:* (commercial loans + long-term marketable securities + fixed assets + other assets) / total assets; *Total deposits / total debts:* (demand deposits + saving deposits + time deposits + other time deposits) / (total deposits + total market debts); *Total short-term deposits / total debts:* (demand deposits + saving deposits) / (total deposits + total market debts); *Total short-term market debts / total debts:* (short-term debts securities) / (total deposits + total market debts). A bank is considered retail (diversified) if its ratio of total gross noninterest income to total income is lower (higher) than the median of this ratio. Because U.S. and European banks have very different profiles of noninterest income, the median of this ratio is calculated separately for U.S. and European banks. In addition, a bank is considered large if its total assets exceed US$1 billion. T-statistics test for null hypothesis of identical means, medians or standard deviation; *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively, for bilateral test.

1.3.2. A statistical analysis of the liquidity creation and the maturity transformation risk profiles of banks

To determine the similarities and differences in terms of liquidity creation and maturity transformation risk profiles according to bank business model, this study presents stylized facts regarding the indicator of liquidity creation of Berger and Bouwman (2009) and the inverse of the net stable funding ratio as defined in the Basel III accords. The liquidity creation measure of Berger and Bouwman (2009) calculates an absolute value of liquidity created by a bank (i.e., a U.S. dollar or euro amount of actual liquidity created on the balance sheets). Thus, to compare the level of liquidity creation across banks, the study considers the amount of liquidity creation performed by a bank scaled by total assets. Furthermore, to allow the comparison of indicators of liquidity creation and maturity transformation risk, the study considers an alternative specification for the inverse of the net stable funding ratio. Instead of using the ratio of the required amount of stable funding to the available amount of stable funding (*I_NSFR*), the study includes the difference between the required amount of stable funding and the available amount of stable funding, scaled by total assets. This difference is defined as the net stable funding difference (*NSFD*). As for the *I_NSFR* variable, three other weights are considered (i.e., by replacing the weight of 0.7 with a weight of 0.5, 0.85 or 1) according to the assumptions on the extent of demand and saving deposits considered stable (*NSFD_D05*, *NSFD_D085* and *NSFD_D1*). Adjusting the definition of the inverse of the net stable funding ratio in the U.S. case (i.e., by using an alternative definition of stable funding and the existence of core deposits for U.S. banks), an alternative specification is used for the core funding ratio (*CFR*). Instead of considering the ratio of the required amount of stable funding to the available amount of core deposits and other stable funding, the study considers the difference between these two components, scaled by total assets. This difference is defined as the core funding difference (*CFD*) for U.S. banks.

Table 1.3 shows descriptive statistics of the liquidity creation (*LC*) indicator and the several indicators of maturity transformation risk (*NSFD*, *NSFD_D05, NSFD_D085, NSFD_D1* and *CFD)* for U.S. and European banks.

Table 1.3. Statistical analysis of the indicators of liquidity creation and maturity transformation risk, for U.S. and European banks over 2000–2008

	LC			NSFD_D05			Correlation with LC	NSFD			Correlation with LC	NSFD_D085			Correlation with LC	NSFD_D1			Correlation with LC	CFD			Correlation with LC
	Mean	Median	Std Dev	Mean	Median	Std Dev		Mean	Median	Std Dev		Mean	Median	Std Dev		Mean	Median	Std Dev		Mean	Median	Std Dev	
All banks																							
U.S. banks	31.3	31.6	13.2	-2.2	-1.5	11.9	0.87 *** (0.00)	-10.8	-10.0	11.3	0.82 *** (0.00)	-17.3	-16.6	11.3	0.75 *** (0.00)	-23.7	-22.9	11.6	0.66 *** (0.00)	-7.9	-8.4	16.5	0.51 *** (0.00)
European banks	32.4	33.3	11.5	6.5	8.7	17.1	0.74 *** (0.00)	-0.2	1.5	17.1	0.68 *** (0.00)	-5.2	-3.6	17.5	0.63 *** (0.00)	-10.2	-8.6	18.2	0.56 *** (0.00)	-	-	-	-
Test statistic & %level	3.05 *** (0.00)	3.44 *** (0.00)	1.31 *** (0.00)	22.80 *** (0.00)	24.15 *** (0.00)	2.05 *** (0.00)	-	28.77 *** (0.00)	28.57 *** (0.00)	2.28 *** (0.00)	-	32.46 *** (0.00)	30.99 *** (0.00)	2.41 *** (0.00)	-	35.21 *** (0.00)	32.58 *** (0.00)	2.48 *** (0.00)	-	-	-	-	-
By specialisation																							
Retail - U.S. banks	32.3	32.4	14.5	-2.2	-2.0	12.3	0.89 *** (0.00)	-10.7	-10.1	11.7	0.84 *** (0.00)	-17.1	-16.5	11.6	0.77 *** (0.00)	-23.4	-22.6	12.0	0.67 *** (0.00)	-6.5	-7.0	18.0	0.50 *** (0.00)
Diversified - U.S. banks	30.4	31.0	11.4	-2.1	-1.0	11.5	0.86 *** (0.00)	-10.8	-9.8	10.9	0.81 *** (0.00)	-17.4	-16.6	10.9	0.74 *** (0.00)	-24.0	-23.2	11.1	0.66 *** (0.00)	-9.5	-9.5	14.5	0.50 *** (0.00)
Test statistic & %level	-4.90 *** (0.00)	4.64 *** (0.00)	1.61 *** (0.00)	0.31 (0.75)	1.03 (0.30)	1.16 *** (0.00)	-	-0.47 (0.64)	0.14 (0.89)	1.14 *** (0.00)	-	-1.08 (0.28)	1.06 (0.29)	1.14 *** (0.00)	-	-1.62 (0.13)	1.83 * (0.07)	1.17 *** (0.00)	-	-6.27 *** (0.00)	5.54 *** (0.00)	1.55 *** (0.00)	-
Retail - European banks	32.5	32.9	11.1	5.7	7.9	14.8	0.70 *** (0.00)	0.3	1.4	14.9	0.63 *** (0.00)	-5.3	-4.2	15.4	0.57 *** (0.00)	-10.8	-9.9	16.3	0.50 *** (0.00)	-	-	-	-
Diversified - European banks	32.3	33.6	12.0	5.1	7.7	19.0	0.77 *** (0.00)	-0.8	1.6	19.0	0.72 *** (0.00)	-5.2	-2.9	19.4	0.67 *** (0.00)	-9.6	-7.7	20.0	0.61 *** (0.00)	-	-	-	-
Test statistic & %level	-0.39 (0.70)	0.31 (0.75)	1.17 *** (0.02)	0.68 (0.55)	0.19 (0.84)	1.66 *** (0.00)	-	-1.36 (0.17)	0.09 (0.93)	1.64 *** (0.00)	-	0.07 (0.94)	1.62 * (0.11)	1.58 *** (0.00)	-	1.41 (0.16)	3.00 *** (0.00)	1.51 *** (0.00)	-	-	-	-	-
By specialisation and size for U.S. banks																							
Large - Retail U.S. banks	34.1	35.1	14.2	-0.1	-0.4	12.6	0.89 *** (0.00)	-8.4	-8.5	12.2	0.84 *** (0.00)	-14.5	-13.8	12.3	0.77 *** (0.00)	-20.7	-19.4	12.8	0.69 *** (0.00)	-1.5	-0.6	19.2	0.50 *** (0.00)
Small - Retail U.S. banks	31.6	31.5	14.6	-3.0	-2.6	12.1	0.89 *** (0.00)	-11.6	-11.0	11.3	0.84 *** (0.00)	-18.0	-17.5	11.2	0.77 *** (0.00)	-24.5	-23.7	11.5	0.66 *** (0.00)	-8.4	-8.7	17.2	0.50 *** (0.00)
Test statistic & %level	-3.71 *** (0.00)	3.94 *** (0.00)	1.05 (0.42)	-5.14 *** (0.00)	4.80 *** (0.00)	1.08 (0.26)	-	-6.07 *** (0.00)	5.86 *** (0.00)	1.16 ** (0.03)	-	-6.56 *** (0.00)	6.57 *** (0.00)	1.21 *** (0.00)	-	-6.56 *** (0.00)	7.05 *** (0.00)	1.24 *** (0.00)	-	-8.46 *** (0.00)	8.32 *** (0.00)	1.25 *** (0.00)	-
Large - Diversified U.S. banks	31.2	31.7	10.7	-0.6	0.6	11.4	0.84 *** (0.00)	-9.3	-8.1	11.1	0.79 *** (0.00)	-15.7	-14.6	11.1	0.73 *** (0.00)	-22.2	-20.9	11.4	0.66 *** (0.00)	-7.6	-7.5	14.7	0.54 *** (0.00)
Small - Diversified U.S. banks	29.4	29.6	12.3	-3.9	-3.3	11.3	0.88 *** (0.00)	-12.9	-12.2	10.4	0.83 *** (0.00)	-19.5	-18.8	10.1	0.76 *** (0.00)	-26.2	-25.8	10.2	0.66 *** (0.00)	-11.8	-12.5	13.8	0.45 *** (0.00)
Test statistic & %level	-3.84 *** (0.00)	3.57 *** (0.00)	1.31 *** (0.00)	-6.94 *** (0.00)	7.40 *** (0.00)	1.02 (0.75)	-	-7.97 *** (0.00)	8.43 *** (0.00)	1.14 ** (0.03)	-	-8.54 *** (0.00)	9.12 *** (0.00)	1.21 *** (0.00)	-	-8.87 *** (0.00)	9.55 *** (0.00)	1.26 *** (0.00)	-	-7.02 *** (0.00)	7.37 *** (0.00)	1.13 ** (0.04)	-

All variables are expressed in percentage. *LC:* liquidity creation / total assets; *NSFD* (considering an intermediate of 0.7 for demand and saving deposits): (required amount of stable funding - available stable funding) / total assets. Because several assumptions are made on the extent of stable demand and saving deposits, alternately three other weights are applied to these types of deposits (i.e., 0.5, 0.85 and 1). *NSFD_D05* is considered with a weight of 0.5 for demand and saving deposits; *NSFD_D085* with a weight of 0.85 for demand and saving deposits; *NSFD_D1* with a weight of 1 for demand and saving deposits. *CFD:* [required amount of stable funding – (core deposits + other available stable funding)] / total assets. A bank is considered retail (diversified) if its ratio of total gross noninterest income to total income is lower (higher) than the median of this ratio. Because U.S. and European banks have very different profiles of noninterest income, the median of this ratio is calculated separately for them. In addition, a bank is considered large if its total assets exceed US$1 billion. T-statistics test for null hypothesis of identical means or null Pearson's coefficient of correlation; *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively, for bilateral test.

Observing U.S. and European publicly traded commercial banks separately over the period 2000–2008, note that the average *LC* and the average *NSFD* of European banks are significantly higher than these of U.S. banks. Indeed, average *LC* is 32.4% for European banks and to 31.3% for U.S. banks. Average *NSFD* varies between 6.5% and –10.2% for European banks and between –2.2% and –23.7% for U.S. banks. In addition, note that the difference between U.S. and European banks in average *NSFD* is significantly higher than the difference in average *LC*. The differences between U.S. and European banks in terms of average *LC* and average *NSFD* might be explained by the descriptive statistics detailed in section 1.3.1 (Table 1.2). The data show that European banks hold a slightly higher average share of short-term debts in total debts (59.7%), which are considered liquid liabilities in *LC*, than do U.S. banks (54.3%). Indeed, the difference in average *LC* is significant between U.S. and European banks, though not large. However, European banks hold on average much more short-term market debts in total debts (23.3%) and fewer short-term deposits in total debts (36.4%) than do U.S. banks (respectively, 6.8% and 46.7%). Short-term market debts are considered unstable liabilities, and short-term deposits are considered stable liabilities in *NSFD*. Thus, European banks hold on average much more unstable funding in *NSFD* than do U.S. banks. On the whole, U.S. banks benefit from the stability of their large deposit base and therefore face a highly negative average *NSFD*. In contrast, European banks are more funded by volatile market funding and thus face a weakly negative average *NSFD*.

In addition to the differences in *NSFD* between U.S. and European banks, note that the estimated values of the average *NSFD* are very different depending on the weight applied to demand and saving deposits. This implies that the assumptions on the extent of demand and saving deposits considered stable strongly alter the measure of the available amount stable funding. This impact might specifically alter the results for the banks that are widely funded by demand and saving deposits. Finally, Pearson's coefficients of correlation exhibit a strong linear and positive relationship between *LC* and *NSFD* for both U.S. and European banks. They illustrate the strong correlation between liquidity creation and bank exposure to maturity transformation risk.

Regarding retail and diversified banks in Europe, there is no significant difference in terms of average *LC* or average *NSFD* across banks. However, U.S. retail banks perform on average significantly higher levels of *LC* than do U.S. diversified banks (see Table 1.3): The average *LC* of retail U.S. banks is 32.3% and 30.4% for diversified U.S. banks. This difference might be explained by the differences in long-term assets and other assets (considered illiquid in the *LC* indicator of Berger and Bouwman, 2009) and short-term debts (considered liquid in the *LC* indicator of Berger and Bouwman, 2009) between retail and diversified banks (see Table 1.2). Diversified banks in the United States hold on average lower shares of long-term assets and other assets (45.9%) and higher shares of short-term debts in total debts (56.6%) than retail banks (respectively, 50.8% and 52.2%). Consequently, diversified banks hold on average higher shares of liquid liabilities and lower shares of illiquid assets than retail banks. These characteristics of retail versus diversified U.S. banks go in opposite directions, but the net result is an average lower level of *LC* for diversified banks. Moreover, there is no significant difference between the average *NSFD* of retail and diversified banks in the United States. Nevertheless, diversified banks have a significantly lower average *CFD* than retail banks (respectively, on average, –9.5% and –6.5%). This difference might be explained by the large difference in long-term loans and other assets between retail and diversified banks, retail banks holding on average relatively higher shares of long-term loans and other assets than diversified banks. Thus, retail banks are more exposed to maturity transformation risk than diversified banks. Finally, as noted previously, Pearson's coefficients of correlation exhibit a strong linear and positive relationship between *LC* and *NSFD* (and *CFD* for U.S. banks). In addition, depending on the weight applied to demand and saving deposits, the estimated values of the *NSFD* variable are very different.

With regard to size of retail and diversified U.S. banks, note that the average *LC* and *NSFD* of large banks are higher than those of small banks. In addition, the difference between large and small banks in average *NSFD* is significantly higher than the difference in average *LC* (see Table 1.3[26]). The differences between large and small U.S. banks considering their business model in terms of average *LC* and average *NSFD* might be explained with the descriptive statistics detailed in section 1.3.1 (Table 1.2). The data show that large banks hold on average a slightly higher share of short-term debts, which are considered liquid liabilities

26 Focusing on retail U.S. banks, note that the average *LC* (equal to 34.1%) and the average *NSFD* (which varies between –.1% and –20.7%) of large banks are significantly higher than these of small banks (the average *LC* of small banks is 31.6%, and the average *NSFD* varies between –.3% and –24.5%). Regarding diversified U.S. banks, note that the average *LC* (31.2%) and the average *NSFD* (which varies between –.6% and –22.2%) of large banks are significantly higher than those of small banks (the average *LC* of small banks is 29.4%, and the average *NSFD* varies between –3.9% and –26.2%).

in *LC*, than small banks[27]. Consequently, the difference in average *LC* between large and small banks considering their business model is significant but not large. Nevertheless, for both retail and diversified banks, large banks hold on average much more short-term market debts in total debts considered unstable liabilities in *NSFD* compared with small banks, which are funded more by short-term deposits in total debts considered stable liabilities in *NSFD*[28]. Indeed, for both retail and diversified banks, large banks hold much more unstable funding in *NSFD* than small banks. On the whole, small U.S. banks benefit from the stability of their large deposit base and therefore face a highly negative average *NSFD*. In contrast, large U.S. banks are funded more by volatile market funding and thus face a weakly negative average *NSFD*. Finally, as mentioned previously, correlation exhibit a strong linear and positive relationship between *LC* and *NSFD* (and *CFD* for U.S. banks), depending on the weight applied to demand and saving deposits.

In summary, this statistical analysis yields two main findings. First, European banks hold a slightly higher share of liquid liabilities in *LC* than do U.S. banks. However, European banks hold much more unstable funding in *NSFD* than U.S. banks. Second, for U.S. banks considering large and small banks separately, large banks hold a higher share of liquid liabilities in *LC* than do small banks. Nevertheless, large banks hold much more unstable funding in *NSFD* than do small banks. Therefore, the conclusions are similar for European banks and large U.S. banks because the European sample includes mainly large banks. On the whole, it is not banks' business models that explain the differences in *LC* and *NSFD* across banks, but rather their size. Small banks benefit from the stability of their large deposit base and face a highly negative average *NSFD*. European banks and large U.S. banks are more involved in debt markets, and they are more funded by volatile market funding. Therefore, they face a weakly negative average *NSFD*.

27 Focusing on retail banks, note that the average share of short-term debts in total debts is 52.9% for large banks and 51.9% for small banks. Regarding diversified banks, note that the average share of short-term debts in total debts is 58.3% for large banks and 54.4% for small banks (see Table 1.2).
28 For retail banks, the average ratios of short-term market debts in total debts and of short-term deposits in total debts are equal to, respectively, 7.5% and 45.5% for large banks and, respectively, 4.3% and 47.6% for small banks. For diversified banks, the average ratios of short-term market debts in total debts and short-term deposits in total debts are, respectively, 10.9% and 47.4% for large banks and, respectively, 5.2% and 49.2% for small banks (see Table 1.2).

1.3.3. An estimation of the level of liquidity creation a bank can perform for a given level of exposure to maturity transformation risk

With regard to the *LC* indicator and the *NSFD* variable, it is possible to estimate the level of *LC* a bank can perform for a given level of exposure to maturity transformation risk. Thus, the ratio of the indicator of *LC* to the *NSFD* variable (i.e., the ratio of the notional amount of liquidity created by a bank to the notional excess or deficit of available stable funding) can be computed.

If the ratio is positive and equal to “x”, the bank creates liquidity and faces maturity transformation risk[29]. Thus, if the bank increases its notional deficit of available stable funding (i.e., its notional amount of exposure to maturity transformation risk) of one dollar, it can create “x” dollars of liquidity. Alternatively, a positive ratio can also imply that the bank destroys liquidity and does not face maturity transformation risk. Consequently, if the bank decreases its notional excess of available stable funding (i.e., its notional amount of “hedge” against maturity transformation risk) of one dollar, it can decrease liquidity by “x” dollars.

If the ratio is negative and equal to “-x”, the bank creates liquidity but does not face maturity transformation risk. Indeed, a bank cannot destroy liquidity and be exposed to maturity transformation risk. Consequently, if the bank decreases its notional excess of available stable funding of one dollar, it can create of “x” dollars liquidity.

Table 1.4 shows the ratio of the indicator of *LC* to the indicator of maturity transformation risk (i.e., *NSFD*, *NSFD_D05*, *NSFD_D085*, *NSFD_D1* or *CFD*). First, the average value of this ratio[30] is calculated separately for U.S. and European banks. Second, the average value of this ratio is calculated separately for U.S. and European banks according to their business model. However, the study does not focus on U.S. banks considering their business model and size simultaneously because there are not enough banks to consider the positive and negative ratios separately.

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29 The notional excess or deficit of available stable funding is calculated as the difference of the required amount of stable funding and the available amount of stable funding. A positive difference means that the required amount of stable funding exceeds the available amount of stable funding. Thus, it implies a deficit of available stable funding, the bank facing maturity transformation risk.

30 To calculate the average value of the ratio, it is necessary to verify that there are no outliers. Otherwise, outliers are excluded because the average value of the ratio may be heavily skewed by an outlier with an *NSFD* close to zero. All observations of this ratio higher than the 0.975 percentile are deleted.

Table 1.4. Estimations of the level of *LC* a bank can perform for a given level of exposure to maturity transformation risk, for U.S. and European banks, over 2000–2008

	LC / NSFD_D05			LC / NSFD			LC / NSFD_D085			LC / NSFD_D1			LC / NCFD		
	LC > 0 and NSFD_05 > 0	LC < 0 and NSFD_05 < 0	LC > 0 and NSFD_05 < 0	LC > 0 and NSFD > 0	LC < 0 and NSFD < 0	LC > 0 and NSFD < 0	LC > 0 and NSFD_085 > 0	LC < 0 and NSFD_085 < 0	LC > 0 and NSFD_085 < 0	LC > 0 and NSFD_1 > 0	LC < 0 and NSFD_1 < 0	LC > 0 and NSFD_1 < 0	LC > 0 and CFD > 0	LC < 0 and CFD < 0	LC > 0 and CFD < 0
All banks															
U.S. banks	8.6	0.15	-5.3	12.8	0.14	-4.5	10.1	0.13	-3.0	5.4	0.12	-1.9	6.1	0.17	-3.7
European banks	4.4	0.12	-4.5	6.1	0.12	-5.0	5.7	0.11	-4.3	4.1	0.11	-3.0	-	-	-
By specialisation															
Retail - U.S. banks	8.5	0.17	-5.2	12.2	0.16	-4.6	10.0	0.15	-3.2	6.5	0.14	-2.0	5.6	0.19	-3.6
Diversified - U.S. banks	8.6	0.14	-5.4	13.4	0.12	-4.5	10.3	0.11	-2.9	4.2	0.10	-1.8	6.9	0.14	-3.7
Retail - European banks	4.3	-	-5.0	6.6	-	-5.3	6.0	-	-4.6	4.1	-	-3.1	-	-	-
Diversified - European banks	4.4	0.12	-4.1	5.7	0.12	-4.8	5.3	0.11	-4.1	4.2	0.11	-3.0	-	-	-

All variables are expressed in percentage. *LC:* liquidity creation / total assets; *NSFD* (considering an intermediate of 0.7 for demand and saving deposits): (required amount of stable funding - available stable funding) / total assets. Because several assumptions are made on the extent of stable demand and saving deposits, three other weights are applied to these types of deposits (i.e., 0.5, 0.85 and 1). *NSFD_D05* is considered with a weight of .5 for demand and saving deposits; *NSFD_D085* with a weight of 0.85 for demand and saving deposits; and *NSFD_D1* with a weight of 1 for demand and saving deposits. *CFD:* [required amount of stable funding – (core deposits + other available stable funding)] / total assets. A bank is considered retail (diversified) if its ratio of total gross noninterest income to total income is lower (higher) than the median of this ratio. Because U.S. and European banks have different profiles of noninterest income, the median of this ratio is calculated separately for U.S. and European banks. No European retail banks in the sample had a positive *LC* and a negative *NSFD*.

On the whole, the data show that banks that face maturity transformation risk and have a positive *LC* can perform higher levels of *LC* when they increase their maturity transformation risk exposure (i.e., when they increase their notional deficit of available stable funding) than the banks that do not face maturity transformation risk and have a positive liquidity creation when they reduce their "hedge" against maturity transformation risk (i.e., when they decrease their notional excess of available stable funding). For example, considering the *NSFD_D05* as an indicator of maturity transformation risk exposure, retail U.S. banks that face maturity transformation risk and have a positive liquidity creation create $8.5 of liquidity when they increase their maturity transformation risk exposure of $1. In contrast, retail U.S. banks that do not face maturity transformation risk and have a positive liquidity creation create only $5.2 of liquidity when they reduce their hedge against maturity transformation risk of $1. In addition, banks that do not face maturity transformation risk and have a negative *LC* can perform a weak level of *LC* when they reduce their hedge against maturity transformation risk. For example, still considering the *NSFD_D05* an indicator of maturity transformation risk exposure, retail U.S. banks that do not face maturity transformation risk and have a negative liquidity creation create only $0.17 of liquidity when they reduce their hedge against maturity transformation risk of one dollar.

This analysis emphasizes that the banks that can perform the highest levels of liquidity creation are those that create liquidity and face maturity transformation risk. It implies that regulators must deal with the trade-off between higher liquidity creation, which is essential for spurring economic growth, and greater exposure to maturity transformation risk, which might increase their instability.

1.4. The sensitivity of maturity transformation risk: The implications of the Basel III liquidity requirements for banks according to their business model

The stylized facts presented in the previous section exhibit the positive relationship between bank liquidity creation and bank exposure to maturity transformation risk. Specifically, banks are likely to experience higher difficulties in meeting unexpected withdrawals from customers if their cushion of assets cannot be readily monetized. Although through their liquidity creation activities, banks face maturity transformation risk and may become fragile, the increasing use of loan securitization and of market funding provides them additional sources of liquidity by reducing their reliance on deposits through market funding

(Mishkin, 2004) and by converting some of their loans into liquid funds through loan securitization (Loutskina, 2011). Using these findings, this study investigates the sensitivity of bank maturity transformation risk to several factors considering bank business model. The aim is to examine how the differences in terms of scope of activities, investment and funding strategies matter to explain the extent of bank exposure to maturity transformation risk. Beyond the bank-level indicators and macroeconomic variables identified in previous literature (Berger and Bouwman, 2009; Chen et al., 2010; Choi et al., 2009; Deep and Schaefer, 2004; Fungacova et al., 2010; Pana et al., 2010; Rauch et al., 2009) that might affect bank exposure to maturity transformation risk, the study considers the impact of bank access to additional sources of liquidity focusing on the importance of (1) potentially securitizable loans and (2) short-term, potentially unstable market debts. This section details the indicators of the importance of potentially securitizable loans and of short-term, potentially unstable market debts. Then, a set of other explanatory variables identified in previous literature is presented. Next, the regression framework is detailed. Finally, the results obtained and robustness checks are commented.

1.4.1. Variables affecting bank maturity transformation risk

1.4.1.1. Measures of the importance of securitizable loans and of short-term market funding

This research focuses on the sensitivity of bank maturity transformation risk to the importance of (1) potentially securitizable loans in illiquid assets and (2) short-term, potentially unstable market debts in total short-term debts. By holding totally illiquid assets, banks may experience acute liquidity problems. Nevertheless, although some assets are not completely liquid, as they are not directly saleable on financial markets (i.e., in opposition to cash, near cash items and trading securities), they can be sold through over-the-counter transactions such as securitized loans. Thus, this research considers the sensitivity of bank maturity transformation risk to the importance of potentially securitizable loans. Potentially securitizable loans are defined as the consumer loans (e.g., credit card loans, residential mortgage loans, installment loans). Indeed, consumer loans are securitizable through the issuance of residential mortgage backed securities (RMBS). Commercial loans and other loans (e.g., loans to commercial and industrial entities, commercial real estate loans, construction loans, loans to agriculture and loans to money market funds) are not securitizable or only securitizable through the issuance of commercial mortgage backed securities (CMBS). However, central banks and prime brokers charge higher discounts on CMBS than on RMBS (International Monetary Fund [IMF], 2008). Appendix 1.A (see Table 1.A.1) shows the table provided by the IMF (2008) that contains initial margins on collateral of asset backed securities (i.e., including, notably, CMBS and RMBS). Consequently, the securitization of consumer loans provides larger amounts of cash than that of commercial loans and other loans. Thus, consumer loans are more liquid than commercial ones. To measure the importance of potentially securitizable loans, two approaches are considered. First, the share of potentially securitizable loans in total loans is taken into account. Thus, the ratio of total consumer loans to total loans is computed as a proxy of the importance of potentially securitizable loans in total loans (*PSLO_TLO*). Second, the proportion of potentially securitizable loans in total loans and other illiquid assets is considered. Thus, the ratio of total consumer loans to total loans and other illiquid assets (i.e., including other investments in long-term assets, net fixed assets and other remaining assets) is computed as a proxy of the importance of potentially securitizable loans in total loans and other illiquid assets (*PSLO_IA*). In both cases, the extent to which the potential liquidity of the loan portfolio is likely to mitigate bank exposure to maturity transformation risk is the main focus. Because loan securitization provides banks with an additional source of funding by converting illiquid loans into liquid funds, a negative sign is expected for the coefficients of *PSLO_TLO* and *PSLO_IA* in the determination of bank maturity transformation risk.

In addition, by holding more unstable funding, banks may also experience acute liquidity problems. Consequently, the sensitivity of bank maturity transformation risk to the importance of potentially unstable funding is the main focus. Short-term liabilities can be considered less stable than long-term ones. Moreover, short-term deposits might be considered more stable than short-term market debts (BIS, 2009a). Consequently, the more banks are funded by short-term market debts, the higher is the potential instability of their funding. The extent to which the potential instability of short-term liabilities is likely to increase bank exposure to maturity transformation risk is the main focus. To measure the importance of short-term, potentially unstable market funding, the ratio of short-term market debts to total short-term debts (*STMD_STD*, total short-term debts including all deposits and all debt securities with a maturity of less than one year) is considered. A positive sign is expected for the coefficient of *STMD_STD* in the determination of bank maturity transformation risk.

1.4.1.2. Variables affecting bank maturity transformation risk from previous literature

Following the existing literature, this study considers a large set of bank-level indicators and macroeconomic variables that are likely to affect bank exposure to maturity transformation risk.

Bank capitalization captures the impact of banks' risk bearing capacity. As argued by Repullo (2004), bank capital allows the bank to absorb risk. Thus, higher capital ratio might allow banks to increase their exposure to maturity transformation risk. Furthermore, because bank liquidity creation and maturity transformation risk are positively related[31] and consistent with previous studies on bank liquidity creation (Berger and Bouwman, 2009), the "financial fragility structure" (Diamond and Rajan, 2000, 2001a) and "deposit crowding-out" (Gorton and Winton, 2000) effects must be considered in determining bank maturity transformation risk. These theories predict a negative relationship between bank capital and liquidity creation. In their model, Diamond and Rajan (2000, 2001a) suggest that bank capital might hamper liquidity creation by making the bank's capital structure less fragile. They model a relationship bank that raises funds from depositors and lends them to borrowers. By monitoring borrowers, the bank obtains private information that gives it an advantage in assessing the profitability of its borrowers. However, this informational advantage might create an agency problem. As the bank maximizes its profitability, it might extort rents from its depositors by demanding a greater share of the loan income. Nevertheless, because depositors know that the bank might abuse their trust, the bank must win their confidence by adopting a fragile financial structure with a large share of liquid deposits. A contract with depositors mitigates the bank's holdup problem because depositors can run on the bank if they have doubts about bank efforts for monitoring borrowers and about the fair reallocation of loan income. Consequently, financial fragility favors liquidity creation because it allows the bank to collect more deposits and grant more loans. In contrast, higher capital tends to mitigate financial fragility and enhances the bargaining power of the bank, hampering the credibility of its commitment to depositors. Consequently, higher capital tends to decrease liquidity creation and bank exposure to maturity transformation risk.

31 Recall that banks create liquidity by funding long-term, illiquid assets with short-term, liquid liabilities. Thus, banks hold illiquid assets and provide cash to the rest of the economy. Therefore, they face maturity transformation risk if some liabilities invested in illiquid assets are suddenly claimed at short notice.

Gorton and Winton (2000) show that a higher capital ratio might reduce liquidity creation through the "crowding-out of deposits". They argue that deposits are more effective liquidity hedges for investors than investments in bank equity capital. Indeed, deposits are totally or partially insured and withdrawable at par value. However, bank capital is not exigible and has a stochastic value that depends on the state of bank fundamentals and on the liquidity of the stock exchange. Consequently, the higher the bank capital ratio, the lower is liquidity creation and bank exposure to maturity transformation risk. This study considers the ratio of Tier 1 and 2 capital to total assets (*T12_TA*) using a broad definition of capital consistently with previous theoretical studies. For example, Diamond and Rajan (2001b) indicate that capital in their analysis might be interpreted as equity and long-term debts, the sources of funds that cannot run on the bank. Considering the "financial fragility structure" effect and the "deposit crowding-out" effect, a negative sign is expected for the coefficient of capital ratio in the determination of bank maturity transformation risk. However, assuming that bank capital allows banks to take higher risk, a positive sign is expected. The expected sign for the coefficient of this variable is ambiguous.

Bank profitability captures the impact of banks' risk-bearing capacity (Chen et al., 2010; Rauch et al., 2009). Thus, there should be a positive relationship between bank profitability and exposure to maturity transformation risk. However, a troubled bank can also take more risk and enhance its liquidity transformation to increase its expected profitability, specifically if it is considered "too-big-to-fail". Thus, a negative relationship between bank profitability and exposure to maturity transformation risk should result. Return on assets (*ROA*)—that is, the ratio of net income to total assets—is considered a proxy of bank profitability. The expected sign for the coefficient of this variable is ambiguous.

In addition, this study also considers the impact of credit risk in the determination of bank exposure to maturity transformation risk (Berger and Bouwman, 2009; Deep and Schaefer, 2004; Fungacova et al., 2010; Rauch et al., 2009). Lower exposure to credit risk enables the bank to enhance its loan activities by continuously meeting the capital at-risk requirements. Consequently, better loan quality will improve the ability of banks to perform liquidity transformation and increase maturity transformation risk. The ratio of loan loss provisions to total loans (*LLP_TLO*) is considered a proxy of bank credit risk. A negative sign for the coefficient of this variable in the determination of bank maturity transformation risk should result.

Furthermore, the impact of bank market power in the determination of bank maturity transformation risk is considered. Market power might affect the availability of funds (Petersen and Rajan, 1995) and the distribution of the loan portfolio (Berger et al. 2005). Higher market power might enables banks to enhance their transformation activities by granting more loans and by attracting more funds (i.e., deposits or market debts). Thus, market power is expected to positively affect liquidity transformation and hence maturity transformation risk. The ratio of total assets of bank *i* located in country *j* to the total assets of the banking system in country *j* (*MKT_POW*) is considered a proxy of bank market power. A positive sign is expected for the coefficient of this variable in the determination of bank maturity transformation risk.

Bank size controls for possible data distortions due to size heterogeneity. Large banks could face higher exposure to maturity transformation risk because they have easier access to the lender of last resort and they would be the first to benefit from the safety net. Therefore, a positive relationship could be expected between bank size and exposure to maturity transformation risk. The natural logarithm of total assets (*LN_TA*) is considered a proxy of bank size. A positive sign for the coefficient of this variable in the determination of bank maturity transformation risk should result.

The macroeconomic environment is also taken into account because it is likely to affect bank activities and investment decisions (Chen and al., 2010; Pana and al., 2010). The demand for differentiated financial products is higher during economic booms and might improve banks' ability to expand their loan and securities portfolios at a higher rate. Similarly, economic downturns are exacerbated by the reduction in bank credit supply. On the basis of these arguments, banks are expected to increase their liquidity transformation and hence their maturity transformation risk during economic booms. The annual growth rate of real GDP (*GDP_GWT*) is considered a proxy of the economic environment. A positive sign is expected for the coefficient of this variable in the determination of bank maturity transformation risk.

Consistent with Rauch et al. (2009), this study also considers the impact of monetary policy on bank exposure to maturity transformation risk. When the central bank's policy rate is relatively low, credit supply increases, which positively affects bank liquidity transformation and maturity transformation risk (Mishkin, 1996). This study considers each country's central bank policy rate (*CB*). A negative sign is expected for the coefficient of this variable in the determination of bank maturity transformation risk.

The impact of liquidity pressures on the interbank market in the determination of bank exposure to maturity transformation risk is also considered using the spread of the one month interbank rate and the central bank's policy rate (*IBK1M_CB*) as a proxy. Higher pressures on the interbank market might prevent banks to access these sources of liquidity and increase their liquidity risk. Consequently, higher values of this spread are expected to negatively affect bank liquidity transformation and maturity transformation risk. A negative sign for the coefficient of this variable in the determination of bank maturity transformation risk should result.

Finally, supervisory regime (Laeven and Levine, 2008; Shehzad et al., 2010) is considered, as it can affect bank risk-taking behavior (Berger et al., 2011). Because banking regulation is likely to vary across countries, this variable can control for possible country effects. Using Shehzad et al. (2010), an index of supervisory oversight (*CONTROL*) is computed from the World Bank's 2007 Regulation and Supervisory Database (Barth et al., 2007)[32]. Under stronger supervisory oversight, banks will be encouraged to lower their risk exposure and are expected to better manage their liquidity. Thus, a negative sign for the coefficient of this variable is expected in the determination of bank maturity transformation risk. Table 1.5 shows descriptive statistics of all the main explanatory variables separately for U.S. and European banks depending on their business model.

32 The proxy of supervisory regime (*CONTROL*) is a combinaison of two indicators. The first indicator refers to supervisory agency control and is the total number of affirmative answers to the following questions: (1) Is the minimum capital adequacy requirement greater than 8%? (2) Can the supervisory authority ask banks to increase minimum required capital in the face of higher credit risk? (3) Can the supervisory authority ask banks to increase minimum required capital in the face of higher market risk? (4) Can the supervisory authority ask banks to increase minimum required capital in the face of higher operational risk? (5) Is an external audit compulsory obligation for banks? (6) Can the supervisory authority force a bank to change its internal organization structure? (7) Can the supervisory authority legally declare that a bank is insolvent? (8) Can the supervisory authority intervene and suspend some or all ownership rights of a problem bank? (9) Can the supervisory authority supersede shareholders rights? (10) Can the supervisory authority remove and replace managers? (11) Can the supervisory authority remove and replace directors? The second indicator of the supervisory regime measures deposit insurance agency control and is the total number of affirmative answers to the following questions: (1) Can the deposit insurance agency legally declare that a bank is insolvent? (2) Can the deposit insurance agency intervene and suspend some or all ownership rights of a problem bank? (3) Can the deposit insurance agency remove and replace managers? (4) Can the deposit insurance agency remove and replace directors? (5) Can the deposit insurance agency supersede shareholders rights? For each country in the sample, the possible changes in the answers to these questions over the 2000–2008 period were considered. Thus, for a given country, the value of the index might vary over time.

Table 1.5. Descriptive statistics of the main explanatory variables, for U.S. and European banks depending on their business model, on average from 2000 to 2008

	PSLO_TLO	PSLO_IA	STMD_STD	T12_TA	ROA	LLP_TLO	MKT_POW	LN_TA
Retail - U.S. banks								
Mean	39.5	35.1	10.8	10.1	0.7	0.4	0.0	6.4
Median	37.2	32.1	7.8	9.3	0.9	0.3	0.0	6.3
Max	99.4	92.1	97.4	60.2	6.9	6.8	0.4	10.9
Min	0.0	0.0	0.0	3.3	-15.1	-0.5	0.0	2.8
Std Dev	23.5	21.1	11.0	4.0	1.2	0.6	0.0	1.0
Obs	2309	2309	2309	2309	2317	2260	2309	2309
Diversified - U.S. banks								
Mean	43.2	37.8	14.8	9.4	1.0	0.5	0.2	7.6
Median	42.1	36.7	12.3	8.9	1.1	0.3	0.0	7.1
Max	98.0	91.6	82.4	54.8	6.7	5.9	16.8	14.6
Min	0.0	0.0	0.0	2.0	-9.0	-0.7	0.0	3.3
Std Dev	19.2	17.1	12.6	3.1	0.8	0.6	1.3	1.8
Obs	2315	2315	2315	2315	2315	2270	2315	2315
Test statistic & %level	5.76 *** (0.00)	4.85 *** (0.00)	11.65 *** (0.00)	-7.20 *** (0.00)	7.14 *** (0.00)	2.13 *** (0.00)	8.56 *** (0.00)	26.04 *** (0.00)
Retail - European banks								
Mean	48.4	43.5	31.6	9.4	0.8	0.7	4.1	8.4
Median	49.0	43.6	27.0	8.4	0.7	0.5	0.4	8.4
Max	99.2	97.7	95.6	28.0	4.3	6.7	59.7	15.1
Min	0.3	0.2	0.0	0.8	-9.8	-1.2	0.0	3.8
Std Dev	17.9	17.9	21.8	4.1	0.9	0.8	9.5	2.2
Obs	864	864	864	864	867	853	864	864
Diversified - European banks								
Mean	40.6	33.7	47.3	8.7	0.9	0.4	7.8	10.2
Median	39.2	32.5	48.0	8.1	0.8	0.4	1.2	9.9
Max	96.7	92.4	100.0	35.5	6.1	5.1	74.5	15.1
Min	0.1	0.1	0.0	1.3	-5.5	-1.2	0.0	4.1
Std Dev	18.1	17.1	22.1	4.2	0.7	0.5	12.1	2.3
Obs	863	863	863	863	866	854	863	863
Test statistic & %level	-9.06 *** (0.00)	-11.60 *** (0.00)	14.83 *** (0.00)	-3.30 *** (0.00)	2.36 *** (0.00)	-2.36 *** (0.00)	7.00 *** (0.00)	16.63 *** (0.00)

Source: Bloomberg (2000–2008), World Bank's 2007 Regulation and Supervisory Database. All variables are expressed in percentage, except *LN_TA* and *CONTROL*. *PSLO_TLO:* consumer loans / total loans; *PSLO_IA:* consumer loans / (total loans + long-term investments + customer acceptances + fixed assets + other assets); *STMD_STD:* short-term market debts / (demand and saving deposits + short-term market debts); *T12_TA:* (Tier 1 capital + Tier 2 capital) / total assets; *ROA:* net income / total assets; *LLP_TLO:* loan loss provisions / total loans; *MKT_POW:* total assets of bank i in country j / total assets of the banking system in country j; *LN_TA:* natural logarithm of total assets. A bank is considered retail (diversified) if its ratio of total gross noninterest income to total income is lower (higher) than the median of this ratio. As U.S. and European banks have very different profiles of noninterest income, the median of this ratio is calculated separately for U.S. and European banks. T-statistics test for null hypothesis of identical means; *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively, for bilateral test.

On average, U.S. retail banks hold fewer shares of potentially securitizable loans in total loans or in total loans and other illiquid assets (respectively, 39.5% and 35.1%) than diversified banks (respectively, 43.2% and 37.8%). In contrast, in Europe, retail banks hold on average higher shares of potentially securitizable loans in total loans or in total loans and other illiquid assets (respectively, 48.4% and 43.5%) than diversified banks (respectively, 40.6% and 33.7%). In addition, the proportions of total short-term market debts in total short-term debts are different for U.S. and European banks. Retail and diversified European banks hold higher shares of short-term market debts in total short-term debts (respectively, 31.6% and 47.3%) compared with retail and diversified U.S. banks (respectively, 10.8% and 14.8%).

1.4.2. The model and regression framework

This study investigates the sensitivity of maturity transformation risk for banks on the basis of their business model. The focus is on the importance of potentially securitizable loans and of short-term, potentially unstable market debts beyond the determinants identified in previous literature. A methodology similar to Berger and Bouwman (2009) is used. Because portfolio changes take time to occur and likely reflect decisions made on the basis of historical experience, the one-year lagged value of all explanatory variables is considered. Like Berger and Bouwman (2009), it is assumed that the future cannot cause the past. From a risk management perspective, the purpose is to outline how previous factors accurately reflect the inputs in bank decisions to determine their current liquidity profile. The dependent variable is the maturity transformation risk measure as defined in the Basel III accords (i.e., the inverse of the Basel III net stable funding ratio (*I_NSFR*)[33]. Because two highly related proxies of the importance of potentially securitizable loans (i.e., *PSLO_TLO* and *PSLO_IA*) are used, they are introduced individually in the regressions. The model is specified as follows, with subscripts *i* and *t* denoting bank and period respectively:

$$I\_NSFR_{it} = \alpha_{it} + \beta_1 PSLO\_TLO_{i,t-1} + \beta_2 STMD\_STD_{i,t-1} + \sum_{k=3}^{12} \beta_k DTR_{ki,t-1} + \varepsilon_{i,t} \qquad (1.a)$$

$$I\_NSFR_{it} = \alpha_{it} + \beta_1 PSLO\_IA_{i,t-1} + \beta_2 STMD\_STD_{i,t-1} + \sum_{k=3}^{12} \beta_k DTR_{ki,t-1} + \varepsilon_{i,t} \qquad (1.b)$$

where *PSLO_TLO* is the ratio of potentially securitizable loans to total loans. *PSLO_IA* is the ratio of potentially securitizable loans to total loans and other illiquid assets. *STMD_STD* is the ratio of short-term market debts to total short-term debts. DTR_k is the k^{th} one-year lagged determinant of maturity transformation risk identified in previous literature. Because the sensitivity of banks' maturity transformation risk considering their business model is of

33 The Basel Committee considers three weights (i.e., 0.5, 0.7, or 0.85) for demand and saving deposits (i.e., all deposits with a maturity of less than one year) according to the type of depositors. In the regressions, *I_NSFR* is the net stable funding ratio calculated considering the intermediate weight of 0.7. In section 1.4.4, robustness checks are performed by considering other weights.

interest and U.S. and European banks have different profiles of noninterest income (see Table 1.2), regressions are run separately for U.S.[34] and European banks and separate retail and diversified banks. After testing the presence of cross-section and time fixed versus random effects and possible heteroskedasticity of error, cross-section and time fixed effects are included in the regressions. To deal with heteroskedasticity issue, the Huber-White robust covariance method is used. Because of colinearity issues, some of the variables are orthogonalised before introducing them in the regressions[35]. Table 1.B.1, Table 1.B.2, Table 1.B.3 and Table 1.B.4 in Appendix 1.B show the correlation coefficients among the explanatory variable for retail versus diversified banks located in the United States and in Europe.

1.4.3. Results and the main implications of the Basel III liquidity requirements for banks according to their business model

Table 1.6 shows the regression results. The variables *PSLO_TLO* (i.e., the ratio of potentially securitizable loans to total loans) and *PSLO_IA* (i.e., the ratio of potentially securitizable loans to total loans and other illiquid assets) have a significant and negative impact on bank maturity transformation risk for both retail and diversified U.S. banks. These results suggest that U.S. banks benefit from the potential liquidity of their loan portfolio to mitigate their exposure to maturity transformation risk (more so for diversified banks). Moreover, the variable *STMD_STD* (i.e., the ratio of short-term market debts to total short-term debts) has a significant and positive impact on bank maturity transformation risk for both retail and diversified European banks. These findings emphasize that European banks are penalized by the potential instability of their short-term market debts, which tend to increase their exposure to maturity transformation risk (more so for diversified banks).

34 Specifically for U.S. banks, the *CONTROL* variable has been removed from equation (1) because its cross sectional variances is null.
35 *LN_TA* with *MKT_POW* are orthagonalised.

Table 1.6. The sensitivity of maturity transformation risk according to bank business model

	U.S. banks				European banks			
	Retail banks		Diversified banks		Retail banks		Diversified banks	
	1. a	1. b	1. a	1. b	1. a	1. b	1. a	1. b
PSLO_TLO	-0.18 *** (-8.32)	-	-0.21 *** (-9.34)	-	-0.13 (-0.99)	-	0.19 (1.24)	-
PSLO_IA	-	-0.18 *** (-7.88)	-	-0.23 *** (-9.26)	-	-0.16 (-1.28)	-	0.16 (0.69)
STMD_STD	-0.01 (-0.24)	-0.01 (-0.23)	0.04 (0.90)	0.04 (0.88)	0.34 *** (3.36)	0.34 *** (3.36)	0.51 *** (4.67)	0.51 *** (4.73)
T12_TA	0.09 (0.98)	0.09 (0.91)	-0.19 (-1.07)	-0.19 (-1.05)	0.63 (1.54)	0.61 (1.48)	-0.13 (-0.45)	-0.10 (-0.35)
ROA	-0.22 (-0.69)	-0.19 (-0.62)	-1.18 (-1.54)	-1.22 (-1.58)	-1.09 (-0.67)	-1.14 (-0.70)	-0.12 (-0.08)	-0.09 (-0.07)
LLP_TLO	-2.21 *** (-3.52)	-2.28 *** (-3.61)	-3.53 *** (-4.90)	-3.60 *** (-4.95)	-3.36 *** (-2.64)	-3.32 *** (-2.60)	-1.64 (-1.05)	-1.56 (-0.96)
MKT_POW	-72.38 * (-1.61)	-75.41 * (-1.67)	3.04 *** (2.85)	3.02 *** (2.86)	0.72 (0.71)	0.74 (0.72)	-0.27 (-0.40)	-0.30 (-0.44)
LN_TA	0.06 *** (7.62)	0.06 *** (7.66)	0.05 *** (4.00)	0.05 *** (3.93)	0.09 (0.80)	0.09 (0.80)	0.05 (0.97)	0.05 (0.87)
GDP_GWT	0.70 *** (3.23)	0.69 *** (3.13)	0.39 * (1.72)	0.36 (1.59)	-0.15 (-0.20)	-0.17 (-0.24)	0.28 (0.28)	0.31 (0.29)
CB	0.18 * (1.62)	0.19 * (1.69)	0.33 *** (3.12)	0.34 *** (3.24)	3.51 *** (3.39)	3.51 *** (3.39)	1.11 (0.74)	1.08 (0.70)
IBK1M_CB	4.26 * (1.80)	4.72 ** (1.99)	4.91 ** (1.96)	5.16 ** (2.05)	0.97 (0.74)	0.96 (0.74)	0.81 (0.41)	0.96 (0.45)
CONTROL	-	-	-	-	0.01 (0.21)	0.01 (0.14)	0.01 (0.17)	0.02 (0.36)
C	0.96 *** (55.23)	0.96 *** (55.69)	0.95 *** (38.04)	0.94 *** (37.86)	0.79 ** (1.92)	0.82 ** (1.96)	0.59 (1.19)	0.52 (1.05)
R^2	0.82	0.82	0.80	0.80	0.66	0.66	0.76	0.76
Fisher Stat	17.18	17.04	17.13	17.10	6.28	6.29	10.37	10.35
P-Value F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Obs.	1921	1921	2081	2081	764	764	747	747

This table shows the result of estimating equation (1) for an unbalanced panel of U.S. and European publicly traded commercial banks over the 2000–2008 period. Equation (1) is estimated separately for retail and diversified banks. A bank is considered retail (diversified) if its ratio of total gross noninterest income to total income is lower (higher) than the median of this ratio. Because U.S. and European banks have different profiles of noninterest income, the median of this ratio is calculated separately for U.S. and European banks. The dependent variable of equation (1) is the inverse of the Basel III net stable funding ratio (*I_NSFR*). Equations (1.a) and (1.b) are the estimations of equation (1) using two proxies of potentially securitizable loans (*PSLO_TLO* and *PSLO_IA*). All explanatory variables are one-year lagged. See Table 1.5 for the definition and descriptive statistics of the explanatory variables. Cross-section and time fixed effects are included in the regressions, and the Huber-White robust covariance method is used. To deal with colinearity issues in all the regressions, *LN_TA* is orthogonalised with *MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% level, respectively.

These different results for U.S. and European banks might be explained by their different banking models and because this study solely considers the liquidity profile of banks stemming from their on-balance sheet positions[36]. The different profiles of noninterest income

36 This study cannot consider the liquidity profile of banks stemming from their off-balance sheet positions because a detailed breakdown of off-balance sheets is not available in standard databases.

of European and U.S. banks imply that both retail and diversified European banks are on average more diversified than both retail and diversified U.S. banks (see Table 1.2). European banks are universal banks. Thus, in addition to traditional intermediation activities (i.e., loan activities and deposits), European banks have developed their market activities, such as trading, market funding and complex off-balance sheet operations. This might imply that European banks are involved in loan activities, as are U.S. banks, but also in other activities that could provide them additional sources of liquidity (i.e., such as loan commitments from other financial institutions off the balance sheet). In addition, securitization markets are much more developed in the United States than in Europe. According to the British Bankers' Association and as detailed in Bannier and Hansel (2008), between 2000 and 2006, European securitization issuance rose from US$73.4 billion to US$605.8 billion, paralleling the even more developed U.S. market for asset-backed securities (ABS), which exceeded US$1200 billion in 2006. In the United States, the ABS market represented almost one-third of the total corporate bond market in 2006. Therefore, loan securitization might not be a key component of the liquidity management framework for European banks. Rather, they might manage their maturity transformation risk by accessing additional sources of liquidity through other activities[37].

Conversely, U.S. banks benefit from their broader access to securitization markets and from the higher liquidity of their loan portfolio to decrease their exposure to maturity transformation risk. Loan securitization is crucial for maturity transformation risk management. It provides an essential source of liquidity. Nevertheless, the advantages loan securitization provide depend on the liquidity of securitization markets, which is likely to fall following a market collapse (e.g., during the subprime crisis). Thus, holding such loans is likely to be inefficient in mitigating bank exposure to maturity transformation risk when the market for securitized loans is disrupted. In this context, a large share of potentially securitizable loans become nonsecuritizable and thus cannot be monetized to meet unexpected customer withdrawals. Moreover, among the several specificities of universal European banks, an important one is their small deposit base. European banks are highly funded by market debts compared with U.S. banks, which are more funded by deposits (see Table 1.2).

In addition, European banks hold more shares of short-term market debts in their total short-term debts than do U.S. banks (see Table 1.2 and Table 1.5). Because short-term market debts are considered potentially more unstable than short-term deposits, the results imply that

37 A case in point is the recent development of the European covered bond market beyond its German and Danish origins (Pfandbriefe), which proved more resilient during the crisis than other forms of securitizations.

the maturity transformation risk of U.S. banks is not sensitive to the extent of their unstable market funding. They suggest that U.S. banks benefit from the stability of their large deposit base, which matches structural unbalances with their long-term loans. In contrast, European banks are sensitive to the instability of their short-term market funding, which significantly increases their exposure to maturity transformation risk, suggesting that the small deposit base of European banks does not provide a sufficient cushion of stable funding to mitigate their exposure to maturity transformation risk. Because European banks are universal, they both collect deposits from customers and access additional sources of funding such as life insurance and mutual fund activities. Thus, European banks still benefit from the stability of funding provided by retail customers, but they do not manage their exposure to maturity transformation risk by building up a large stable deposit base on their balance sheets.

These findings raise numerous challenges for banks, specifically European ones, to modify their business strategies. The most diversified banks should make the biggest efforts. These findings support the need to improve the stability of funding, as stressed by the Basel Committee (2009a). Banks can consider several ways to increase their stable funding base. They can attract more retail deposits through new marketing strategies and higher interest payment on deposits. For example, in France, the Société Générale and the Banque Populaire et Caisse d'Epargne have respectively collected in 2010 €1 billion of deposits from retail customers. In addition, banks can develop their private banking activities to benefit from the liquidity provided by wealth management. For example, in 2010–2011, BNP Paribas has reorganized its wealth management banking. Société Générale Private Banking has increased its assets management activities. Crédit Agricole has created a special holding for private banking. Furthermore, instead of increasing their deposits, banks can increase the share of long-term market debts by issuing covered bonds or contingent convertible bonds[38] (CoCos). Rabobank and Lloyds in 2010 and Crédit Suisse in February 2011 have issued this type of debt securities. Finally, as Grégoire and Menoni (2011) suggest, these findings raise questions about the need to include funding collected through life insurance and mutual fund shares activities on the balance sheets to improve banks' stable deposit base. In addition, Artus (2011) argues that it also questions the need to consider market fundings' insurance regulations to improve their stability and mitigate bank exposure to maturity transformation risk.

38 Contingent convertible bonds are convertible into capital if Tier 1 capital ratio becomes too weak. Considering the latest contingent convertible bonds issued Rabobank, if the Tier 1 capital becomes lower than 7%, 25% of the par value of the bond is repaid to bondholders.

Regarding the other determinants of maturity transformation risk, credit risk (*LLP_TLO*) and the central bank policy rate (*CB*) are the most relevant factors to explain bank maturity transformation risk of both U.S. and European banks. The coefficient of the ratio of loan loss provisions to total loans (*LLP_TLO*) is significantly negative. Consequently, lower levels of credit risk enable banks to increase their liquidity transformation, because their exposure to maturity transformation risk tends to be greater. In addition, the findings highlight that an increase in the central bank policy rate (*CB*) is associated with greater bank exposure to maturity transformation risk. A possible explanation is that a higher interest rate provides incentives for depositors to increase their saving. In this context, they are encouraged to invest in bank deposits or bank debt securities with a higher expected return rather than in other financial assets such as corporate equities (Rauch et al., 2009). Thus, banks can attract more funds and can possibly increase their maturity transformation. Besides, economic activity (*GDP_GWT*) and the spread of the one-month interbank rate and the central bank's policy rate (*IBK1M_CB*) are also significant for U.S. banks. The coefficient of the annual growth rate of real GDP (*GDP_GWT*) is significantly positive. Consequently, during economic booms, banks expand their loan and their securities portfolios that tend to increase their exposure to maturity transformation risk. Furthermore, perhaps surprisingly, higher liquidity pressures on the interbank market significantly and positively impact bank exposure to maturity transformation risk (*IBK1M_CB*).

In summary, the main results show that loan securitization is crucial in maturity transformation risk management for all types of U.S. banks. Because European banks are universal, they can access additional sources of liquidity provided by other activities. In addition, securitization markets are much more developed in the United States than in Europe. Thus, loan securitization might not be a key component of the liquidity management framework for European banks, which can manage their maturity transformation risk by accessing to additional sources of liquidity through other activities. Conversely, the loan securitization might be essential for U.S. banks, which can benefit from the higher liquidity of their loan portfolio to decrease their exposure to maturity transformation risk. In addition, the results show that both retail and diversified European banks are widely penalized by the potential instability of their market funding, because they are more involved in debt markets than are U.S. banks. Thus, U.S. banks might benefit from the stability of their large deposit base to match structural unbalances with their long-term loans. The small deposit base of

European banks does not provide a sufficient cushion of stable funding to mitigate their exposure to maturity transformation risk. Finally, for both U.S. and European banks, diversified banks are the most sensitive to these factors. These findings imply several challenges for banks to modify their business strategies, specifically for European banks, which could strengthen the stability of their funding. Among the several ways banks can consider to improve funding stability, some solutions might raise concerns about the possible emergence of destructive competition for deposits and the wide increase of the proportion of long-term market debts. In addition, these findings raise challenges for regulatory authorities, who might need to reconsider their method of implementing uniform liquidity requirements to all types of banks.

1.4.4. Further issues and robustness checks

1.4.4.1. Further issues for U.S. banks

The sensitivity of maturity transformation risk depending on bank business model and size for U.S. banks

As discussed in section 1.3.1, bank size is likely to affect the structure of bank balance sheets and the sensitivity of maturity transformation risk to several ratios computed with balance sheet data. Using these facts, this study investigates on a deeper level the sensitivity of maturity transformation risk depending on bank business model and size for U.S. banks (recall that the European bank sample includes relatively low numbers of small retail and small diversified banks). Thus, equations (1.a) and (1.b) are estimated separately for retail and diversified U.S. banks considering large versus small banks. Table 1.7 shows the regression results.

Table 1.7. The sensitivity of maturity transformation risk according to bank business model and size, for U.S. banks

	Retail banks				Diversified banks			
	Large banks		Small banks		Large banks		Small banks	
	1. a	1. b	1. a	1. b	1. a	1. b	1. a	1. b
PSLO_TLO	-0.13 *** (-2.86)	-	-0.17 *** (-7.01)	-	-0.22 *** (-6.74)	-	-0.17 *** (-5.46)	-
PSLO_IA	-	-0.10 ** (-2.00)	-	-0.18 *** (-7.01)	-	-0.24 *** (-6.68)	-	-0.19 *** (-5.59)
STMD_STD	0.20 *** (2.94)	0.20 *** (2.92)	0.05 (0.71)	0.05 (0.70)	0.10 * (1.61)	0.10 * (1.60)	-0.04 (-0.58)	-0.04 (-0.60)
T12_TA	0.27 (1.31)	0.27 (1.31)	0.11 (0.89)	0.10 (0.84)	-0.99 *** (-3.91)	-0.96 *** (-3.83)	0.09 (0.42)	0.08 (0.40)
ROA	-0.16 (-0.42)	-0.11 (-0.30)	-0.62 (-1.55)	-0.57 (-1.43)	-2.31 ** (-2.23)	-2.30 ** (-2.24)	0.75 (0.61)	0.74 (0.60)
LLP_TLO	-6.19 *** (-2.79)	-6.17 *** (-2.77)	-1.69 *** (-2.96)	-1.77 *** (-3.07)	-4.16 *** (-4.04)	-4.16 *** (-4.04)	-2.08 ** (-2.02)	-2.20 ** (-2.09)
MKT_POW	-105.69 ** (-2.08)	-109.43 ** (-2.15)	-107.62 *** (-5.10)	-108.66 *** (-5.16)	2.46 ** (1.94)	2.45 ** (1.93)	-934.18 *** (-4.37)	-936.20 *** (-4.36)
LN_TA	0.09 *** (4.77)	0.09 *** (4.77)	0.08 *** (7.17)	0.08 *** (7.16)	0.04 *** (2.80)	0.04 *** (2.72)	0.08 *** (3.80)	0.08 *** (3.83)
GDP_GWT	-0.01 (-0.02)	-0.05 (-0.10)	0.67 *** (2.74)	0.66 *** (2.67)	0.16 (0.52)	0.12 (0.41)	0.21 (0.59)	0.18 (0.53)
CB	1.08 *** (4.56)	1.11 *** (4.68)	0.11 (0.81)	0.11 (0.85)	0.39 *** (2.90)	0.41 *** (3.04)	0.52 *** (2.78)	0.53 *** (2.84)
IBK1M_CB	2.14 (0.45)	2.66 (0.55)	4.53 * (1.66)	4.88 * (1.80)	-1.55 (-0.48)	-1.26 (-0.39)	8.90 *** (2.39)	9.20 *** (2.47)
C	0.89 *** (26.10)	0.88 *** (25.20)	1.03 *** (43.35)	1.02 *** (43.19)	1.01 *** (19.86)	1.00 *** (19.85)	1.00 *** (30.33)	1.00 *** (30.24)
R^2	0.85	0.85	0.84	0.84	0.84	0.83	0.78	0.78
Fisher Stat	13.24	13.09	17.28	17.23	21.95	21.91	10.27	10.24
P-Value F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Obs.	565	565	1356	1356	1174	1174	907	907

This table shows the result of estimating equation (1) for an unbalanced panel of U.S. publicly traded commercial banks over the 2000–2008 period. Equation (1) is estimated separately for retail and diversified banks according to their size. A bank is considered retail (diversified) if its ratio of total gross noninterest income to total income is lower (higher) than the median of this ratio. A bank is considered large if its total assets exceed US$1 billion. The dependent variable of equation (1) is the inverse of the Basel III net stable funding ratio (*I_NSFR*). Equations (1.a) and (1.b) are the estimations of equation (1) using two proxies of potentially securitizable loans (*PSLO_TLO* and *PSLO_IA*). All explanatory variables are one year lagged. See Table 1.5 for the definition and descriptive statistics of the explanatory variables. Cross-section and time fixed effects are included in the regressions, and the Huber-White robust covariance method is used. To deal with colinearity issues in all the regressions, *LN_TA* is orthogonalised with *MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

The results are consistent with those previously obtained considering the *PSLO_TLO* and the *PSLO_IA* variables for both large and small U.S. banks. This confirms that U.S. banks benefit from their access to securitization markets and from the liquidity of their loan portfolio to mitigate their exposure to maturity transformation risk. However, the results differ with regard the *STMD_STD* variable for large U.S. banks, the coefficient of the *STMD_STD* variable becoming significantly positive for both retail and diversified banks. Therefore, large U.S. banks are penalized by the potential instability of their short-term debts, which tends to increase their exposure to maturity transformation risk. This result is similar to that obtained for European banks, which are mainly large in this sample.

This difference in result for large and small U.S. banks might be explained by their abilities to access financial markets. Like the large European banks in the sample, large U.S. banks benefit from a reputational advantage, which provides broader access to debt markets. Considering descriptive statistics in Table 1.2, the data show that large U.S. banks (both retail and diversified banks) are less funded by deposit and are more reliant on short-term market debts than are small U.S. banks. Because short-term market debts are considered potentially more unstable than short-term deposits, the results imply that the maturity transformation risk of small U.S. banks is not sensitive to the importance of their unstable market funding. It might suggest that small U.S. banks benefit from the stability of their large deposit base to match structural unbalances with their long-term loans. However, large U.S. banks are sensitive to the instability of their short-term market funding, which significantly increases their exposure to maturity transformation risk. This suggests that the small deposit base of large U.S. banks does not provide them a sufficient cushion of stable funding to mitigate their exposure to maturity transformation risk.

These findings confirm that loan securitization is crucial for maturity transformation risk management for all types of U.S. banks. In addition, they support the need to improve the stability of funding specifically, for large U.S. banks, as stressed by the Basel Committee (2009a). This finding is consistent with that obtained for European banks. On the whole, it is not banks' business models that matter in studying the sensitivity of their maturity transformation risk, but rather their size and ability to access financial markets, specifically to debt markets and securization markets. These findings imply several challenges for large banks to modify their business strategies to mitigate their exposure to maturity transformation risk. In addition, these findings raise questions regarding the implementation of uniform liquidity requirements to all types of banks.

The sensitivity of maturity transformation risk depending on bank business model: The importance of core deposits for U.S. banks

Harvey and Spong (2001) and Saunders and Cornett (2006) emphasize the importance of core deposits, typically considered the most stable and least costly source of funding for U.S. banks. Core deposits are defined as the sum of demand deposits, saving deposits and time deposits lower than US$100,000. According to this definition of core deposits and consistently with BIS (2009a), short-term deposits (i.e., demand deposits and saving deposits with a maturity of less than one year) are core deposits and can be still considered stable. However, in contrast to BIS (2009a), all long-term funding (including time deposits and long-term market debts) cannot be considered stable because a portion of time deposits are considered non-core funding. Consequently, it might be relevant to consider the importance of long-term market debts in total long-term debts to study the sensitivity of bank maturity transformation risk. The aim is to study the sensitivity of bank maturity transformation risk according to the mix between non core time deposits and long-term market funding (such as covered bonds). More precisely, this study investigates to what extent banks might benefit from the potential stability of their long-term market funding to manage their exposure to maturity transformation risk.

To measure the importance of long-term, potentially stable market funding compared with core time deposits, the ratio of long-term market debts to total long-term market debts and noncore time deposits (*LTMD_NCDLTMD*) must be considered. A negative sign for the coefficient of *LTMD_NCDLTMD* in the determination of bank maturity transformation risk is expected. Equations (1.a′) and (1.b′) are estimated for U.S. banks according to their business model by adding the *LTMD_NCDLTMD* variable in the set of the explanatory variables. An alternative maturity transformation risk proxy is the dependent variable: the *CFR* variable as defined in section 1.2.1.2. Consequently, equations (1.a′′) and (1.b′′) are estimated for U.S. banks according to their business model by replacing the *I_NSFR* variable with the *CFR* variable and still considering *LTMD_NCDLTMD* as an additional explanatory variable. Table 1.8 shows the regression results.

Table 1.8. The sensitivity of maturity transformation risk according to bank business model, considering the importance of core deposits for U.S. banks

	I_NSFR				CFR			
	Retail banks		Diversified banks		Retail banks		Diversified banks	
	1. a'	1. b'	1. a'	1. b'	1. a''	1. b''	1. a''	1. b''
PSLO_TLO	-0.18 *** (-8.20)	-	-0.21 *** (-9.23)	-	-0.19 *** (-3.19)	-	-0.26 *** (-6.95)	-
PSLO_IA	-	-0.18 *** (-7.79)	-	-0.23 *** (-9.17)	-	-0.19 *** (-2.92)	-	-0.29 *** (-7.02)
STMD_STD	-0.02 (-0.49)	-0.02 (-0.49)	0.04 (0.78)	0.03 (0.76)	0.17 * (1.65)	0.17 * (1.65)	0.14 ** (2.18)	0.14 ** (2.19)
LTMD_NCDLTMD	-0.03 ** (-1.72)	-0.03 ** (-1.79)	-0.04 ** (-2.13)	-0.04 ** (-2.23)	-0.11 ** (-2.19)	-0.11 ** (-2.22)	-0.07 *** (-2.50)	-0.08 *** (-2.57)
T12_TA	0.08 (0.84)	0.07 (0.77)	-0.18 (-1.03)	-0.18 (-1.01)	0.16 (0.65)	0.16 (0.62)	-0.03 (-0.11)	-0.03 (-0.09)
ROA	-0.23 (-0.74)	-0.21 (-0.67)	-1.18 (-1.51)	-1.21 (-1.55)	-0.64 (-0.71)	-0.61 (-0.68)	-1.56 (-1.48)	-1.60 (-1.51)
LLP_TLO	-2.20 *** (-3.50)	-2.26 *** (-3.59)	-3.54 *** (-4.89)	-3.61 *** (-4.94)	2.26 (0.43)	2.20 (0.42)	-3.64 *** (-3.56)	-3.73 *** (-3.62)
MKT_POW	-73.72 * (-1.64)	-76.83 * (-1.70)	3.27 *** (3.06)	3.25 *** (3.07)	-88.46 (-0.51)	-91.80 (-0.53)	10.64 *** (5.20)	10.56 *** (5.19)
LN_TA	0.06 *** (7.87)	0.06 *** (7.93)	0.05 *** (4.14)	0.05 *** (4.06)	0.22 *** (6.48)	0.22 *** (6.47)	0.14 *** (7.18)	0.14 *** (7.06)
GDP_GWT	0.73 *** (3.34)	0.71 *** (3.25)	0.35 (1.52)	0.32 (1.39)	0.11 (0.18)	0.09 (0.15)	1.49 *** (3.76)	1.45 *** (3.66)
CB	0.14 (1.32)	0.15 (1.37)	0.26 *** (2.41)	0.27 *** (2.51)	0.92 *** (2.53)	0.93 *** (2.55)	0.01 (0.03)	0.02 (0.09)
IBK1M_CB	4.62 ** (1.96)	5.08 ** (2.14)	4.49 * (1.79)	4.73 ** (1.89)	30.05 *** (3.03)	30.54 *** (3.09)	17.67 *** (3.83)	17.83 *** (3.87)
C	0.97 *** (53.63)	0.96 *** (53.86)	0.96 *** (36.69)	0.96 *** (36.95)	1.08 *** (16.79)	1.08 *** (16.68)	0.90 *** (22.14)	0.91 *** (22.21)
R^2	0.83	0.82	0.80	0.80	0.61	0.61	0.65	0.65
Fisher Stat	17.25	17.11	16.76	16.74	5.65	5.64	7.67	7.69
P-Value F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Obs.	1916	1916	2070	2070	1915	1915	2068	2068

This table shows the result of estimating equation (1) for an unbalanced panel of U.S. publicly traded commercial banks, over the 2000–2008 period. Equation (1) is estimated separately for retail and diversified banks. A bank is considered retail (diversified) if its ratio of total gross noninterest income to total income is lower (higher) than the median of this ratio. The dependent variable of equations (1.a′) and (1.b′) is the inverse of the Basel III net stable funding ratio (*I_NSFR*). Equations (1.a′) and (1.b′) are the estimations of equation (1), using two proxies of potentially securitizable loans (*PSLO_TLO* and *PSLO_IA*) and *LTMD_NCDLTMD* as an additional explanatory variable. In addition, equations (1.a′′) and (1.b′′) are estimated by replacing the dependent variable of equations (1.a') and (1.b') with *CFR*. All explanatory variables are one year lagged. See Table 1.5 for the definition and descriptive statistics of the explanatory variables. Cross-section and time fixed effects are included in the regressions, and the Huber-White robust covariance method is used. To deal with colinearity issues in all the regressions, *LN_TA* is orthogonalised with *MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

For both definitions of the dependent variable, the coefficient of the *LTMD_NCDLTMD* variable is significantly negative for both retail and diversified U.S. banks. These findings highlight the benefit of increasing the use of long-term market funding to reduce bank exposure to maturity transformation risk. Moreover, they question the need to consider incentive mechanisms for customers making large deposits against unexpected deposit withdrawals and improve the stability of noncore time deposits. In addition, these findings indicate the benefits of banks' access to debt markets and the increasing use of market funding, but they raise questions about the essential role of banks as financial intermediaries.

In addition, the results are consistent with those previously obtained using the variables *PSLO_TLO* and *PSLO_IA* for retail and diversified banks with both definitions of the dependent variable. However, the results differ when using the variable *STMD_STD*. The coefficient of the variable *STMD_STD* becomes significantly positive for both retail and diversified banks with *CFR* variable as the dependent variable. Thus, U.S. banks are also sensitive to the instability of their short-term market funding when using an alternative indicator of maturity transformation risk adjusted for the importance of core deposits for U.S. banks.

To further analyse this issue, the impact of bank size in taken into account to study the sensitivity of maturity transformation risk. Thus, equations (1.a′), (1.b′), (1.a′′) and (1.b′′) are estimated separately for retail and diversified U.S. banks, differentiating large and small banks. Table 1.9 and Table 1.10 show the regression results.

Table 1.9. The sensitivity of maturity transformation risk according to bank business model and size, considering the importance of core deposits for retail banks in the United States

	I_NSFR				CFR			
	Large banks		Small banks		Large banks		Small banks	
	1. a'	1. b'	1. a'	1. b'	1. a''	1. b''	1. a''	1. b''
PSLO_TLO	-0.12 *** (-2.80)	-	-0.12 ** (-1.81)	-	-0.17 *** (-6.91)	-	-0.12 ** (-2.04)	-
PSLO_IA	-	-0.10 ** (-1.97)	-	-0.10 * (-1.75)	-	-0.18 *** (-6.91)	-	-0.12 ** (-1.91)
STMD_STD	0.20 *** (3.02)	0.21 *** (3.01)	0.05 (0.26)	0.05 (0.25)	0.10 *** (2.40)	0.10 *** (2.40)	0.16 (1.60)	0.16 (1.59)
LTMD_NCDLTMD	-0.01 (-0.25)	-0.01 (-0.31)	0.02 (0.18)	0.02 (0.16)	-0.03 * (-1.63)	-0.03 * (-1.62)	-0.10 ** (-2.10)	-0.10 ** (-2.10)
T12_TA	0.26 (1.24)	0.26 (1.24)	0.84 * (1.73)	0.84 * (1.73)	0.09 (0.79)	0.08 (0.73)	0.27 (0.79)	0.27 (0.77)
ROA	-0.15 (-0.39)	-0.10 (-0.27)	-1.42 (-1.05)	-1.37 (-1.00)	-0.68 * (-1.71)	-0.62 * (-1.60)	-0.69 (-0.56)	-0.65 (-0.53)
LLP_TLO	-6.13 *** (-2.80)	-6.11 *** (-2.77)	-7.96 (-1.43)	-7.94 (-1.42)	-1.69 *** (-2.95)	-1.77 *** (-3.05)	3.64 (0.58)	3.59 (0.57)
MKT_POW	-106.08 ** (-2.08)	-109.90 ** (-2.15)	-255.68 (-1.40)	-259.19 (-1.42)	-107.18 *** (-5.15)	-109.60 *** (-5.21)	-405.71 *** (-6.23)	-406.40 *** (-6.25)
LN_TA	0.09 *** (4.74)	0.09 *** (4.76)	0.35 *** (4.54)	0.36 *** (4.54)	0.08 *** (7.46)	0.08 *** (7.46)	0.28 *** (7.91)	0.28 *** (7.85)
GDP_GWT	-0.01 (-0.02)	-0.05 (-0.11)	-1.40 (-1.15)	-1.44 (-1.18)	0.71 *** (2.92)	0.70 *** (2.85)	-0.07 (-0.11)	-0.08 (-0.13)
CB	1.07 *** (4.60)	1.10 *** (4.70)	2.84 *** (4.35)	2.87 *** (4.43)	0.06 (0.46)	0.06 (0.49)	1.12 *** (2.60)	1.12 *** (2.61)
IBK1M_CB	2.20 (0.45)	2.72 (0.56)	16.39 (0.84)	16.88 (0.87)	4.92 * (1.82)	5.26 ** (1.95)	33.01 *** (2.66)	33.26 *** (2.69)
C	0.90 *** (25.20)	0.88 *** (24.08)	0.76 *** (5.44)	0.75 *** (5.23)	1.04 *** (42.81)	1.03 *** (42.75)	1.31 *** (16.87)	1.31 *** (16.86)
R^2	0.85	0.84	0.69	0.69	0.84	0.84	0.60	0.60
Fisher Stat	13.15	13.00	5.24	5.23	17.37	17.32	5.01	5.01
P-Value F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Obs.	564	564	1352	1352	564	564	1351	1351

This table shows the result of estimating equation (1) for an unbalanced panel of U.S. publicly traded commercial banks, over the 2000–2008 period. Equation (1) is estimated for retail banks according to their size. A bank is considered retail if its ratio of total gross noninterest income to total income is lower than the median of this ratio. A bank is considered large if its total assets exceed US$1 billion. The dependent variable of equations (1.a′) and (1.b′) is the inverse of the Basel III net stable funding ratio (*I_NSFR*). Equations (1.a′) and (1.b′) are the estimations of equation (1) using two proxies of potentially securitizable loans (*PSLO_TLO* and *PSLO_IA*) and the *LTMD_NCDLTMD* as an additional explanatory variable. In addition, equations (1.a′′) and (1.b′′) are estimated by replacing the dependent variable of equations (1.a') and (1.b') with *CFR*. All explanatory variables are one year lagged. See Table 1.5 for the definition and descriptive statistics of the explanatory variables. Cross-section and time fixed effects are included in the regressions, and the Huber-White robust covariance method is used. To deal with colinearity issues in all the regressions, *LN_TA* is orthagonalised with *MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 1.10. The sensitivity of maturity transformation risk according to bank business model and size, considering the importance of core deposits for diversified banks in the United States

	I_NSFR				CFR			
	Large banks		Small banks		Large banks		Small banks	
	1. a'	1. b'	1. a'	1. b'	1. a''	1. b''	1. a''	1. b''
PSLO_TLO	-0.22 *** (-6.63)	-	-0.17 *** (-5.45)	-	-0.28 *** (-4.92)	-	-0.17 *** (-3.69)	-
PSLO_IA	-	-0.24 *** (-6.60)	-	-0.19 *** (-5.58)	-	-0.32 *** (-5.08)	-	-0.20 *** (-3.80)
STMD_STD	0.10 * (1.64)	0.09 * (1.64)	-0.04 (-0.62)	-0.04 (-0.65)	0.20 ** (2.14)	0.20 ** (2.11)	0.06 (0.65)	0.06 (0.67)
LTMD_NCDLTMD	-0.04 * (-1.65)	-0.04 * (-1.71)	-0.01 (-0.29)	-0.01 (-0.37)	-0.12 *** (-2.72)	-0.12 *** (-2.73)	0.005 (0.13)	0.003 (0.08)
T12_TA	-0.98 *** (-3.83)	-0.95 *** (-3.73)	0.09 (0.43)	0.09 (0.41)	-0.89 ** (-2.01)	-0.85 ** (-1.90)	0.10 (0.28)	0.10 (0.27)
ROA	-2.41 ** (-2.28)	-2.41 ** (-2.29)	0.75 (0.61)	0.73 (0.59)	-1.65 (-0.92)	-1.63 (-0.91)	0.75 (0.46)	0.73 (0.44)
LLP_TLO	-4.25 *** (-4.05)	-4.24 *** (-4.04)	-2.09 ** (-2.03)	-2.21 ** (-2.11)	-4.10 *** (-2.82)	-4.09 *** (-2.81)	-0.62 (-0.36)	-0.75 (-0.43)
MKT_POW	2.69 ** (2.11)	2.65 ** (2.08)	-939.63 *** (-4.38)	-942.94 *** (-4.37)	10.46 *** (4.07)	10.30 *** (4.00)	-416.02 *** (-9.17)	-416.41 *** (-9.17)
LN_TA	0.04 *** (2.90)	0.04 *** (2.80)	0.08 *** (3.84)	0.08 *** (3.87)	0.14 *** (4.78)	0.14 *** (4.62)	0.24 *** (7.25)	0.24 *** (7.28)
GDP_GWT	0.11 (0.35)	0.08 (0.25)	0.20 (0.56)	0.17 (0.49)	1.02 * (1.86)	0.98 * (1.80)	0.01 (0.02)	-0.02 (-0.03)
CB	0.31 ** (2.17)	0.33 ** (2.30)	0.51 *** (2.69)	0.52 *** (2.75)	-0.01 (-0.02)	0.02 (0.05)	1.33 *** (4.82)	1.34 *** (4.85)
IBK1M_CB	-1.94 (-0.60)	-1.61 (-0.50)	8.76 *** (2.34)	9.03 *** (2.41)	11.45 * (1.67)	11.72 * (1.72)	12.85 *** (2.48)	12.99 *** (2.51)
C	1.03 *** (19.97)	1.02 *** (19.95)	1.00 *** (28.34)	1.00 *** (28.67)	0.88 *** (9.72)	0.88 *** (9.71)	1.25 *** (21.06)	1.25 *** (21.36)
R^2	0.83	0.83	0.78	0.78	0.65	0.65	0.74	0.74
Fisher Stat	21.22	21.19	10.11	10.09	7.93	7.96	8.07	8.08
P-Value F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Obs.	1164	1164	906	906	1163	1163	905	905

This table shows the result of estimating equation (1) for an unbalanced panel of U.S. publicly traded commercial banks, over the 2000–2008 period. Equation (1) is estimated for diversified banks according to their size. A bank is considered diversified if its ratio of total gross noninterest income to total income is higher than the median of this ratio. A bank is considered large if its total assets exceed US$1 billion. The dependent variable of equations (1.a′) and (1.b′) is the inverse of the Basel III net stable funding ratio (*I_NSFR*). Equations (1.a′) and (1.b′) are the estimations of equation (1) using two proxies of potentially securitizable loans (*PSLO_TLO* and *PSLO_IA*) and the *LTMD_NCDLTMD* as an additional explanatory variable. In addition, equations (1.a″) and (1.b″) are estimated by replacing the dependent variable of equations (1.a′) and (1.b′) with *CFR*. All explanatory variables are one year lagged. See Table 1.5 for the definition and descriptive statistics of the explanatory variables. Cross-section and time fixed effects are included in the regressions, and the Huber-White robust covariance method is used. To deal with colinearity issues in all the regressions, *LN_TA* is orthagonalised with *MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

In the baseline of the estimations with both definitions of the dependent variable, the results are consistent with those previously obtained for the variables *PSLO_TLO*, *PSLO_IA* and *STMD_STD* for large and small banks according to their business model. However, the coefficient of the variable *LTMD_NCDLTMD* becomes not significant for large and small retail banks and for small diversified banks with *I_NSFR* variable as the dependent variable.

In addition, the coefficient of the variable *LTMD_NCDLTMD* becomes not significant for small diversified banks with *CFR* variable as the dependent variable.

1.4.4.2. Robustness checks

Several robustness checks were performed. Appendix 1.C shows the regression results.

The robustness of the results is checked by considering two other criteria defining a retail bank. First, a bank is considered retail (diversified) if its ratio of total gross noninterest income to total income is lower (higher) than the mean instead of the median of this ratio. Second, a bank is considered retail (diversified) if its ratio of total gross noninterest income to total income is lower (higher) than percentile 0.33 (0.66). As for the median, because U.S. and European banks have very different profiles of noninterest income, the mean and the percentile values of the ratio are calculated on each subsample of banks. Thus, equations (1.a) and (1.b) are estimated separately for U.S. and European banks using these two criteria to separate banks according to their business model (see Table 1.C.1 and Table 1.C.2). In all cases, the results are consistent with those previously obtained.

A specification related robustness check is performed by considering an alternative definition of the dependent variable (i.e., the *I_NSFR* variable). The weight of 0.7 for demand and saving deposits is changed considering three other weights: 0.5 (*I_NSFR_D05*), 0.85 (*I_NSFR_D085*) and 1 (*I_NSFR_D1*)[39]. The aim is to determine whether the results are affected by the extent of stable deposits. Thus, equations (1.a) and (1.b) are estimated separately for U.S. and European banks according to their business model and using *I_NSFR_D05, I_NSFR_D085* or *I_NSFR_D1* as the dependent variable (see Table 1.C.3, Table 1.C.4 and Table 1.C.5). In addition, equations (1.a′) and (1.b′) separately for U.S. banks using the three alternative specifications of the *I_NSFR* variable and including the *LTMD_NCDLTMD* variable (i.e., the ratio of long-term market debts to total long-term market debts and noncore time deposits) in the set of the explanatory variables (see Table 1.C.6). The results are consistent with those previously obtained and confirm the main conclusions for the sensitivity of bank maturity transformation risk to the importance of the

39 As detailed in section 1.2.1.1, a weight of 0.5 is used because it is the minimum weight set by the Basel Committee on Banking Regulation and Supervision for stable demand and saving deposits. Then, 0.85 is considered because it is the maximum weight set by the Basel Committee on Banking Regulation and Supervision for stable demand and saving deposits. Finally, 1 is considered by assuming that all demand and saving deposits are stable. Explicit deposit insurance systems and implicit government guarantee of deposits mitigate the risk of a run on deposits and strengthen their stability.

potentially securitizable loans, of short-term, potentially unstable market debts and of long-term, stable market debts for U.S. banks.

1.5. Concluding remarks

Through their essential role of liquidity creation, banks face transformation risk and are potentially fragile. This chapter reviews the existing literature on the measures of bank liquidity creation and maturity transformation risk. Then, stylized facts focus on the importance of banks' liquidity creation and exposure to maturity transformation risk according to their business model. The chapter investigates the impact of the differences in terms of scope of activities, funding and investment strategies on banks' role of liquidity provision and on the extent of their exposure to maturity transformation risk. Finally, the sensitivity of bank maturity transformation risk to several factors according to the orientation of bank activities is discussed. Beyond the bank-level indicators and macroeconomic variables identified in previous literature, this study considers the impact of bank access to additional sources of liquidity focusing on the importance of potentially securitizable loans and of short-term, potentially unstable market debts. The main purpose is to emphasize the strengths and weaknesses of banks according to the orientation of their activities for the management of maturity transformation risk.

Using listed commercial U.S. and European banks separately over the 2000–2008 period, the results show that European banks perform higher levels of liquidity creation and face much higher exposure to maturity transformation risk than do U.S. banks. In addition, large U.S. banks perform higher levels of liquidity creation and face much greater exposure to maturity transformation risk than do small U.S. banks. Thus, similar results are obtained for large U.S. banks and European banks. On the whole, banks' business models do not explain the differences in liquidity creation and maturity transformation risk profile; the banks' size does. Indeed, small banks benefit from the stability of their large deposit base and face a lower exposure to maturity transformation risk. European and large U.S. banks are more involved in debt markets and are more funded by volatile market funding, thus facing a higher exposure to maturity transformation risk.

In addition, the results show that the loan securitization is crucial in maturity transformation risk management for all types of U.S. banks. This result might be explained by noting that securitization markets are much more developed in the United States than in Europe. In addition, because European banks are universal, compared with U.S. banks, which are more focused on retail activities, European banks might access to additional sources of liquidity provided by other activities than loan activities. Therefore, loan securitization might not be a key component of the liquidity management framework for European banks, which can manage their maturity transformation risk by accessing to additional sources of liquidity. Conversely, loan securitization might be essential for U.S. banks, which could benefit from the greater liquidity of their loan portfolio to decrease their exposure to maturity transformation risk.

In addition, the results show that European banks and large U.S. banks are widely penalized by the potential instability of their short-term market funding. This may be because European banks and large U.S. banks are more involved in debt markets than are small U.S. banks. Thus, small banks might benefit from the stability of their large deposit base to match structural unbalances with their long-term loans. The small deposit base of European banks and large U.S. banks does not provide a sufficient cushion of stable funding to mitigate their exposure to maturity transformation risk.

These findings raise numerous challenges for banks to modify their business strategies, specifically European and large U.S. banks. These findings support the need to improve funding stability, as the Basel Committee (2009a) stresses. However, some of the ways banks could increase their stable funding base might raise concerns about the possible emergence of destructive competition for stable deposits and the widespread increase of the proportion of long-term market debts. In addition, these findings raise questions about the necessity and method of including funding collected through life insurance and mutual fund shares activities on the balance sheets. Moreover, these findings also indicate that market funding insurance systems should be implemented to improve banks' stability and mitigate their exposure to maturity transformation risk. Finally, these findings raise questions regarding the implementation of uniform liquidity requirements to all types of banks (i.e., if US banks have a broader access to securitization markets than European banks or if European banks and large US banks are widely sensitive to the instability of their market funding).

APPENDIX 1.A. Typical haircuts or initial margins on collateral of asset backed securities (IMF, 2008)

Table 1.A.1. Typical haircuts or initial margins on collateral of asset backed securities

Type of collateral		January - May 2007	April 2008
US Treasuries		0.25	3
Investment grade bonds		0 - 3	8 - 12
High yield bonds		10 - 15	25 - 40
Equities		15	20
Investment grade CDS		1	5
Synthetic super senior		1	2
Senior leveraged loans		10 - 12	15 - 20
Second lien leveraged loans		15 - 20	25 - 35
Mezzanine level loans		18 - 25	35+
ABS CDOs - CMBS:			
	AAA	2 - 4	15
	AA	4 - 7	20
	A	8 - 15	30 - 50
	BBB	10 - 20	40 - 70
	Equity	50	100
AAA CLO		4	10 - 20
AAA RMBS		2 - 4	10 - 20
Alt-a MBS		3 - 5	20 - 50

Source: Citigroup, IMF staff estimates (2008). Typical haircuts are expressed in percentage. *ABS:* asset backed securities; *CDO:* collateralized debt obligation; *CDS:* credit default swap; *CLO:* collateralized debt obligation; *CMBS:* commercial mortgage backed securities; *RMBS:* residential mortgage backed securities; *MBS:* mortgage backed securities.

APPENDIX 1.B. Correlation analysis of the determinants of bank maturity transformation risk

Table 1.B.1. Correlations among the main determinants of bank maturity transformation risk for retail U.S. banks from 2000 to 2008

	PSLO_TLO	PSLO_IA	STMD_STD	T12_TA	ROA	LLP_TLO	MKT_POW	LN_TA	GDP_GWT	CB	IBK1M_CB
PSLO_TLO	1										
PSLO_IA	0.98 *0.00*	1									
STMD_STD	-0.05 *0.03*	-0.03 *0.11*	1								
T12_TA	0.09 *0.00*	0.06 *0.00*	-0.10 *0.00*	1							
ROA	0.08 *0.00*	0.07 *0.00*	-0.04 *0.09*	-0.20 *0.00*	1						
LLP_TLO	-0.13 *0.00*	-0.11 *0.00*	0.06 *0.00*	0.03 *0.20*	-0.51 *0.00*	1					
MKT_POW	-0.10 *0.00*	-0.10 *0.00*	0.19 *0.00*	-0.05 *0.01*	0.04 *0.08*	0.05 *0.01*	1				
LN_TA	-0.14 *0.00*	-0.14 *0.00*	0.27 *0.00*	-0.26 *0.00*	0.14 *0.00*	0.02 *0.26*	0.73 *0.00*	1			
GDP_GWT	0.09 *0.00*	0.08 *0.00*	-0.05 *0.02*	0.06 *0.00*	0.25 *0.00*	-0.32 *0.00*	-0.06 *0.01*	-0.10 *0.00*	1		
CB	0.03 *0.10*	0.03 *0.10*	0.01 *0.51*	0.07 *0.00*	0.15 *0.00*	-0.22 *0.00*	0.00 *0.90*	-0.03 *0.16*	0.69 *0.00*	1	
IBK1M_CB	-0.14 *0.00*	-0.13 *0.00*	0.09 *0.00*	-0.05 *0.03*	-0.14 *0.00*	0.14 *0.00*	0.03 *0.14*	0.09 *0.00*	-0.41 *0.00*	-0.15 *0.00*	1

Source: Bloomberg (2000–2008), World Bank's 2007 Regulation and Supervisory Database. A bank is considered retail if its ratio of total gross noninterest income to total income is lower than the median of this ratio. All variables are expressed in percentage, except *LN_TA* and *CONTROL*. *PSLO_TLO*: consumer loans / total loans; *PSLO_IA*: consumer loans / (total loans + long-term investments + customer acceptances + fixed assets + other assets); *STMD_STDBT*: short-term market debts / (demand and saving deposits + short-term market debts); *T12_TA:* (Tier 1 capital + Tier 2 capital) / total assets; *ROA:* net income / total assets; *LLP_TLO:* loan loss provisions / total loans; *MKT_POW:* total assets of bank *i* in country *j* / total assets of the banking system in country *j*; *LN_TA:* natural logarithm of total assets; *GDP_GWT:* annual growth rate of real GDP; *CB*: central bank's policy rate; *IBK1M_CB:* spread of one-month interbank rate and central bank's policy rate.

Table 1.B.2. Correlations among the main determinants of bank maturity transformation risk for diversified U.S. banks from 2000 to 2008

	PSLO_TLO	PSLO_IA	STMD_STD	T12_TA	ROA	LLP_TLO	MKT_POW	LN_TA	GDP_GWT	CB	IBK1M_CB
PSLO_TLO	1										
PSLO_IA	0.98	1									
	0.00										
STMD_STD	-0.10	-0.12	1								
	0.00	*0.00*									
T12_TA	0.01	0.02	-0.13	1							
	0.54	*0.28*	*0.00*								
ROA	0.07	0.07	0.02	0.20	1						
	0.00	*0.00*	*0.32*	*0.00*							
LLP_TLO	-0.14	-0.14	0.09	0.02	-0.37	1					
	0.00	*0.00*	*0.00*	*0.24*	*0.00*						
MKT_POW	-0.02	-0.06	0.43	-0.07	0.02	0.16	1				
	0.45	*0.01*	*0.00*	*0.00*	*0.30*	*0.00*					
LN_TA	-0.12	-0.17	0.52	-0.11	0.11	0.14	0.54	1			
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*				
GDP_GWT	0.07	0.06	0.00	0.02	0.27	-0.36	0.01	-0.01	1		
	0.00	*0.00*	*0.98*	*0.47*	*0.00*	*0.00*	*0.72*	*0.75*			
CB	0.02	0.01	0.08	-0.01	0.14	-0.27	0.04	0.06	0.61	1	
	0.35	*0.52*	*0.00*	*0.59*	*0.00*	*0.00*	*0.08*	*0.01*	*0.00*		
IBK1M_CB	-0.09	-0.09	0.03	-0.05	-0.13	0.07	0.00	0.03	-0.35	-0.02	1
	0.00	*0.00*	*0.11*	*0.01*	*0.00*	*0.00*	*0.83*	*0.18*	*0.00*	*0.30*	

Source: Bloomberg (2000–2008), World Bank's 2007 Regulation and Supervisory Database. A bank is considered diversified if its ratio of total gross noninterest income to total income is higher than the median of this ratio. All variables are expressed in percentage, except *LN_TA* and *CONTROL*. *PSLO_TLO*: consumer loans / total loans; *PSLO_IA*: consumer loans / (total loans + long-term investments + customer acceptances + fixed assets + other assets); *STMD_STDBT*: short-term market debts / (demand and saving deposits + short-term market debts); *T12_TA:* (Tier 1 capital + Tier 2 capital) / total assets; *ROA:* net income / total assets; *LLP_TLO:* loan loss provisions / total loans; *MKT_POW:* total assets of bank *i* in country *j* / total assets of the banking system in country *j*; *LN_TA:* natural logarithm of total assets; *GDP_GWT:* annual growth rate of real GDP; *CB*: central bank's policy rate; *IBK1M_CB:* spread of one-month interbank rate and central bank's policy rate.

Table 1.B.3. Correlations among the main determinants of bank maturity transformation risk for retail European banks from 2000 to 2008

	PSLO_TLO	PSLO_IA	STMD_STD	T12_TA	ROA	LLP_TLO	MKT_POW	LN_TA	GDP_GWT	CB	IBK1M_CB	CONTROL
PSLO_TLO	1											
PSLO_IA	0.97	1										
	0.00											
STMD_STD	-0.32	-0.34	1									
	0.00	*0.00*										
T12_TA	0.06	0.10	-0.29	1								
	0.07	*0.00*	*0.00*									
ROA	0.06	0.09	-0.15	0.49	1							
	0.06	*0.01*	*0.00*	*0.00*								
LLP_TLO	-0.19	-0.21	0.02	0.02	-0.38	1						
	0.00	*0.00*	*0.63*	*0.62*	*0.00*							
MKT_POW	-0.24	-0.28	0.34	-0.27	-0.08	-0.06	1					
	0.00	*0.00*	*0.00*	*0.00*	*0.02*	*0.07*						
LN_TA	-0.25	-0.31	0.53	-0.57	-0.25	-0.10	0.51	1				
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.01*	*0.00*					
GDP_GWT	-0.12	-0.11	0.00	-0.06	0.21	-0.17	0.12	0.06	1			
	0.00	*0.00*	*0.98*	*0.07*	*0.00*	*0.00*	*0.00*	*0.09*				
CB	0.01	0.05	0.12	0.15	0.14	-0.07	0.11	-0.18	0.21	1		
	0.73	*0.17*	*0.00*	*0.00*	*0.00*	*0.05*	*0.00*	*0.00*	*0.00*			
IBK1M_CB	0.03	0.04	0.05	-0.05	-0.11	0.03	0.08	-0.03	-0.06	0.30	1	
	0.46	*0.21*	*0.16*	*0.12*	*0.00*	*0.32*	*0.01*	*0.32*	*0.08*	*0.00*		
CONTROL	0.26	0.28	-0.29	0.15	-0.03	-0.04	-0.01	-0.30	-0.20	0.24	0.12	1
	0.00	*0.00*	*0.00*	*0.00*	*0.31*	*0.27*	*0.79*	*0.00*	*0.00*	*0.00*	*0.00*	

Source: Bloomberg (2000–2008), World Bank's 2007 Regulation and Supervisory Database. A bank is considered retail if its ratio of total gross noninterest income to total income is lower than the median of this ratio. All variables are expressed in percentage, except *LN_TA* and *CONTROL*. *PSLO_TLO*: consumer loans / total loans; *PSLO_IA*: consumer loans / (total loans + long-term investments + customer acceptances + fixed assets + other assets); *STMD_STDBT*: short-term market debts / (demand and saving deposits + short-term market debts); *T12_TA:* (Tier 1 capital + Tier 2 capital) / total assets; *ROA:* net income / total assets; *LLP_TLO:* loan loss provisions / total loans; *MKT_POW:* total assets of bank *i* in country *j* / total assets of the banking system in country *j*; *LN_TA:* natural logarithm of total assets; *GDP_GWT:* annual growth rate of real GDP; *CB*: central bank's policy rate; *IBK1M_CB:* spread of one-month interbank rate and central bank's policy rate; *CONTROL*: index of supervisory regime.

Table 1.B.4. Correlations among the main determinants of bank maturity transformation risk for diversified European banks from 2000 to 2008

	PSLO_TLO	PSLO_IA	STMD_STD	T12_TA	ROA	LLP_TLO	MKT_POW	LN_TA	GDP_GWT	CB	IBK1M_CB	CONTROL
PSLO_TLO	1											
PSLO_IA	0.94	1										
	0.00											
STMD_STD	-0.30	-0.36	1									
	0.00	*0.00*										
T12_TA	0.07	0.15	-0.27	1								
	0.06	*0.00*	*0.00*									
ROA	0.11	0.18	-0.27	0.50	1							
	0.00	*0.00*	*0.00*	*0.00*								
LLP_TLO	0.01	-0.02	-0.12	-0.05	-0.13	1						
	0.70	*0.50*	*0.00*	*0.15*	*0.00*							
MKT_POW	-0.17	-0.26	0.26	-0.32	-0.12	-0.07	1					
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.03*						
LN_TA	-0.17	-0.31	0.55	-0.56	-0.42	-0.06	0.56	1				
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.10*	*0.00*					
GDP_GWT	-0.05	-0.02	-0.06	0.01	0.19	-0.18	0.15	0.02	1			
	0.12	*0.48*	*0.07*	*0.66*	*0.00*	*0.00*	*0.00*	*0.60*				
CB	-0.12	-0.08	0.04	-0.10	0.09	-0.04	0.18	0.07	0.48	1		
	0.00	*0.01*	*0.19*	*0.00*	*0.01*	*0.28*	*0.00*	*0.05*	*0.00*			
IBK1M_CB	0.04	0.03	-0.02	-0.10	0.00	0.09	0.05	0.04	0.12	0.25	1	
	0.23	*0.37*	*0.65*	*0.01*	*0.91*	*0.01*	*0.11*	*0.29*	*0.00*	*0.00*		
CONTROL	0.15	0.21	-0.22	0.24	0.04	-0.04	-0.16	-0.26	-0.21	-0.05	-0.01	1
	0.00	*0.00*	*0.00*	*0.00*	*0.24*	*0.25*	*0.00*	*0.00*	*0.00*	*0.11*	*0.78*	

Source: Bloomberg (2000–2008), World Bank's 2007 Regulation and Supervisory Database. A bank is considered diversified if its ratio of total gross noninterest income to total income is higher than the median of this ratio. All variables are expressed in percentage, except *LN_TA* and *CONTROL*. *PSLO_TLO*: consumer loans / total loans; *PSLO_IA*: consumer loans / (total loans + long-term investments + customer acceptances + fixed assets + other assets); *STMD_STDBT*: short-term market debts / (demand and saving deposits + short-term market debts); *T12_TA:* (Tier 1 capital + Tier 2 capital) / total assets; *ROA:* net income / total assets; *LLP_TLO:* loan loss provisions / total loans; *MKT_POW:* total assets of bank *i* in country *j* / total assets of the banking system in country *j*; *LN_TA:* natural logarithm of total assets; *GDP_GWT:* annual growth rate of real GDP; *CB*: central bank's policy rate; *IBK1M_CB:* spread of one-month interbank rate and central bank's policy rate; *CONTROL*: index of supervisory regime.

APPENDIX 1.C. Regression results of the robustness checks

Table 1.C.1. The sensitivity of maturity transformation risk using the average value of the noninterest income ratio as a cutoff to separate banks by their business model

	U.S. banks				European banks			
	Retail banks		Diversified banks		Retail banks		Diversified banks	
	1. a	1. b	1. a	1. b	1. a	1. b	1. a	1. b
PSLO_TLO	-0.18 *** (-9.36)	-	-0.20 *** (-8.21)	-	-0.18 (-1.42)	-	0.29 * (1.67)	-
PSLO_IA	-	-0.18 *** (-8.96)	-	-0.22 *** (-8.18)	-	-0.20 * (-1.73)	-	0.27 (0.99)
STMD_STD	0.04 (0.97)	0.04 (0.98)	-0.01 (-0.13)	-0.01 (-0.17)	0.37 *** (4.08)	0.37 *** (4.07)	0.50 *** (3.88)	0.51 *** (3.97)
T12_TA	0.02 (0.27)	0.02 (0.20)	-0.08 (-0.50)	-0.08 (-0.50)	0.56 (1.51)	0.53 (1.44)	-0.20 (-0.62)	-0.16 (-0.49)
ROA	-0.34 (-1.09)	-0.31 (-1.02)	-1.11 (-1.17)	-1.11 (-1.16)	-0.86 (-0.54)	-0.92 (-0.58)	0.34 (0.25)	0.39 (0.29)
LLP_TLO	-2.11 *** (-3.91)	-2.17 *** (-4.01)	-3.19 *** (-4.55)	-3.24 *** (-4.58)	-3.19 *** (-2.76)	-3.15 *** (-2.71)	-2.19 (-1.34)	-2.08 (-1.22)
MKT_POW	-102.12 *** (-2.63)	-104.88 *** (-2.69)	2.72 *** (2.44)	2.66 *** (2.41)	0.58 (0.62)	0.60 (0.65)	-0.09 (-0.12)	-0.13 (-0.18)
LN_TA	0.06 *** (8.47)	0.06 *** (8.50)	0.04 *** (3.41)	0.04 *** (3.31)	0.07 (0.73)	0.08 (0.74)	0.07 (1.28)	0.06 (1.13)
GDP_GWT	0.65 *** (3.06)	0.63 *** (2.98)	0.49 ** (2.11)	0.46 ** (1.99)	-0.26 (-0.39)	-0.29 (-0.44)	0.58 (0.48)	0.63 (0.50)
CB	0.21 ** (2.04)	0.22 ** (2.09)	0.27 *** (2.42)	0.28 *** (2.50)	3.05 *** (3.14)	3.04 *** (3.15)	2.16 (1.28)	2.10 (1.17)
IBK1M_CB	4.18 ** (1.93)	4.62 ** (2.13)	6.25 *** (2.39)	6.50 *** (2.48)	0.69 (0.59)	0.66 (0.57)	0.41 (0.20)	0.60 (0.27)
CONTROL	-	-	-	-	0.01 (0.31)	0.01 (0.23)	-0.01 (-0.16)	0.004 (0.07)
C	0.97 *** (61.08)	0.96 *** (62.08)	0.93 *** (32.99)	0.92 *** (32.86)	0.79 ** (2.06)	0.82 ** (2.09)	0.65 (1.22)	0.56 (1.03)
R^2	0.83	0.83	0.80	0.80	0.65	0.65	0.77	0.76
Fisher Stat	20.11	19.93	15.88	15.90	6.56	6.57	10.14	10.11
P-Value F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Obs.	2283	2283	1719	1719	836	836	675	675

This table shows the result of estimating equation (1) for an unbalanced panel of U.S. and European publicly traded commercial banks over the 2000–2008 period. Equation (1) is estimated separately for retail and diversified banks. A bank is considered retail (diversified) if its ratio of total gross noninterest income to total income is lower (higher) than the mean of this ratio. Because U.S. and European banks have very different profiles of noninterest income, the mean of this ratio is calculated separately for U.S. and European banks. The dependent variable of equation (1) is the inverse of the Basel III net stable funding ratio (*I_NSFR*). Equations (1.a) and (1.b) are the estimations of equation (1) using two proxies of potentially securitizable loans (*PSLO_TLO* and *PSLO_IA*). All explanatory variables are one year lagged. See Table 1.5 for the definition and descriptive statistics of the explanatory variables. Cross-section and time fixed effects are included in the regressions, and the Huber-White robust covariance method is used.To deal with colinearity issues in all the regressions, *LN_TA* is orthogonalised with *MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 1.C.2. The sensitivity of maturity transformation risk using percentiles 0.33 and 0.66 for noninterest income ratio as a cutoff to separate banks by their business model

	U.S. banks				European banks			
	Retail banks		Diversified banks		Retail banks		Diversified banks	
	1. a	1. b	1. a	1. b	1. a	1. b	1. a	1. b
PSLO_TLO	-0.17 *** (-5.95)	-	-0.17 *** (-6.64)	-	-0.06 (-0.39)	-	0.30 (1.44)	-
PSLO_IA	-	-0.17 *** (-5.60)	-	-0.19 *** (-6.59)	-	-0.13 (-0.89)	-	0.23 (0.67)
STMD_STD	-0.04 (-0.91)	-0.04 (-0.91)	-0.001 (-0.03)	-0.01 (-0.13)	0.23 ** (1.71)	0.23 ** (1.71)	0.37 ** (2.29)	0.39 *** (2.43)
T12_TA	0.13 (0.98)	0.13 (0.96)	-0.38 ** (-2.13)	-0.38 ** (-2.15)	1.04 * (1.71)	1.00 * (1.63)	0.09 (0.25)	0.14 (0.37)
ROA	0.005 (0.01)	0.01 (0.02)	-0.41 (-0.38)	-0.41 (-0.37)	-1.74 (-0.76)	-1.77 (-0.77)	0.40 (0.27)	0.39 (0.27)
LLP_TLO	-1.69 *** (-2.36)	-1.78 *** (-2.47)	-2.86 *** (-3.81)	-2.90 *** (-3.84)	-2.54 (-1.49)	-2.46 (-1.43)	-1.66 (-0.82)	-1.48 (-0.69)
MKT_POW	-73.36 (-0.91)	-79.43 (-1.00)	3.31 *** (2.61)	3.24 *** (2.55)	0.65 (0.50)	0.69 (0.52)	-0.29 (-0.42)	-0.21 (-0.29)
LN_TA	0.07 *** (6.23)	0.07 *** (6.29)	0.05 *** (3.56)	0.05 *** (3.42)	0.05 (0.34)	0.05 (0.33)	0.05 (0.74)	0.04 (0.55)
GDP_GWT	0.72 *** (2.44)	0.69 *** (2.33)	0.44 * (1.66)	0.41 (1.56)	-0.84 (-0.93)	-0.85 (-0.94)	-0.26 (-0.16)	-0.29 (-0.17)
CB	0.14 (0.96)	0.16 (1.08)	0.33 *** (2.65)	0.34 *** (2.69)	2.51 ** (2.30)	2.44 ** (2.25)	0.99 (0.41)	0.87 (0.33)
IBK1M_CB	1.94 (0.62)	2.48 (0.79)	6.93 *** (2.40)	7.11 *** (2.46)	1.97 (1.46)	2.00 (1.48)	0.53 (0.19)	0.94 (0.31)
CONTROL	-	-	-	-	0.04 (0.60)	0.04 (0.54)	-0.03 (-0.31)	-0.02 (-0.25)
C	0.97 *** (45.51)	0.97 *** (46.00)	0.91 *** (27.13)	0.91 *** (26.92)	0.53 (0.73)	0.60 (0.82)	0.86 (1.17)	0.85 (1.16)
R^2	0.83	0.83	0.81	0.81	0.71	0.71	0.78	0.78
Fisher Stat	14.85	14.72	15.20	15.22	5.16	5.17	9.09	9.04
P-Value F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Obs.	1241	1241	1423	1423	500	500	507	507

This table shows the result of estimating equation (1) for an unbalanced panel of U.S. and European publicly traded commercial banks over the 2000–2008 period. Equation (1) is estimated separately for retail and diversified banks. A bank is considered retail if its ratio of total gross noninterest income to total income is lower than percentile 0.33. A bank is considered diversified if its ratio of total gross noninterest income to total income is higher than percentile 0.66. Because U.S. and European banks have very different profiles of noninterest income, the percentile values are calculated separately for U.S. and European banks. The dependent variable of equation (1) is the inverse of the Basel III net stable funding ratio (*I_NSFR*). Equations (1.a) and (1.b) are the estimations of equation (1) using two proxies of potentially securitizable loans (*PSLO_TLO* and *PSLO_IA*). All explanatory variables are one year lagged. See Table 1.5 for the definition and descriptive statistics of the explanatory variables. Cross-section and time fixed effects are included in the regressions, and the Huber-White robust covariance method is used. To deal with colinearity issues in all the regressions, *LN_TA* is orthagonalised with *MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 1.C.3. The sensitivity of maturity transformation risk according to bank business model, using an alternative weight of 0.5 for stable deposits in the inverse of the net stable funding ratio

	U.S. banks				European banks			
	Retail banks		Diversified banks		Retail banks		Diversified banks	
	1. a	1. b	1. a	1. b	1. a	1. b	1. a	1. b
PSLO_TLO	-0.21 *** (-8.14)	-	-0.24 *** (-9.01)	-	-0.13 (-0.85)	-	0.28 (1.61)	-
PSLO_IA	-	-0.21 *** (-7.74)	-	-0.27 *** (-8.92)	-	-0.17 (-1.13)	-	0.27 (1.02)
STMD_STD	-0.05 (-1.16)	-0.05 (-1.14)	0.02 (0.34)	0.02 (0.32)	0.35 *** (2.96)	0.35 *** (2.96)	0.55 *** (4.29)	0.55 *** (4.37)
T12_TA	0.06 (0.52)	0.05 (0.45)	-0.27 (-1.38)	-0.27 (-1.36)	0.78 (1.60)	0.76 (1.55)	-0.23 (-0.65)	-0.19 (-0.55)
ROA	-0.39 (-1.01)	-0.36 (-0.96)	-1.25 (-1.41)	-1.29 (-1.45)	-0.95 (-0.51)	-1.00 (-0.53)	0.18 (0.11)	0.22 (0.14)
LLP_TLO	-2.72 *** (-3.44)	-2.80 *** (-3.54)	-4.20 *** (-5.02)	-4.28 *** (-5.06)	-4.09 *** (-2.69)	-4.04 *** (-2.66)	-1.57 (-0.86)	-1.48 (-0.78)
MKT_POW	-84.54 * (-1.60)	-87.94 * (-1.66)	1.92 (1.52)	1.90 (1.52)	0.63 (0.55)	0.65 (0.57)	-0.40 (-0.52)	-0.43 (-0.57)
LN_TA	0.06 *** (5.62)	0.06 *** (5.63)	0.04 *** (2.55)	0.04 *** (2.48)	0.08 (0.65)	0.08 (0.65)	0.05 (0.87)	0.05 (0.76)
GDP_GWT	1.11 *** (4.19)	1.09 *** (4.10)	0.64 ** (2.31)	0.60 ** (2.19)	-0.20 (-0.24)	-0.23 (-0.27)	0.20 (0.18)	0.27 (0.23)
CB	-0.22 * (-1.66)	-0.21 (-1.59)	0.05 (0.40)	0.07 (0.52)	4.23 *** (3.37)	4.22 *** (3.36)	1.97 (1.19)	1.93 (1.13)
IBK1M_CB	1.47 (0.50)	1.96 (0.67)	4.16 (1.36)	4.45 (1.45)	0.56 (0.36)	0.55 (0.36)	0.42 (0.19)	0.61 (0.26)
CONTROL	-	-	-	-	0.03 (0.52)	0.02 (0.46)	0.01 (0.21)	0.03 (0.45)
C	1.09 *** (53.43)	1.09 *** (53.82)	1.10 *** (37.91)	1.09 *** (37.66)	0.72 (1.48)	0.76 (1.53)	0.60 (1.10)	0.50 (0.91)
R^2	0.82	0.82	0.80	0.80	0.65	0.65	0.75	0.75
Fisher Stat	16.95	16.84	16.72	16.70	5.99	6.00	9.51	9.49
P-Value F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Obs.	1921	1921	2081	2081	764	764	747	747

This table shows the result of estimating equation (1) for an unbalanced panel of U.S. and European publicly traded commercial banks over the 2000–2008 period. Equation (1) is estimated separately for retail and diversified banks. A bank is considered retail (diversified) if its ratio of total gross noninterest income to total income is lower (higher) than the median of this ratio. Because U.S. and European banks have different profiles of noninterest income, the median of this ratio is calculated separately for U.S. and European banks. The dependent variable of equation (1) is an alternative specification of the inverse of the net stable funding ratio (*I_NSFR*) by replacing the weight of 0.7 with 0.5 for demand and saving deposits (*I_NSFR_D05*). Equations (1.a) and (1.b) are the estimations of equation (1) using two proxies of potentially securitizable loans (*PSLO_TLO* and *PSLO_IA*). All explanatory variables are one year lagged. See Table 1.5 for the definition and descriptive statistics of the explanatory variables. Cross-section and time fixed effects are included in the regressions, and the Huber-White robust covariance method is used. To deal with colinearity issues in all the regressions, *LN_TA* is orthogonalised with *MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 1.C.4. The sensitivity of maturity transformation risk according to bank business model using an alternative weight of 0.85 for stable deposits in the inverse of the net stable funding ratio

	U.S. banks				European banks			
	Retail banks		Diversified banks		Retail banks		Diversified banks	
	1. a	1. b	1. a	1. b	1. a	1. b	1. a	1. b
PSLO_TLO	-0.16 *** (-8.30)	-	-0.19 *** (-9.40)	-	-0.12 (-1.04)	-	0.14 (0.98)	-
PSLO_IA	-	-0.17 *** (-7.87)	-	-0.21 *** (-9.33)	-	-0.14 (-1.34)	-	0.11 (0.49)
STMD_STD	0.01 (0.41)	0.01 (0.42)	0.05 (1.26)	0.05 (1.26)	0.34 *** (3.60)	0.34 *** (3.60)	0.48 *** (4.88)	0.49 *** (4.93)
T12_TA	0.11 (1.27)	0.10 (1.21)	-0.14 (-0.86)	-0.14 (-0.84)	0.55 (1.49)	0.53 (1.43)	-0.08 (-0.30)	-0.06 (-0.21)
ROA	-0.12 (-0.43)	-0.09 (-0.34)	-1.14 * (-1.60)	-1.17 * (-1.65)	-1.16 (-0.79)	-1.20 (-0.81)	-0.26 (-0.20)	-0.24 (-0.18)
LLP_TLO	-1.91 *** (-3.42)	-1.97 *** (-3.51)	-3.17 *** (-4.80)	-3.23 *** (-4.85)	-2.96 *** (-2.57)	-2.92 *** (-2.53)	-1.62 (-1.15)	-1.55 (-1.05)
MKT_POW	-65.38 * (-1.60)	-68.17 * (-1.67)	3.60 *** (3.70)	3.58 *** (3.72)	0.76 (0.81)	0.78 (0.83)	-0.19 (-0.30)	-0.21 (-0.33)
LN_TA	0.06 *** (8.73)	0.06 *** (8.78)	0.05 *** (4.92)	0.05 *** (4.85)	0.09 (0.90)	0.09 (0.90)	0.05 (1.04)	0.05 (0.96)
GDP_GWT	0.49 *** (2.50)	0.47 *** (2.41)	0.26 (1.30)	0.23 (1.16)	-0.13 (-0.20)	-0.15 (-0.23)	0.29 (0.32)	0.30 (0.31)
CB	0.37 *** (3.78)	0.38 *** (3.85)	0.46 *** (4.90)	0.47 *** (5.02)	3.13 *** (3.41)	3.12 *** (3.40)	0.64 (0.45)	0.60 (0.41)
IBK1M_CB	5.66 *** (2.69)	6.08 *** (2.88)	5.30 *** (2.35)	5.52 *** (2.45)	1.16 (0.98)	1.15 (0.97)	0.99 (0.54)	1.12 (0.57)
CONTROL	-	-	-	-	-0.001 (-0.02)	-0.003 (-0.08)	0.01 (0.14)	0.02 (0.30)
C	0.88 *** (55.30)	0.88 *** (55.84)	0.86 *** (37.55)	0.85 *** (37.47)	0.82 ** (2.19)	0.85 ** (2.22)	0.58 (1.24)	0.53 (1.14)
R^2	0.83	0.83	0.81	0.81	0.67	0.67	0.78	0.77
Fisher Stat	18.23	18.07	17.65	17.63	6.68	6.69	11.09	11.07
P-Value F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Obs.	1921	1921	2081	2081	764	764	747	747

This table shows the result of estimating equation (1) for an unbalanced panel of U.S. and European publicly traded commercial banks, over the 2000–2008 period. Equation (1) is estimated separately for retail and diversified banks. A bank is considered retail (diversified) if its ratio of total gross noninterest income to total income is lower (higher) than the median of this ratio. Because U.S. and European banks have different profiles of noninterest income, the median of this ratio is calculated separately for U.S. and European banks. The dependent variable of equation (1) is an alternative specification of the inverse of the net stable funding ratio (*I_NSFR*) by replacing the weight of 0.7 with 0.85 for demand and saving deposits (*I_NSFR_D085*). Equations (1.a) and (1.b) are the estimations of equation (1) using alternately two proxies of potentially securitizable loans (*PSLO_TLO* and *PSLO_IA*). All explanatory variables are one year lagged. See Table 1.5 for the definition and descriptive statistics of the explanatory variables. Cross-section and time fixed effects are included in the regressions, and the Huber-White robust covariance method is used. To deal with colinearity issues in all the regressions, *LN_TA* is orthogonalised with *MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 1.C.5. The sensitivity of maturity transformation risk according to bank business model, using an alternative weight of 1 for stable deposits in the inverse of the net stable funding ratio

	U.S. banks				European banks			
	Retail banks		Diversified banks		Retail banks		Diversified banks	
	1. a	1. b	1. a	1. b	1. a	1. b	1. a	1. b
PSLO_TLO	-0.15 *** (-8.19)	-	-0.18 *** (-9.35)	-	-0.11 (-1.06)	-	0.10 (0.75)	-
PSLO_IA	-	-0.15 *** (-7.78)	-	-0.19 *** (-9.31)	-	-0.13 (-1.36)	-	0.06 (0.31)
STMD_STD	0.03 (1.03)	0.03 (1.03)	0.06 (1.58)	0.06 (1.58)	0.33 *** (3.81)	0.33 *** (3.81)	0.46 *** (5.06)	0.46 *** (5.09)
T12_TA	0.12 (1.52)	0.12 (1.47)	-0.11 (-0.68)	-0.10 (-0.66)	0.49 (1.44)	0.47 (1.38)	-0.04 (-0.16)	-0.02 (-0.07)
ROA	-0.05 (-0.18)	-0.02 (-0.09)	-1.10 * (-1.65)	-1.13 * (-1.69)	-1.21 (-0.89)	-1.25 (-0.92)	-0.36 (-0.29)	-0.34 (-0.28)
LLP_TLO	-1.65 *** (-3.23)	-1.70 *** (-3.31)	-2.87 *** (-4.69)	-2.93 *** (-4.74)	-2.63 *** (-2.50)	-2.60 *** (-2.45)	-1.58 (-1.22)	-1.51 (-1.11)
MKT_POW	-59.64 (-1.59)	-62.23 * (-1.66)	3.99 *** (4.42)	3.97 *** (4.45)	0.80 (0.91)	0.81 (0.93)	-0.12 (-0.20)	-0.14 (-0.23)
LN_TA	0.07 *** (9.53)	0.07 *** (9.58)	0.06 *** (5.69)	0.06 *** (5.63)	0.10 (1.00)	0.10 (1.00)	0.05 (1.12)	0.05 (1.04)
GDP_GWT	0.33 * (1.81)	0.31 * (1.72)	0.17 (0.91)	0.14 (0.77)	-0.12 (-0.21)	-0.15 (-0.24)	0.29 (0.33)	0.29 (0.31)
CB	0.52 *** (5.65)	0.52 *** (5.72)	0.54 *** (6.45)	0.56 *** (6.55)	2.84 *** (3.42)	2.83 *** (3.41)	0.25 (0.19)	0.22 (0.16)
IBK1M_CB	6.68 *** (3.46)	7.07 *** (3.65)	5.58 *** (2.69)	5.78 *** (2.78)	1.27 (1.17)	1.27 (1.16)	1.11 (0.64)	1.22 (0.66)
CONTROL	-	-	-	-	-0.01 (-0.22)	-0.01 (-0.28)	0.01 (0.12)	0.01 (0.25)
C	0.82 *** (54.64)	0.81 *** (55.25)	0.78 *** (36.80)	0.78 *** (36.81)	0.83 *** (2.42)	0.86 *** (2.44)	0.57 (1.28)	0.53 (1.21)
R^2	0.84	0.84	0.81	0.81	0.69	0.69	0.79	0.79
Fisher Stat	19.72	19.54	18.25	18.23	7.18	7.19	11.84	11.83
P-Value F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Obs.	1921	1921	2081	2081	764	764	747	747

This table shows the result of estimating equation (1) for an unbalanced panel of U.S. and European publicly traded commercial banks over the 2000–2008 period. Equation (1) is estimated separately for retail and diversified banks. A bank is considered retail (diversified) if its ratio of total gross noninterest income to total income is lower (higher) than the median of this ratio. Because U.S. and European banks have different profiles of noninterest income, the median of this ratio is calculated separately for U.S. and European banks. The dependent variable of equation (1) is an alternative specification of the inverse of the net stable funding ratio (*I_NSFR*) by replacing the weight of 0.7 with 1 for demand and saving deposits (*I_NSFR_D1*). Equations (1.a) and (1.b) are the estimations of equation (1) using two proxies of potentially securitizable loans (*PSLO_TLO* and *PSLO_IA*). All explanatory variables are one year lagged. See Table 1.5 for the definition and descriptive statistics of the explanatory variables. Cross-section and time fixed effects are included in the regressions, and the Huber-White robust covariance method is used. To deal with colinearity issues in all the regressions, *LN_TA* is orthogonalised with *MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 1.C.6. The sensitivity of maturity transformation risk according to bank business model for U.S. banks, focusing on the importance of core deposits and alternative weights for stable deposits in the inverse of the net stable funding ratio

	I_NSFR_05				I_NSFR_085				I_NSFR_1			
	Retail banks		Diversified banks		Retail banks		Diversified banks		Retail banks		Diversified banks	
	1. a' 1	1. b' 1	1. a' 1	1. b' 1	1. a' 2	1. a' 2	1. a' 2	1. a' 2	1. a' 3	1. a' 3	1. a' 3	1. a' 3
PSLO_TLO	-0.20 ***	-	-0.24 ***	-	-0.16 ***	-	-0.19 ***	-	-0.19 ***	-	-0.17 ***	-
	(-8.02)		(-8.93)		(-8.19)		(-9.28)		(-9.28)		(-9.22)	
PSLO_IA	-	-0.21 ***	-	-0.27 ***	-	-0.17 ***	-	-0.21 ***	-	-0.21 ***	-	-0.19 ***
		(-7.64)		(-8.87)		(-7.78)		(-9.21)		(-9.21)		(-9.17)
STMD_STD	-0.06	-0.06	0.01	0.01	0.01	0.01	0.05	0.05	0.05	0.05	0.06	0.06
	(-1.43)	(-1.42)	(0.21)	(0.19)	(0.18)	(0.18)	(1.15)	(1.14)	(1.15)	(1.14)	(1.47)	(1.47)
LTMD_NCDLTMD	-0.04 *	-0.04 *	-0.04 **	-0.05 **	-0.02 **	-0.02 **	-0.03 **	-0.03 **	-0.03 **	-0.03 **	-0.03 **	-0.03 **
	(-1.67)	(-1.74)	(-2.13)	(-2.23)	(-1.78)	(-1.75)	(-2.10)	(-2.21)	(-2.10)	(-2.21)	(-2.07)	(-2.17)
T12_TA	0.04	0.03	-0.27	-0.26	0.10	0.09	-0.14	-0.13	-0.14	-0.13	-0.10	-0.10
	(0.38)	(0.30)	(-1.34)	(-1.31)	(1.14)	(1.08)	(-0.82)	(-0.80)	(-0.82)	(-0.80)	(-0.64)	(-0.62)
ROA	-0.41	-0.38	-1.26	-1.30	-0.14	-0.11	-1.13	-1.16 *	-1.13	-1.16 *	-1.08 *	-1.11 *
	(-1.05)	(-1.01)	(-1.40)	(-1.44)	(-0.48)	(-0.40)	(-1.56)	(-1.60)	(-1.56)	(-1.60)	(-1.60)	(-1.64)
LLP_TLO	-2.69 ***	-2.77 ***	-4.18 ***	-4.26 ***	-1.90 ***	-1.95 ***	-3.19 ***	-3.25 ***	-3.19 ***	-3.25 ***	-2.91 ***	-2.96 ***
	(-3.42)	(-3.51)	(-4.97)	(-5.01)	(-3.41)	(-3.49)	(-4.81)	(-4.86)	(-4.81)	(-4.86)	(-4.72)	(-4.78)
MKT_POW	-86.34 *	-89.82 *	2.17 *	2.14 *	-66.52 *	-69.41 *	3.81 ***	3.79 ***	3.81 ***	3.79 ***	4.19 ***	4.17 ***
	(-1.63)	(-1.70)	(1.72)	(1.71)	(-1.63)	(-1.70)	(3.93)	(3.95)	(3.93)	(3.95)	(4.66)	(4.69)
LN_TA	0.06 ***	0.06 ***	0.04 ***	0.04 ***	0.07 ***	0.07 ***	0.06 ***	0.05 ***	0.06 ***	0.05 ***	0.06 ***	0.06 ***
	(5.90)	(5.93)	(2.67)	(2.59)	(8.95)	(9.02)	(5.06)	(4.99)	(5.06)	(4.99)	(5.84)	(5.77)
GDP_GWT	1.14 ***	1.12 ***	0.59 **	0.55 **	0.51 ***	0.50 ***	0.22	0.19	0.22	0.19	0.13	0.10
	(4.31)	(4.23)	(2.12)	(1.99)	(2.61)	(2.52)	(1.10)	(0.96)	(1.10)	(0.96)	(0.71)	(0.56)
CB	-0.27 **	-0.26 **	-0.02	-0.01	0.35 ***	0.35 ***	0.40 ***	0.41 ***	0.40 ***	0.41 ***	0.49 ***	0.50 ***
	(-2.02)	(-1.97)	(-0.18)	(-0.08)	(3.52)	(3.57)	(4.13)	(4.22)	(4.13)	(4.22)	(5.62)	(5.70)
IBK1M_CB	1.92	2.42	3.62	3.89	5.97 ***	6.40 ***	4.95 **	5.16 **	4.95 **	5.16 **	5.28 ***	5.47 ***
	(0.66)	(0.83)	(1.18)	(1.27)	(2.83)	(3.03)	(2.20)	(2.29)	(2.20)	(2.29)	(2.55)	(2.64)
C	1.11 ***	1.10 ***	1.12 ***	1.11 ***	0.89 ***	0.88 ***	0.87 ***	0.87 ***	0.87 ***	0.87 ***	0.79 ***	0.79 ***
	(51.67)	(51.82)	(36.83)	(36.98)	(53.77)	(54.08)	(36.13)	(36.46)	(36.13)	(36.46)	(35.35)	(35.76)
R^2	0.82	0.82	0.80	0.80	0.83	0.83	0.80	0.80	0.80	0.80	0.81	0.81
Fisher Stat	17.03	16.92	16.41	16.40	18.30	18.14	17.25	17.23	17.25	17.23	17.83	17.82
P-Value F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Obs.	1916	1916	2070	2070	1916	1916	2070	2070	1916	1916	2070	2070

This table shows the result of estimating equation (1) for an unbalanced panel of U.S. publicly traded commercial banks over the 2000–2008 period. Equation (1) is estimated separately for retail and diversified banks. A bank is considered retail (diversified) if its ratio of total gross noninterest income to total income is lower (higher) than the median of this ratio. The dependent variable of equations (1.a′) and (1.b′) is the inverse of the net stable funding ratio (*I_NSFR*). Equations (1.a′) and (1.b′) are the estimations of equation (1) using two proxies of potentially securitizable loans (*PSLO_TLO* and *PSLO_IA*) and the ratio of long-term market debts to total long-term market debts and noncore deposits as additional explanatory variables (*LTMD_NCDLTMD*). In equations (1.a′1) and (1.b′1), an alternative specification of the inverse of the net stable funding ratio (*I_NSFR*) is used by replacing the weight of 0.7 with 0.5 for demand and saving deposits (*I_NSFR_D05*). In equations (1.a′2) and (1.b′2), an alternative specification of the inverse of the net stable funding ratio (*I_NSFR*) is used by replacing the weight of 0.7 with 0.85 for demand and saving deposits (*I_NSFR_D085*). In equations (1.a′3) and (1.b′3), an alternative specification of the inverse of the net stable funding ratio (*I_NSFR*) is used by replacing the weight of 0.7 with 1 for demand and saving deposits (*I_NSFR_D1*). All explanatory variables are one year lagged. See Table 1.5 for the definition and descriptive statistics of the explanatory variables. Cross-section and time fixed effects are included in the regressions, and the Huber-White robust covariance method is used. To deal with colinearity issues in all the regressions, *LN_TA* is orthogonalised with *MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

CHAPTER 2.

THE USE OF A BASEL III LIQUIDITY RATIO

TO PREDICT BANK FINANCIAL DISTRESS

This chapter refers to the working paper titled "The use of a Basel III liquidity ratio to predict bank financial distress" (Angora and Roulet, 2011).

ABSTRACT.

Chapter 2 assesses the advantage of using a liquidity ratio as defined in the Basel III accords to identify bank financial distress. Using a standard logit model, the study determines whether the Basel III net stable funding ratio adds predictive value to models relying on liquidity ratios from the CAMELS approach to explain bank default probability for European and U.S. publicly traded commercial banks during the 2005–2009 period. On the whole, the results support the use of a liquidity ratio as defined in the Basel III accords and emphasize the advantage of improving the definition of liquidity to identify bank financial distress. These findings emphasize that it is essential to consider a liquidity indicator that includes information on the cash value of assets and on the availability of deposits and market funding, in addition to the liquidity ratios from the CAMELS approach.

JEL classification: G01; G21; G28

Keywords: Financial Crisis; Bank Financial Distress; CAMELS; Liquidity; Bank Regulation

2.1. Introduction

Financial globalization and deregulation have highlighted the potential fragility of banks; therefore, prudential policies to strengthen banking system stability have been progressively reinforced. Following the subprime crisis that began in mid-2007, proposals from governments at the Pittsburgh G-20 summit and the Basel Committee on Banking Regulation and Supervision have supported the need to improve the regulatory framework. The debate focuses on various aspects of financial regulation, such as the redefinition of core capital, implementation of liquidity ratios, improvement of risk valuation models, extension of the scope of the regulation (i.e., to the "shadow financial system") and implementation of a macroprudential regulation. Without minimizing the importance of various regulatory standards, prudential policies can be generally broken down into two main principles: solvency standards and deposit insurance systems. Whereas the first principle is based on capital requirements to prevent insolvency, the second is expected to prevent depositors' panic and run on deposits. However, the Basel I and II accords are focused on the first principle and require banks to maintain a given level of capital compared to their risk weighted assets. These banking regulatory frameworks have been widely criticized, in particular because of their procyclicality. Moreover, they place high importance on capital standards and minimize several other aspects, such as the role of liquidity.

There is a large consensus in the literature that financial market failures and liquidity shortages are among the root causes of the subprime crisis (Adrian and Shin, 2009). Most of the empirical studies on the determinants of bank financial distress using nonlinear econometric models consider bank-level indicators from the CAMELS rating approach[40] (Demirgüc-Kunt, 1990; Demyanyk and Hasan, 2009; Demyanyk and Van Hemert, 2009; Gonzalez-Hermosillo, 1999; Torna, 2010). With this approach, bank liquidity is measured using liquidity ratios computed from accounting data such as liquid assets to total assets or total loans to total deposits. However, as Poorman and Blake (2005) argue, using such liquidity ratios could be inaccurate under certain conditions. For example, a large regional bank such as the Southeast Bank of Miami, with a ratio of liquid assets to total assets above

40 In November 1979, U.S. regulators introduced the Uniform Financial Rating System, informally known as the CAMEL ratings system, to assess the health of individual banks. The CAMEL approach refers to five components to assess bank financial soundness: capital adequacy, asset quality, management, earnings and liquidity. Since 1997, a sixth component has been added and the CAMEL approach, making it the CAMELS approach: sensitivity to market risk. Following an onsite bank examination, bank examiners assign a score on a scale of 1 (best) to 5 (worst) for each component; they also assign a single summary measure, known as the composite rating.

30%, bankrupted in September 1991 because of its inability to repay some liabilities claimed on demand with its liquid assets[41], thus emphasizing the importance of considering the liquidity mismatch of assets and liabilities in assessing banks' liquidity profile. Furthermore, loan portfolios have become an important factor in liquidity management. Banks can use loans as collateral to secure borrowings, enter into loan participation agreements and sell the loans on the secondary market. Moreover, focusing on deposits ignores some widely used alternative sources of funding through the issue of commercial papers or covered bonds (Bradley and Shibut, 2006). In addition, Decker (2000) mentions that bank liquidity has bank-specific components but also is likely to be affected by market collapses. Thus, given the development of bank market activities[42], the cash value of assets and the availability of market funding are essential for liquidity assessment in banking.

In recognition of the need for banks to improve their liquidity management and following the subprime crisis[43], the Basel Committee on Banking Regulation and Supervision has developed an international framework for liquidity assessment in banking (BIS, 2009a). The Basel III accords include the implementation of the net stable funding ratio[44]. It measures the amount of stable sources of funding an institution employs compared with the amount of assets that cannot be monetized through the sale or the use as collateral in a secured borrowing. It also includes the potential contingent calls on funding liquidity arising from off-balance sheet commitments and obligations. This ratio is computed from accounting data, but it includes the liquidity unbalances of both sides of on- and off-balance sheets. In addition, it

41 The Southeast Bank of Miami had experienced significant problems as a result of concentrated lending in commercial real estate and weak underwriting and credit administration practices. As of August 31, 1991, real estate loans at Southeast Bank of Miami totaled US$3.5 billion, or 45% of the bank's total loan portfolio, and nonperforming assets equaled 10% of loans. Southeast Bank of Miami reported a loss of US$116.6 million for the first quarter and US$139 million for the second quarter of 1991. The announcement of these huge losses caused more depositors to withdraw their funds, and the bank's liquidity problems grew worse. Finally, the bank was closed on September 19, 1991, when it was unable to repay a loan from the Federal Reserve Bank of Atlanta.

42 Financial globalization and the development of financial innovation have led to increase the connection between banks and financial markets—for example, the widespread use of loan securitization and the issuance of complex debt instruments (e.g., collateralized debt obligations), the fact that many banks lend directly to highly leveraged institutions such as hedge funds, the increasing share of trading activities and the increasing use of market funding.

43 Throughout the global financial crisis, which began in mid-2007, many banks struggled to maintain adequate liquidity. Unprecedented levels of liquidity support were required from central banks to sustain the financial system, and even with such extensive support, several banks failed, were forced into mergers or required resolution. These circumstances and events were preceded by several years of ample liquidity in the financial system, during which liquidity and its management did not receive the same level of scrutiny and priority as other areas.

44 The Basel Committee on Banking Regulation and Supervision also introduced the "*liquidity coverage ratio*". This ratio is intended to promote the short-term resiliency of the liquidity profile of banks by ensuring that they have sufficient high-quality liquid resources to survive an acute stress scenario lasting for one month. This thesis focuses on a one-year horizon and does not compute such a ratio, which requires the use of monthly data.

includes the cash value of assets and the availability of deposit and market fundings to define the liquidity of bank assets and liabilities. Indeed, banks are likely to face too many losses from selling some assets at fire sale prices to meet unexpected withdrawals from customers. Alternatively, banks might pledge assets as collateral, refinancing operations being functionally equivalent to the sale of assets. However, high discounts on the value of collateral of assets may prevent banks from repaying the unexpected withdrawals from customers. On the whole, these losses could prevent banks from repaying this amount of debt, because the cash value of their assets might be too weak. A higher net stable funding ratio implies that the available amount of stable funding deviates from the amount of assets that cannot be monetized. In this context, the bank might experience fewer difficulties in meeting its current commitments with its current internal liquidity. Thus, the inverse of the net stable funding ratio indicates to what extent a bank is unable to meet unexpected withdrawals from customers without borrowing money or selling its assets at a loss. A higher value of this ratio indicates higher bank illiquidity, which increases bank default probability. Therefore, it seems relevant to reconsider the broad role of liquidity in the occurrence of bank financial distress. Thus far, most empirical studies on bank default probability only consider indicators from the CAMELS approach.

The purpose in this chapter is to investigate whether introducing the inverse of the Basel III net stable funding ratio in addition to the liquidity ratios from the CAMELS approach would contribute improving prediction of bank financial distress. The novelty of the inverse of the Basel III net stable funding ratio is that, in addition of the information provided by accounting data on the liquidity profile of banks, it considers the information on the cash value of assets and the availability of deposit and market fundings to determine the liquidity of bank assets and liabilities. Using a standard logit model, this study investigates whether the inverse of the Basel III net stable funding ratio adds predictive value to models relying on liquidity ratios from the CAMELS approach to explain bank default probability. Corresponding to the proposals BIS (2009a) makes and given the increasing connections between banks and financial markets, this study questions the added value of improving the definition of bank liquidity to predict financial distress. In particular, this research involves using a liquidity ratio that not only includes information provided by accounting data but that also considers the cash value of assets and the availability of deposit and market fundings to define the liquidity of bank assets and liabilities. It contributes to the strand of the empirical literature on the determinants of individual bank failure as well as to the debate on liquidity regulation implemented in the Basel III regulatory framework. This issue is important to assess the accuracy of improving the definition of liquidity ratios to predict bank financial distress.

The main results, obtained for listed U.S. and European banks during the 2005–2009 period, show that the inverse of the Basel III net stable funding ratio adds predictive value to models relying on liquidity ratios from the CAMELS approach to explain bank default probability. These findings emphasize the benefits of improving the definition of bank liquidity by using a liquidity ratio as defined in the Basel III accords in addition to the liquidity ratios from the CAMELS approach to predict bank financial distress.

The remainder of this chapter is organized as follows. Section 2.2 presents the data set, the issue and empirical strategy. Section 2.3 describes the variables considered in the analysis. Results and robustness checks are presented in sections 2.4 and 2.5. Section 2.6 provides a conclusion.

2.2. Sample and empirical strategy

2.2.1. Presentation of the sample

The sample consists of U.S. and European[45] publicly traded commercial banks over the 2005–2009 period. The empirical analysis is performed in the context of the most recent financial crisis: the subprime crisis (beginning in mid-2007), which was characterized by important liquidity shortages. The study considers a precrisis period of two years to capture the changes that occurred from a calm period to a period of financial distress and focus on U.S. and European banks, because they have been widely affected by the subprime crisis. Finally, the sample includes listed banks because a detailed breakdown of bank balance sheets is needed to compute the inverse of the Basel III net stable funding ratio. In standard databases, these informations are more frequently and extensively reported for listed banks.

Annual consolidated financial statements were extracted from Bloomberg. The study also includes data from the World Bank’s 2007 Regulation and Supervisory Database (Barth et al., 2007) to compute an indicator of supervisory oversight.

Because the objective of the study is to model bank default probability, information on bank defaults until 2009 is required; however, the study includes financial statements over the

45 The sample includes banks from the 27 EU member countries, Norway and Switzerland. However, the required data are available only for banks located in the 20 following countries: Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Liechtenstein, Malta, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

2005–2008 period. Over this period, 870 listed commercial banks have been identified (645 in the United States and 225 in Europe). To enable the computation of the inverse of the Basel III net stable funding ratio, the sample is restricted to banks for which the breakdown for loans by category and the breakdown for deposits by maturity were available in Bloomberg or in annual reports. The final sample consists of 781 commercial banks (574 in the United States and 207 in Europe). Table 2.1 presents the distribution of banks by country and the representativeness of the sample. The study compares aggregate total assets of banks included in the final sample with aggregate total assets of the whole banking system. Over the 2005–2008 period, the final sample accounts, on average, for 75.1% of the total assets of U.S. commercial banks as reported by the Federal Deposit Insurance Corporation (FDIC) and 63.3% of the total assets of European commercial banks as reported by central banks.

Table 2.1. Distribution of U.S. and European listed commercial banks

	Banks available in Bloomberg	**Banks included in the final sample**	**Total assets of banks in final sample / total assets of the banking system (%)**
United States	**645**	**574**	**75.1**
Europe	**225**	**207**	**63.3**
Austria	8	8	60.3
Belgium	4	3	81.9
Cyprus	4	4	69.7
Denmark	44	38	60.9
Finland	2	2	76.5
France	22	22	72.4
Germany	15	14	44.4
Greece	12	12	87.9
Iceland	2	2	66.4
Ireland	3	3	28.7
Italy	24	22	69.7
Liechtenstein	2	2	47.8
Malta	4	4	31.9
Netherlands	2	2	47.7
Norway	23	20	73.5
Portugal	6	6	61.3
Spain	15	15	66.0
Sweden	4	4	72.2
Switzerland	22	18	74.9
United Kingdom	7	6	73.0

Source: Bloomberg, European Central Bank, Bank of England, National Bank of Switzerland, Sveriges Riskbank, Danmarks Nationalbank, Central Bank of Iceland, FDIC and Finance Norway. To deal with the issue of sample representativeness, the study compares aggregate total assets of banks included in the final sample (i.e., U.S. and European publicly traded commercial banks) with aggregate total assets of the whole banking system. From 2005 to 2008, the ratio of aggregate total assets of banks included in the final sample to aggregate total assets of the whole banking system is computed. This table reports the average value of this ratio country by country.

Table 2.2 presents some general descriptive statistics of the final sample. By indicating several key accounting ratios, the data show that banks are on average focused on traditional intermediation activities, as loans and deposits account for a large share of bank total assets and total liabilities. Indeed, the average share of total loans in total assets is 68.9%, and on average, the ratio of total deposits to total assets is 69.2%. In addition, on average, interest income accounts for nearly three-quarters of total income (73.2%). However, there is a high heterogeneity across banks, as shown by the high standard deviation and the extreme values of each ratio[46]. Considering the ratios of total loans to total assets and total deposits to total assets, minimum values are, respectively, 3.7% and 6.6%. Because after checking these very low minima are not outliers but prevail for several large European universal banks, these observations are kept in the panel. Regarding the quality of bank assets, the average share of loan loss provisions in total loans is 0.6%. Moreover, considering profitability, the average return on assets is 0.8%. Last, in terms of capitalization, the average risk weighted capital ratio is higher than the minimum regulatory requirement (of 8% in most countries) at 12.7% and the average ratio of Tier 1 capital to total assets is 7.9%.

Table 2.2. Summary descriptive statistics of the sample of U.S. and European listed commercial banks, on average from 2005 to 2008

	Total assets in US$ billion	Total loans / total assets	Total deposits / total assets	Loan loss provisions / total loans	Tier 1 capital / total assets	Tier 1 and 2 capital / RWA	ROA	Total interest income / total income
Mean	61.6	68.9	69.2	0.6	7.9	12.7	0.8	73.2
Median	1.3	71.4	74.6	0.3	7.1	12.1	0.8	76.8
Max	3768.2	94.0	96.0	7.2	28.5	31.3	6.1	99.8
Min	0.02	3.7	6.6	-1.1	0.1	4.5	-13.3	7.0
Std. Dev.	280.9	13.9	17.0	0.8	3.8	3.3	1.0	15.9

Source: Bloomberg (2005–2008). All variables are expressed in percentage, except *Total assets*. *Total assets* in US$ billion; *Total loans / total assets:* (commercial loans + consumer loans + other loans) / total assets; *Total deposits / total assets:* (demand deposits + saving deposits + time deposits + other time deposits) / total assets; *Loan loss provisions / total loans:* loan loss provisions / (commercial loans + consumer loans + other loans); *Tier 1 capital / total assets:* Tier 1 capital / total assets; *Tier 1* and *2 capital / RWA:* (Tier 1 capital + Tier 2 capital) / total risk weighted assets; *ROA:* net income / total assets; *Total interest income / total income:* (interest income from loans + resale agreements + interbank investments + other interest income or losses) / total income.

46 On average, U.S. commercial banks exhibit significantly higher ratios of loans to total assets (69.6% for US banks and 65% for European banks), deposits to total assets (77% for US banks and 49% for European banks) and gross interest income to total income (78% for U.S. banks and 58% for European banks) than European banks. This might be explained as follows: U.S. banking groups are allowed to perform activities "closely related to banking", such as investment banking and insurance, only if they are considered "well capitalized" by the Federal Reserve (i.e., if they meet the Fed's highest risk-based capital rating). Therefore, most banking groups are focused on banking business, primarily issuing deposits and making loans. In Europe, banking groups are not subject to such requirements and can more easily develop their market activities.

2.2.2. The issue and empirical method

There is a large strand of the empirical literature that focuses on individual bank failure. The seminal studies (developed in the 1970s and 1980s) consider several empirical methods and financial ratios computed from balance sheets and income statement consistent with the CAMEL rating approach to explain bank default probability (Altman, 1977; Avery and Hanweck, 1984; Barth et al., 1985; Benston, 1985; De Young, 2003; Demirgüc-Kunt 1990; Demyanyk and Hasan, 2009; Demyanyk and Van Hemert, 2009; Gajewsky, 1988; Gonzalez-Hermosillo, 1999; Martin, 1977; Oshinsky et al., 2005; Sinkey, 1975; Torna, 2010; Whalen, 1991; Wheelock et al., 2000). As mentioned previously, in 1997, the CAMEL approach became the CAMELS approach to accommodate sensitivity to market risk. Among all components of the CAMELS rating approach, liquidity is one relevant factor to assess bank financial soundness. Consistently with the previous literature, the liquidity ratios are defined according to two definitions. The first definition used considers the proportion of liquid assets such as cash and near cash items, interbank assets, government bonds and trading assets (Barth et al., 2003; Bourke, 1989; Chen et al., 2010; Demirgüç-Kunt et al., 2003; Kosmidou et al., 2005; Hadley and Touhey, 2007; Molyneux and Thornton, 1992; Shen and al., 2001). The second definition used considers the proportion of loans (Athanasoglou et al., 2006; Demirgüç-Kunt and Huizinga, 1999; Kosmidou, 2008; Kosmidou et al., 2007; Naceur and Kandil, 2009; Wheelock and Wilson, 2000). Recognizing that banks must improve their liquidity management, the Basel Committee on Banking Regulation and Supervision developed an international framework for liquidity assessment in banking (BIS, 2009a). Among the several guidelines, the Basel III accords include the implementation of "*net stable funding ratio*". This ratio is defined consistent with the recent evolutions of the banking industry with the increasing connections between banks and financial markets. It is the ratio of the amount of stable sources of funding employed by an institution to the amount of assets that cannot be monetized or pledged as collateral in a secured borrowing. It includes the information provided by accounting data on the liquidity profile of banks by including the liquidity mismatch of both sides of bank balance sheets. Besides, it also considers the cash value of assets and the availability of deposit and market fundings to evaluate the liquidity of bank assets and liabilities. Indeed, banks are likely to face too many losses from selling some assets at loss to meet unexpected withdrawals from customers. In addition, banks might pledge assets as collateral but high discounts on the value of collateral of assets may prevent them to meet unexpected withdrawals from customers. Thus, banks might be unable to repay such amount of debt, the cash value of assets being too weak. A higher "*net stable funding ratio*" indicates that a bank might experience fewer difficulties to meet its current commitments with its current internal liquidity. Thus, it is the inverse of the "*net stable funding ratio*" that indicates to what extent a bank is unable to meet unexpected withdrawals from customers without borrowing money or sell assets at loss. The inverse of the Basel III net stable funding ratio is positively correlated with bank illiquidity that might increase bank default probability.

The novelty of this study consists in considering a liquidity ratio as defined in the Basel III accords in addition to the liquidity ratios traditionally used in the CAMELS approach to explain bank default probability. The study questions whether introducing the inverse of the Basel III net stable funding ratio in addition to the liquidity ratios from the CAMELS approach contributes to improve the prediction of bank financial distress.

To address this empirical issue, the dependent variable is a binary variable that takes on a value of 1 at time *t* if the bank is bankrupt or quasi-bankrupt at time *t + 1* and a value of 0 otherwise[47], following Gonzalez-Hermosillo (1999). This study considers such an approach because most default events are identified *ex post*. Furthermore, because the values of some explanatory variables at time *t + 1* are likely to be affected by the crisis itself, all observations at time *t + 1* have been deleted from the panel; and so on for banks in default or quasi-default at time *t + 1* to avoid feedback effects that are likely to disturb the relationship.

Following Gonzalez-Hermosillo (1999) and Bongini et al. (2001a), a bank is defined bankrupt or quasi-bankrupt at time *t + 1* if (1) the bank failed; (2) the bank was acquired by other financial institution on last resort; (3) the bank's operations were temporarily suspended by the government; (4) the bank was recapitalized by either the central bank or an agency specifically created to address the crisis; (5) required a liquidity injection from the monetary authorities or (6) was nationalized to prevent its default (because of its too-big-to-fail position)[48]. Table 2.3 contains the name, nature and date of default for each bank included in the sample of banks that failed or was quasi-bankrupt during the 2005–2009 period. More precisely, in Europe, 20 commercial banks of a total of 207 banks were bankrupt or quasi-

47 A bank is considered to have defaulted at time *t* if it is bankrupt or quasi-bankrupt at time *t + 1*. Indeed, the study assumes that its fundamentals have been considerably damaged at time *t* and public intervention has been necessary at time *t + 1*.

48 In practice, the information to identify banks that failed or was quasi-bankrupt is provided by Bloomberg archives on ownership, merger and acquisition history. Following Bongini et al. (2001b), the specific terms, such as *bankrupt*, *failed*, *closed*, *recapitalized*, *suspended* and *majority purchase* have been used as keywords in Bloomberg to identify banks that failed or were quasi-bankrupt since the beginning of the subprime crisis.

bankrupt (12 in 2008 and 8 in 2009). In the United States, of 574 banks, 17 commercial banks (10 in 2008 and 7 in 2009) are bankrupt or quasibankrupt.

Table 2.3. U.S. and European listed commercial banks in default or quasi default during the subprime crisis (from mid 2007 to the end of 2009)

Bank name	Country	Type of default	Date of default
A/S Ringjoebing Bank	Denmark	Acquired by Vestjysk Bank A/S	2008
Allied Irish Bank	Ireland	Acquired by Federal Republic of Ireland	2008
Anglo Irish Bank	Ireland	Acquired by Federal Republic of Ireland	2008
Banca Monte Dei Pashi Di Siena	Italy	Acquired by Italian Republic	2009
Banca Popolare Di Milano	Italy	Acquired by Italian Republic	2009
Bank of Ireland	Ireland	Acquired by Federal Republic of Ireland	2008
Bonusbanken	Denmark	Acquired by Vestjysk Bank A/S	2008
Dexia SA	Belgium	Acquired by Investor consortium and governements	2008
EBH Bank A/S	Denmark	Acquired by Bankaktieselskabet	2008
Fionia Bank	Denmark	Acquired by Nordea Bank	2009
Forstaedernes Bank A/S	Denmark	Acquired by Nykredit Realkredit A/S	2008
Fortis	Belgium	Acquired by Investor consortium and governements	2008
Glitnir Banki HF	Iceland	Acquired by The Republic of Iceland	2008
HBOS Plc	United Kingdom	Acquired by Lloyds and then the Kingdom of Britain	2009
IKB Bank	Germany	Acquired by Lone Star funds	2009
Landsbanki Island	Iceland	Acquired by The Republic of Iceland	2008
Lloyds Plc	United Kingdom	Acquired by the Kingdom of Britain	2009
RBS Plc	United Kingdom	Acquired by the Kingdom of Britain	2009
Roskilde Bank	Denmark	Bankruptcy	2009
Sandvaer Sparebank	Norway	Acquired by SpareBank1 Buskerud - Vestf	2008
Cape Fear Bank Corp	United States	Bankruptcy - Chapter 11 North Carolina	2008
Capital Corp of the West		Bankruptcy - Chapter 11 California Eastern district	2008
CIB Marine Bancshares Inc		Bankruptcy - Chapter 11 West Virginia	2009
Commerce Bancorp Inc		Acquired by Toronto Domingo Bank	2008
First State Financial Corp		Acquired by Stearns Financial Services	2008
Frontier Financial Corp		Acquired by SP Acquisition Holdings Company	2009
Harleysville National Corp		Acquired by LFirst Niagara Financial Group	2009
National City Corp		Acquired by PNC Financial Services Group	2008
Ohio Legacy Corp		Acquired by Excel Financial LLC	2009
Security Bank Corp		Bankruptcy - Chapter 7 Georgia Middle district	2009
Silver State Bancorp		Bankruptcy - Chapter 7 Nevada	2008
Team Financial Inc		Bankruptcy - Chapter 11 Kansas	2009
UnionBanCal Corporation Inc		Acquired by Mitsubishi UFJ Financial Group	2008
Vineyard National Bancorp		Bankruptcy - Chapter 11 California Central district	2008
Wachovia Corp		Acquired by Wells Fargo	2008
Washington Mutual Inc		Acquired by JP Morgan	2008
WSB Financial Group Inc		Bankruptcy	2009

Source: Bloomberg. The information to identify banks that failed or was quasi-bankrupt is provided by Bloomberg archives on ownership, merger and acquisition history. Following Bongini et al. (2001b), the specific terms, such as *bankrupt, failed, closed, recapitalized, suspended* and *majority purchase* have been used as keywords in Bloomberg to identify banks that failed or were quasi-bankrupt since the beginning of the subprime crisis.

Then, bank default probability at time *t* is estimated using a standard logit model. The binary dependent variable is regressed on a set of explanatory variables that correspond to time *t* if the bank is bankrupt or quasi-bankrupt at time *t + 1* to identify the main factors that have contributed to increase bank financial distress before its bankruptcy or quasi-bankruptcy. From this perspective, the deterioration of bank fundamentals explains bank failure and not bank financial distress explains the deterioration of bank fundamentals, thus mitigating the endogeneity issue.

2.3. Determinants of bank financial distress

According to the empirical issue and consistent with previous studies, the study includes a set of indicators from the CAMELS approach that are likely to affect bank default probability [49]. In addition, the study considers the inverse of the Basel III net stable funding ratio. Finally, a set of other potentially explanatory variables traditionally used in the literature is also included.

2.3.1. CAMELS indicators

The ratio of Tier 1 and 2 capital to total risk weighted assets (*T12_RWA*) is considered a proxy of bank capitalization. A bank could be more vulnerable when its capital is weaker compared with the volume of its risky assets (Campbell 2007; Martin, 1977; Oshinsky et al., 2005). In this context, the bank security buffer could be too weak to absorb losses from bad quality assets. A negative sign is expected for the coefficient of this variable in the determination of bank default probability.

The ratio of loan loss provisions to total loans (*LLP_TLO*) is considered a proxy to assess the quality bank assets. A higher ratio implies a lower quality of assets as the bank holds provisions since it expects to face losses following defaults on its credit portfolio (Arena, 2005; Cihak and Poghosyan, 2009; Cole and White, 2010; Gajewski, 1988; Gonzalez-Hermosillo, 1999). A positive sign is expected for the coefficient of this variable in the determination of bank default probability.

49 In the existing literature, there is no consensus about the definition of the indicators of the component “S” capturing sensitivity to market risk (i.e., including exposure to interest rate risk, currency risk and equity risk). Thus, this study does not include an indicator of market risk. However, in this study, bank sensitivity to market risk is to some extent measured by net stable funding ratio. This indicator considers the state of financial markets to approximate the cash value of assets that is likely to fall following a market collapse. In addition, this indicator considers the liquidity of debt markets to assess the amount of available funding. Following a shock, some fundings are likely to become more volatile. Consequently, the bank faces the risk of being unable to meet unexpected withdrawals from customers.

Management efficiency is measured by the cost to income ratio (*M_EFCY*) that corresponds to the ratio of operating expenses to net income as in Cihak and Pogosyhan (2009), Gajewski (1988), and Sinkey (1975). In this accounting measure, management efficiency corresponds to the ability of managers to minimize costs. Consequently, the deterioration in bank financial soundness with higher production costs is likely to increase bank fragility. A positive sign is expected for the coefficient of this variable in the determination of bank default probability.

The return on assets (i.e., the ratio of net income to total assets) is considered a proxy of bank earnings (*ROA*) as in Altman (1977), Arena (2005) and Cole and White (2010). The deterioration in profitability could increase bank default probability. Consequently, a negative sign is expected for the coefficient of this variable in the determination of bank default probability. Nevertheless, higher profitability might result from greater risk taking and capture possible "gamble for resurrection" behavior or the too-big-to-fail position of large banks. Thus, a positive sign can also be expected for the coefficient of this variable in the determination of bank default probability. The expected sign for the coefficient of this variable is ambiguous.

Furthermore, this study includes different measures of bank liquidity used in the existing literature. Liquidity can be measured using liquid assets ratios. First, the liquid assets (i.e., cash and reserves, government bonds and trading securities) to total assets ratio (*LA_TA*) is considered an indicator of the maturity structure of the asset portfolio that can reflect excessive maturity unbalances (Arena, 2005; Cole and White, 2010). Higher value of this ratio indicates higher bank liquidity. Second, the liquid assets to total customer deposits ratio (*LA_DEPO*) shows to what extent a bank is able to meet unexpected deposit withdrawals with the liquid assets from its balance sheets (Calomiris and Mason, 1997; Gonzalez-Hermosillo, 1999). Higher values of this ratio imply a higher ability of a bank to meet unexpected deposit withdrawals with its own liquid assets. Third, the liquid assets to total customer deposits and short-term market funding ratio (*LA_DP_STMD*) shows the ability of a bank to repay its liabilities that can be claimed at short notice with its cushion of cash and with the assets that can be readily monetized (Cihak and Poghosyan, 2009; Said and Saucier, 2003). Higher values of this ratio mean that a bank is better able to repay its short-term liabilities (following unexpected deposit withdrawals or market funding roll-offs) with the liquid assets from its balance sheets. A negative sign is expected for the coefficients of these variables in the determination of bank default probability. Fourth, liquidity can also be measured using loan ratios. The total loans to total assets ratio (*LO_TA*) is considered an indicator of the illiquidity of the asset portfolio, as loans are generally long-term assets that cannot be readily monetized (Wheelock and Wilson, 2000). Nevertheless, loan portfolios are not completely illiquid; some loans can be used as collateral for secured borrowings and sold on the secondary market. Thus, higher values of this ratio indicate relatively higher bank illiquidity. Fifth, the idea behind the total loans to total customer deposits ratio (*LO_DEPO*) is that loans are illiquid, and any deposit runoff would be funded through the sale of securities (Gonzalez-Hermosillo, 1999; Hadley and Touhey, 2007). Higher values of this ratio imply higher difficulties for a bank to face unexpected deposit withdrawals as illiquid loans cannot be readily monetized. Sixth, the total loans to total customer deposits and short-term market funding ratio (*LO_DP_STMD*) shows to what extent a bank holds illiquid loans but must fund any deposit runoff or market funding roll-off through the sale of securities (Gonzalez-Hermosillo, 1999). Higher values of this ratio imply greater difficulties for a bank to meet unexpected withdrawals from customers at short notice. A positive sign is expected for the coefficients of these variables in the determination of bank default probability.

2.3.2. The inverse of the Basel III net stable funding ratio

The inverse of the Basel III net stable funding ratio corresponds to the ratio of the required amount of stable funding to the available amount of stable funding. As the regulation on bank liquidity is not yet implemented, this ratio is an indicator of bank illiquidity as defined in the Basel III accords, but it does not establish a minimum acceptable amount of stable funding based on the liquidity characteristics of an institution’s assets and activities over a one-year time horizon. The required amount of stable funding is the amount of a particular asset that cannot be monetized through the sale or the use as collateral in a secured borrowing on an extended basis during a liquidity event lasting one year. The available stable funding is the total amount of an institution’s (1) capital, (2) liabilities with effective maturities of one year or greater and (3) a portion of “stable” nonmaturity deposits and/or term deposits with maturities of less than one year that would be expected to stay within the institution. To calculate the inverse of the Basel III net stable funding ratio, a specific required stable funding factor is assigned to each particular type of asset, and a specific available stable funding factor is assigned to each particular type of liability. Appendix C briefly summarizes the composition of asset and liability categories and related stable funding factors as defined in the Basel III accords.

Appendix D shows the breakdown of bank balance sheets[50] as provided by Bloomberg and its weighting with respect to the Basel III framework to calculate the inverse of the net stable funding ratio. On the asset side, the type and maturity of assets is defined consistent with the definition of BIS (2009a) to apply the corresponding weights. On the liability side, only the maturity of liabilities is considered to apply the corresponding weights. Because the data only provide the breakdown of deposits according to their maturity and not according to the type of depositors, the intermediate weight of 0.7[51] is considered for stable demand deposits and saving deposits (including all deposits with a maturity of less than one year). In this study the inverse of the net stable funding ratio (*I_NSFR*) is calculated as follows:

$$\text{I\_NSFR} = \frac{\text{Required amount of stable funding}}{\text{Available amount of stable funding}} = \frac{\begin{array}{l} 0 * (\text{cash} + \text{interbank assets} + \text{short-term marketable assets}) \\ + 0.5 * (\text{long-term marketable assets} + \text{customer acceptances}) \\ + 0.85 * \text{consumer loans} \\ + 1 * (\text{commercial loans} + \text{other loans} + \text{other assets} + \text{fixed assets}) \end{array}}{\begin{array}{l} 0.7 * (\text{demand deposits} + \text{saving deposits}) \\ + 0 * (\text{short-term market debt} + \text{other short-term liabilities}) \\ + 1 * (\text{long-term liabilities} + \text{equity}) \end{array}}$$

A higher value of the inverse of the Basel III net stable funding ratio implies that the required amount of stable funding deviates from the available amount of stable funding. In this context, the bank might experience greater difficulties in meeting its current commitments with its current internal liquidity. Consequently, it might need to immediately obtain unsecured funding or be recapitalized or rescued by national authorities. A positive sign is expected for the coefficient of this variable in the determination of bank default probability.

2.3.3. Other explanatory variables

This section introduces a set of other explanatory variables as control variables. Bank size is taken into account in this study because of the too-big-to-fail position of large banks, which could lead to moral hazard behavior and excessive risk exposure. In addition, it

50 Bank liquidity is affected by on- and off-balance sheets positions. This study considers the liquidity profile of banks only from on-balance sheet positions because a detailed breakdown of off-balance sheets is not available in standard databases. The potential contingent calls on funding liquidity arising from off-balance sheet commitments and obligations can generate lacks of liquidity and thus increase bank illiquidity. However, banks can hold loan commitments from other financial institutions. These liquidity facilities are likely to negatively affect bank liquidity creation and illiquidity. Consequently, the net effect of off-balance sheet positions on bank illiquidity is not clear-cut.

51 The Basel Committee considers three weights (i.e., 0.5, 0.7 and 0.85) for demand and saving deposits (i.e., all deposits with a maturity of less than one year) according to the type of depositors. Here, the intermediate weight of 0.7 is considered. In section 2.5, robustness checks are performed by considering other weights.

captures the impact of complexity in large organizations (i.e., governance conflicts, origination of sophisticated products and complex transactions) that is likely to affect bank stability. The natural logarithm of total assets (*LN_TA*) is considered a proxy of bank size. A positive sign is expected for the coefficient of this variable in the determination of bank default probability.

In addition, this study considers the impact of bank business model through revenue diversification, an alternative measure of bank risk absorption capability that is likely to affect bank default probability (Lepetit et al., 2008; Stiroh, 2002). According to the financial theory, lower diversification leads to increase bank default probability (Santomero and Chung, 1992; Saunders and Walters, 1994). However, other studies show that higher diversification leads to increase bank default probability (De Young and Roland, 2001; Demsetz and Strahan, 1997; Lepetit et al., 2008; Stiroh and Rumble, 2006). A normalized Herfindalh–Hirschman index of concentration on interest versus noninterest income (*HHI_INC*)[52] is considered a proxy of bank revenue diversification. Normalized Herfindalh–Hirschman index varies between 0 and 1. The closer the index is to 0, the higher is the diversification. Under the first view, a positive sign is expected for the coefficient of this variable in the determination of bank default probability. Under the second view, a negative sign is expected. Therefore, the expected sign for the coefficient of this variable is ambiguous.

In addition, the influence of goodwill is considered to explain bank default probability. Goodwill mainly represents the underappreciated excess over book value that a bank paid when acquiring another bank. Although it can represent legitimate franchise value, it can often represent simply the overpayment in an acquisition. It is expected to have a positive influence on bank default probability. The ratio of total intangible assets to total assets (*GDWL_TA*) is considered a proxy of goodwill. A positive sign is expected for the coefficient of this variable in the determination of bank default probability.

Moreover, the existing empirical literature on individual bank failure emphasizes the relevance of macroeconomic variables complementary to bank-level indicators to explain bank default probability (Festic et al., 2010; Gonzalez-Hermosillo, 1999; Kaminsky and

52 Following Stiroh (2002), an Herfindalh–Hirschman index is calculated to proxy the level of concentration of bank revenue. Bank revenue is splitted into interest and noninterest income. The Herfindalh–Hirschman index (*HHI_I*) is computed as follows:

$$HHI\_I = (\text{total interest income} / \text{total income})^2 + (\text{total noninterest income} / \text{total income})^2$$

Normalised *HHI_INC* is calculated as follows:

$$HHI\_INC = \frac{HHI\_I - \frac{1}{2}}{1 - \frac{1}{2}}$$

Reinhart, 1996; Shen, 2004; Thomson, 1991; Whalen, 1991). All macroeconomic data were extracted from Bloomberg. Many researchers consider economic downturn an important factor in explaining bank default probability, because the quality of bank loans deteriorates when the business cycle is in a downtrend. The annual growth rate of real GDP (*GDP_GWT*) is considered a proxy of macroeconomic environment in the determination of bank fragility. A negative sign is expected for the coefficient of this variable in the determination of bank default probability. In addition, the impact of liquidity pressures on the interbank market is taken into account, because liquidity shortages are likely to disturb the management of bank liquidity and might lead to acute liquidity problems. The spread of the one-month interbank rate and the central bank policy rate (*IBK1M_CB*) is considered a proxy of the liquidity pressures on the interbank market. Higher values of the spread reflect higher pressures on the interbank market that will make it more difficult for banks to access these sources of liquidity and will therefore increase their default probability. A positive sign is expected for the coefficient of this variable in the determination of bank default probability.

Last, the impact of supervisory regime is considered in this study. Laeven and Levine (2008) and Shehzad et al. (2010) show that it can affect bank risk-taking behavior (Berger et al., 2011). In addition, because banking regulation is likely to vary across countries, this variable can control for possible country effects. Using Shehzad et al. (2010), an index of supervisory oversight (*CONTROL*) is computed from the World Bank's 2007 Regulation and Supervisory Database (Barth et al., 2007)[53]. Higher values of this index reflect stronger regulatory oversight. Under strong supervisory oversight, banks are expected to be encouraged to better control their risk exposure. A negative sign is expected for the coefficient of this variable in the determination of bank default probability.

53 The proxy of supervisory regime (*CONTROL*) is a combinaiason of two indicators. The first indicator refers to supervisory agency control and is the total number of affirmative answers to the following questions: (1) Is the minimum capital adequacy requirement greater than 8%? (2) Can the supervisory authority ask banks to increase minimum required capital in the face of higher credit risk? (3) Can the supervisory authority ask banks to increase minimum required capital in the face of higher market risk? (4) Can the supervisory authority ask banks to increase minimum required capital in the face of higher operational risk? (5) Is an external audit compulsory obligation for banks? (6) Can the supervisory authority force a bank to change its internal organization structure? (7) Can the supervisory authority legally declare that a bank is insolvent? (8) Can the supervisory authority intervene and suspend some or all ownership rights of a problem bank? (9) Can the supervisory authority supersede shareholders rights? (10) Can the supervisory authority remove and replace managers? (11) Can the supervisory authority remove and replace directors? The second indicator of the supervisory regime measures deposit insurance agency control and is the total number of affirmative answers to the following questions: (1) Can the deposit insurance agency legally declare that a bank is insolvent? (2) Can the deposit insurance agency intervene and suspend some or all ownership rights of a problem bank? (3) Can the deposit insurance agency remove and replace managers? (4) Can the deposit insurance agency remove and replace directors? (5) Can the deposit insurance agency supersede shareholders rights? For each country in the sample, the possible changes in the answers to these questions over the 2005–2008 period were considered. Thus, for a given country, the value of the index might vary over time.

Table 2.4 shows descriptive statistics of the explanatory variables. Table 2.5 provides summary descriptive statistics of the main determinants of bank financial distress for U.S. and European commercial banks in default or quasi-default versus nonfailed banks[54]. Mean tests show that banks in default or quasi-default have significantly lower average total risk weighted capital ratio (*T12_RWA*) and average return on assets (*ROA*) but significantly higher average cost to income ratio (*M_EFCY*) and average ratio of loan loss provisions to total loans (*LLP_TLO*) than nonfailed banks. Regarding liquidity indicators, banks in default or quasi-default have significantly lower ratios of liquid assets to total customer deposits (*LA_DEPO*) but significantly higher ratios of total loans to total customer deposits (*LO_DEPO*) and total loans to total customer deposits and short-term market funding (*LO_DP_STMD*) than nonfailed banks. Finally, banks in default or quasi-default have significantly higher average inverse net stable funding ratio (*I_NSFR*) than nonfailed banks.

54 This study considers the year just before the bank default or quasi-default to indicate which indicators are significant to explain bank default. To compute statistics for banks in default or quasi-default, only the figures corresponding to the year just before their default are kept in the study (e.g., 2007 if the bank has defaulted in 2008, 2008 if the bank has defaulted in 2009), and the figures corresponding to the year of the default and to the years after have been deleted from the analysis. Then, over this period (i.e., e.g., including the years 2007 and 2008), the analysis compares these figures to those of banks that did not default from 2005 to 2009.

Table 2.4. Descriptive statistics of explanatory variables, for U.S. and European listed commercial banks, on average, from 2005 to 2008

Variables	Mean	Median	Max	Min	Std Dev	Obs
T12_RWA	13.1	12.5	34.0	4.5	3.1	2878
LLP_TLO	0.5	0.3	7.2	-1.2	0.8	2939
M_EFCY	65.2	62.9	312.7	2.4	20.5	3030
ROA	0.7	0.9	6.9	-15.1	1.2	3028
LA_TA	22.6	20.5	93.8	0.4	12.6	3014
LA_DEPO	39.6	28.9	850.8	0.8	51.0	3014
LA_DP_STMD	30.6	26.0	328.2	0.8	23.0	3014
LO_TA	68.4	70.7	95.1	3.7	14.1	3014
LO_DEPO	108.7	95.7	1045.0	7.4	59.9	3014
LO_DP_STMD	90.4	87.9	514.6	3.9	29.5	3014
I_NSFR	93.1	92.8	477.2	17.8	19.6	3014
LN_TA	7.8	7.2	15.1	3.2	2.1	3018
HHI_INC	0.3	0.3	1.0	0.0	0.2	2992
GDWL_TA	0.8	0.0	14.7	0.0	1.5	3018
GDP_GWT	2.0	2.3	7.5	-3.5	1.3	3124
IBK1M_CB	0.2	0.2	2.6	-0.3	0.2	3124
CONTROL	10.5	11.0	12.0	4.0	1.3	3124

Source: Bloomberg (2005–2008), World Bank’s 2007 Regulation and Supervisory Database. All variables are expressed in percentage, except *LN_TA*, *HHI_INC* and *CONTROL*. *T12_RWA:* (Tier 1 capital + Tier 2 capital) / total risk weighted assets; *LLP_TLO:* loan loss provisions / total loans; *M_EFCY:* total operating expenses / net income; *ROA:* net income / total assets; *LA_TA:* (cash and near items + interbank assets + government and other short-term trading securities) / total assets; *LA_DEPO:* (cash and near items + interbank assets + government and other short-term trading securities) / total deposits; *LA_DP_STMD:* (cash and near items + interbank assets + government and other short-term trading securities) / (total deposits + short-term market debts); *LO_TA:* total loans / total assets; *LO_DEPO:* total loans / total deposits; *LO_DP_STMD:* total loans / (total deposits + short-term market debts); *I_NSFR:* required amount of stable funding / available amount of stable funding; *LN_TA:* natural logarithm of total assets; *HHI_INC:* normalized Herfindalh–Hirschman index for concentration of bank interest versus noninterest income; *GDWL_TA:* intangible assets / total assets; *GDP_GWT:* annual growth rate of real GDP; *IBK1M_CB:* spread of one-month interbank rate and central bank policy rate; *CONTROL*: index of supervisory regime.

Table 2.5. Average comparisons of the main determinants of bank financial distress, for U.S. and European listed commercial banks over the 2007–2008 period

	Mean		Standard deviation		
	Banks in default or quasi default	Non failed banks	Banks in default or quasi default	Non failed banks	Mean test statistic
T12_RWA	11.2	12.9	2.1	2.9	-3.49 ***
LLP_TLO	1.4	0.7	1.7	0.9	4.27 ***
M_EFCY	73.1	67.5	32.1	20.4	1.61 *
ROA	-0.7	0.4	2.9	1.3	-4.76 ***
LA_TA	19.6	21.5	7.8	12.5	-0.92
LA_DEPO	37.5	55.3	63.6	49.4	-2.14 **
LA_DP_STMD	29.3	33.8	23.1	24.0	-1.12
LO_TA	69.4	68.5	12.3	13.9	0.39
LO_DEPO	168.2	109.0	146.8	52.6	6.25 ***
LO_DP_STMD	113.8	91.3	67.1	26.0	4.87 ***
I_NSFR	127.9	93.9	61.9	17.5	10.35 ***

This study considers the year just before the bank default or quasi-default to indicate which indicators are significant to explain bank default. To compute statistics for banks in default or quasi-default, only the figures corresponding to the year just before their default are kept in the study (e.g., 2007 if the bank has defaulted in 2008, 2008 if the bank has defaulted in 2009), and the figures corresponding to the year of the default and to the years after have been deleted from the analysis. Then, over this period (i.e., e.g., including the years 2007 and 2008), the analysis compares these figures to those of banks that did not default from 2005 to 2009.
All variables are expressed in percentage. *T12_RWA:* (Tier 1 capital + Tier 2 capital) / total risk weighted assets; *LLP_TLO:* loan loss provisions / total loans; *M_EFCY:* total operating expenses / net income; *ROA:* net income / total assets; *LA_TA:* (cash and near items + interbank assets + government and other short-term trading securities) / total assets; *LA_DEPO:* (cash and near items + interbank assets + government and other short-term trading securities) / total deposits; *LA_DP_STMD:* (cash and near items + interbank assets + government and other short-term trading securities) / (total deposits + short-term market debts); *LO_TA:* total loans / total assets; *LO_DEPO:* total loans / total deposits; *LO_DP_STMD:* total loans / (total deposits + short-term market debts); *I_NSFR:* required amount of stable funding / available amount of stable funding. T-statistics test for null hypothesis of identical means; *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively, for bilateral test.

According to the empirical issue and considering the indicators of bank financial distress as discussed previously, bank default probability is defined by the following equation:

$$\text{Prob}\,(Y_{it}=1) = \Phi\begin{pmatrix}\alpha + \beta_c C_{i,t} + \beta_a A_{i,t} + \beta_m M_{i,t} + \beta_e E_{i,t} + \beta_{lc} L_{i,t} \\ + \beta_{lb} I\_NSFR_{i,t} + \sum_{k=1}^{K} \beta_k CV_{ki,t} + \varepsilon_{i,t}\end{pmatrix} \quad (1)$$

where Φ is the logistic cumulative distribution and subscripts *i* and *t* denote bank and period, respectively. *Y* is a binary variable that takes on a value of 1 at time *t* if the bank is bankrupt or quasi-bankrupt at time *t + 1* and a value of 0 otherwise. *C*, *A*, *M* and *E* are proxies of bank capital adequacy, quality of assets, management efficiency and earnings, respectively. *L* corresponds to a liquidity ratio from the CAMELS approach. *I_NSFR* corresponds to the inverse of the Basel III net stable funding ratio. While the *I_NSFR* variable is correlated with the liquidity ratios from the CAMELS approach[55], coefficients of correlation are relatively weak, suggesting that the *I_NSFR* variable includes additional information compared with the liquidity ratios from the CAMELS approach. To deal with such potential colinearity issues, regressions are run by introducing each liquidity indicator individually[56]. CV_k is the k^{th} control variable. Equation (1) is estimated over the 2005–2008 period jointly for U.S. and European banks because they were affected by the subprime crisis[57]. The coefficients are estimated by the maximum likelihood using Huber–White robust covariance method. To deal with colinearity issues, some of the variables were orthagonalised before introducing them in the regressions (see Table 2.A.1 in Appendix 2.A)[58]. The quality of the model specification is assessed by McFadden R-square and the likelihood ratio test (i.e., a test for the joint significance of regressors by comparing the likelihood of the model with that of a model with only an intercept). In addition, another likelihood ratio test is performed to test for the contribution of the inverse of the Basel III net stable funding ratio to the predictive value of models relying on liquidity ratios from the CAMELS approach (i.e., a test for the joint significance of regressors by comparing the likelihood of the model with that of a model without *I_NSFR* as explanatory variable). Furthermore, to assess the classification accuracy of the model, the in-sample classifications are reported by considering the extent of type 1 and type 2 classification errors[59]. Because it might be also interesting to consider whether regulators could use the model as a forecasting tool for identifying future bank failures, out-of-sample tests are also performed. More precisely, the model is estimated on the period 2005 to 2007 and out-of-sample classifications are performed on the year 2008. The purpose is to predict bank financial distress occurring in 2008. For both the in-sample and the out-of-sample classifications, the cutoff value corresponds to the proportion of *Y* equal to 1 in the whole sample.

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55 Table 2.A.1 in Appendix 2.A shows the correlation coefficients among the explanatory variables. *I_NSFR* is correlated at least –0.15 and at most –0.58 with the liquidity ratios from the CAMELS approach.

56 To check the robustness of the results, equation (1) is estimated by orthogonalising the *I_NSFR* variable with each liquidity ratio from the CAMELS approach. For further details, see section 2.5.

57 To check the robustness of the results, equation (1) is estimated separately for U.S. and European banks. The main conclusions are consistent with those obtained by considering all banks in the sample. For further details, see section 2.5.

58 In all regressions, *LLP_TLO* is orthagonalised with *ROA* and *M_EFCY* with *ROA*.

59 A type 1 error corresponds to misclassifying a failed bank as a survivor, and a type 2 error corresponds to misclassifying a surviving bank as a failure.

2.4. Results

2.4.1. Logit regression results

In this chapter, the purpose is to test for the contribution of a liquidity ratio as defined in the Basel III accords in addition to the liquidity ratios from the CAMELS approach to improve the prediction of bank default probability. The regression results are shown in Table 2.6 and Table 2.7. In the CAMELS approach, bank liquidity is measured by several ratios which are correlated with the inverse of the Basel III net stable funding ratio. To consider the potential impact of such colinearity, a standard logit model is estimated by introducing each liquidity indicator individually (i.e., each liquidity ratio from the CAMELS approach or the inverse of the Basel III net stable funding ratio, see Table 2.6; equations (1.a)–(1.g)). Then, equation (1) is estimated by introducing each liquidity ratio from the CAMELS approach and the inverse of the Basel III net stable funding ratio (see Table 2.7; equations (1.a′) – (1.f′)).

Table 2.6. Liquidity and bank financial distress: Logit regression results introducing each liquidity ratio individually

	1. a	1. b	1. c	1. d	1. e	1. f	1. g
LA_TA	-5.34 *** (-3.04)						
LA_DEPO		-0.41 (-0.77)					
LA_DP_STMD			-2.08 * (-1.68)				
LO_TA				4.00 *** (2.73)			
LO_DEPO					0.30 *** (2.95)		
LO_DP_STMD						0.57 ** (2.28)	
I_NSFR							4.35 *** (6.42)
T12_RWA	-18.99 ** (-2.32)	-20.68 *** (-2.68)	-19.40 *** (-2.55)	-17.77 ** (-2.25)	-22.19 *** (-3.15)	-20.55 *** (-2.65)	-23.17 *** (-2.40)
LLP_TLO	43.85 *** (2.93)	41.44 *** (2.82)	43.18 *** (2.97)	43.87 *** (2.96)	48.00 *** (3.48)	43.32 *** (2.96)	54.69 *** (3.65)
M_EFCY	1.38 ** (2.16)	0.97 (1.35)	1.49 ** (1.92)	1.46 ** (2.29)	0.80 (1.36)	0.75 (1.35)	1.54 * (1.82)
ROA	-48.72 *** (-5.31)	-47.89 *** (-5.29)	-50.58 *** (-5.57)	-50.87 *** (-5.49)	-46.50 *** (-5.18)	-46.91 *** (-5.12)	-47.14 *** (-4.63)
LN_TA	0.44 *** (3.17)	0.36 *** (2.35)	0.44 *** (2.89)	0.44 *** (3.30)	0.27 *** (2.73)	0.28 *** (2.78)	0.38 *** (3.14)
HHI_INC	0.58 (0.60)	0.70 (0.68)	0.74 (0.76)	0.75 (0.76)	0.59 (0.69)	0.41 (0.43)	1.70 * (1.61)
GDWL_TA	-12.29 (-0.99)	-10.75 (-0.76)	-13.20 (-0.93)	-6.63 (-0.51)	-3.63 (-0.29)	-5.11 (-0.39)	-3.82 (-0.36)
GDP_GWT	11.67 (0.66)	9.64 (0.52)	13.19 (0.73)	10.16 (0.57)	12.67 (0.68)	6.94 (0.38)	31.89 (1.40)
IBK1M_CB	192.29 *** (4.87)	203.62 *** (5.30)	219.24 *** (5.21)	186.88 *** (4.82)	176.67 *** (4.58)	168.53 *** (3.83)	216.50 *** (5.53)
CONTROL	-0.09 (-0.81)	-0.12 (-1.08)	-0.10 (-0.96)	-0.15 (-1.41)	-0.11 (-0.97)	-0.13 (-1.16)	0.06 (0.44)
C	-4.55 ** (-1.93)	-4.26 * (-1.80)	-4.91 ** (-2.02)	-8.00 *** (-2.59)	-3.98 * (-1.82)	-4.07 * (-1.88)	-11.54 *** (-3.82)
Mc Fadden R^2	0.24	0.22	0.22	0.23	0.22	0.22	0.31
LR Stat and % level to reject: **H0: $b_j = 0$ " $b_j \neq a$**	92.47 *** (0.00)	84.50 *** (0.00)	87.96 *** (0.00)	89.12 *** (0.00)	87.00 *** (0.00)	86.55 *** (0.00)	123.21 *** (0.00)
Total Obs.	2763	2763	2763	2763	2763	2763	2763
Total Obs. with Y = 1	37	37	37	37	37	37	37
In sample classification							
Overall correct classification (%)	95.27	95.19	95.27	94.79	95.34	95.38	96.29
Y = 1 correct (%)	54.05	54.05	54.05	51.35	51.35	59.46	62.16
Y = 0 correct (%)	94.72	94.64	94.72	94.21	94.75	94.90	95.84

This table shows the result of estimating equation (1) using a standard logit model for an unbalanced panel of U.S. and European publicly traded commercial banks over the 2005–2008 period. The dependent variable is a binary variable that takes on a value of 1 at time *t* if the bank is bankrupt or quasi-bankrupt at time *t + 1* and a value of 0 otherwise. See Table 2.4 for the definition of the explanatory variables. Equation (1) is estimated by introducing each liquidity ratio from the CAMELS approach individually (equations (1.a)–(1.g)). To deal with colinearity issues in all the regressions, *LLP_TLO* is orthogonalised with *ROA* and *M_EFCY* with *ROA*. The quality of the model is assessed with the McFadden R-square and the likelihood ratio test (i.e., *LR1*, to test the joint significance of regressors by comparing the likelihood of the model with that of a model with only an intercept). In addition, another likelihood ratio test is performed (*LR2*) to test the joint significance of regressors by comparing the likelihood of the model with that of a model without *I_NSFR* as explanatory variable. To assess the classification accuracy of the model, in-sample classifications are reported. The cutoff value is the proportion of *Y* equal to 1 in the whole sample (4.7%). *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 2.7. Liquidity and bank financial distress: Logit regression results introducing each liquidity ratio from the CAMELS approach and the inverse of the Basel III net stable funding ratio

	1. a'	1. b'	1. c'	1. d'	1. e'	1. f'
LA_TA	-2.31 (-0.98)					
LA_DEPO		-0.89 (-1.51)				
LA_DP_STMD			-0.01 (-0.01)			
LO_TA				2.36 (1.26)		
LO_DEPO					-0.07 (-0.25)	
LO_DP_STMD						0.74 *** (2.93)
I_NSFR	4.05 *** (5.53)	4.30 *** (6.40)	4.34 *** (6.23)	4.20 *** (6.15)	4.43 *** (5.26)	4.42 *** (6.55)
T12_RWA	-22.82 *** (-2.36)	-22.84 *** (-2.40)	-23.16 *** (-2.39)	-21.24 ** (-2.26)	-23.32 *** (-2.41)	-22.56 ** (-2.31)
LLP_TLO	54.93 *** (3.70)	53.34 *** (3.62)	54.69 *** (3.65)	55.74 *** (3.68)	54.03 *** (3.44)	55.46 *** (3.68)
M_EFCY	1.75 ** (1.93)	1.95 ** (2.10)	1.54 * (1.67)	1.95 ** (2.23)	1.56 * (1.82)	1.49 ** (2.18)
ROA	-47.70 *** (-4.65)	-48.82 *** (-4.84)	-47.15 *** (-4.61)	-50.38 *** (-4.82)	-46.91 *** (-4.52)	-47.25 *** (-4.65)
LN_TA	0.44 *** (2.70)	0.49 *** (2.92)	0.38 *** (2.34)	0.48 *** (2.85)	0.39 *** (3.15)	0.39 *** (2.95)
HHI_INC	1.63 (1.54)	1.76 * (1.60)	1.70 * (1.62)	1.83 * (1.68)	1.66 (1.59)	1.69 * (1.62)
GDWL_TA	-6.27 (-0.59)	-9.04 (-0.76)	-3.83 (-0.34)	-3.72 (-0.35)	-4.52 (-0.41)	-1.27 (-0.12)
GDP_GWT	31.56 (1.45)	31.90 (1.48)	31.90 (1.40)	32.49 (1.49)	31.68 (1.38)	28.92 (1.31)
IBK1M_CB	213.15 *** (5.45)	225.22 *** (5.51)	216.55 *** (5.24)	210.15 *** (5.38)	220.94 *** (4.97)	178.63 *** (3.96)
CONTROL	0.06 (0.47)	0.06 (0.51)	0.06 (0.44)	0.03 (0.26)	0.06 (0.44)	0.06 (0.45)
C	-11.31 *** (-3.74)	-12.18 *** (-3.77)	-11.54 *** (-3.76)	-13.93 *** (-3.58)	-11.52 *** (-3.82)	-12.36 *** (-4.04)
Mc Fadden R²	0.32	0.32	0.31	0.32	0.31	0.33
LR1 Stat and % level to reject: H0: $b_j = 0$ " $b_j \neq a$	124.33 *** (0.00)	126.04 *** (0.00)	123.21 *** (0.00)	124.82 *** (0.00)	123.30 *** (0.00)	128.28 *** (0.00)
LR2 Stat and % level to reject: H0: $b_{LB} = 0$	31.87 *** (0.00)	41.54 *** (0.00)	35.25 *** (0.00)	35.70 *** (0.00)	36.29 *** (0.00)	41.73 *** (0.00)
Total Obs.	2763	2763	2763	2763	2763	2763
Total Obs. with Y = 1	37	37	37	37	37	37
In sample classification						
Overall correct classification (%)	95.73	95.62	95.80	95.73	95.91	95.73
Y = 1 correct (%)	64.86	64.86	62.16	64.86	64.86	62.16
Y = 0 correct (%)	96.15	96.04	96.26	96.15	96.33	96.18

This table shows the result of estimating equation (1) using a standard logit model for an unbalanced panel of U.S. and European publicly traded commercial banks over the 2005–2008 period. The dependent variable is a binary variable that takes on a value of 1 at time *t* if the bank is bankrupt or quasi-bankrupt at time *t + 1* and a value of 0 otherwise. See Table 2.4 for the definition of the explanatory variables. Equation (1) is estimated by introducing each liquidity ratio from the CAMELS approach individually with the inverse of the net stable funding ratio (equations (1.a′)–(1.f′)). To deal with colinearity issues in all the regressions, *LLP_TLO* is orthogonalised with *ROA* and *M_EFCY* with *ROA*. The quality of the model is assessed with the McFadden R-square and the likelihood ratio test (i.e., *LR1*, to test the joint significance of regressors by comparing the likelihood of the model with that of a model with only an intercept). In addition, another likelihood ratio test is performed (*LR2*) to test the joint significance of regressors by comparing the likelihood of the model with that of a model without *I_NSFR* as explanatory variable. To assess the classification accuracy of the model, in-sample classifications are reported. The cutoff value is the proportion of *Y* equal to 1 in the whole sample (4.7%). *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

In the baseline of the estimations, most of the liquidity ratios from the CAMELS approach and the inverse of the Basel III net stable funding ratio are significant, their related coefficients having the expected signs (see Table 2.6). Consistent with Cole and White (2010) which consider US commercial banks during the subprime crisis (i.e., over the 2007-2009 period) and with Arena (2005) focusing on commercial banks in East Asia from 1995 to 1999, higher liquid asset ratios are associated with a lower default probability (i.e., the coefficients of *LA_TA* and *LA_DP_STMD* are significantly negative). In addition, consistent with Gonzalez-Hermosillo (1999) considering Southwest US commercial banks over the 1985-1992 period, higher loan ratios are associated with a higher default probability (i.e., the coefficients of *LO_TA*, *LO_DEPO* and *LO_DP_STMD* are significantly positive). Besides, the estimation with only the inverse of the Basel III net stable funding ratio (*I_NSFR*) has a 31% Mc Fadden R-square compared with the Mc Fadden R-square of the other models (e.g., including only a liquidity ratio from the CAMELS approach) varying between 22% and 24%. These results emphasize the relevance of considering liquidity to explain bank default probability. The findings suggest that liquidity pressures on banks are significantly damaging and tend to make them significantly more fragile following an exogenous and unexpected shock. These results confirm the need of monitoring liquidity to strengthen bank stability. In addition, the model with only the inverse of the Basel III net stable funding ratio as liquidity ratio has the highest predictive value. This highlights the relevance of the liquidity indicator as defined in the Basel III accords to predict bank financial distress.

Considering each liquidity ratio from the CAMELS approach and the inverse of the Basel III net stable funding ratio, only the coefficient of the ratio of total loans to total deposits and short-term market debts (*LO_DP_STMD*) is significantly positive (see Table 2.7). In contrast, the coefficient of the inverse of the Basel III net stable funding ratio (*I_NSFR*) is significantly positive. In addition, from likelihood ratio test (see Table 2.7, *LR2*), the results show that the introduction of the inverse of the Basel III net stable funding ratio significantly adds predictive value to models relying on liquidity ratios from the CAMELS approach. These findings highlight the relevance of the liquidity indicator as defined in the Basel III accords to predict bank financial distress. These findings also imply that the liquidity ratio as defined in the Basel III accords captures a large part of the information provided by the liquidity ratios traditionally used in the CAMELS approach. Thus, the results confirm the need to improve the definition of bank liquidity, because the inverse of the Basel III net stable finding ratio performs well in explaining bank financial distress. Considering only the traditional liquidity ratios from the CAMELS approach ignores additional information provided by the liquidity ratio as defined in the Basel III accords. Given the increasing connections between banks and financial markets, these results emphasize that it is essential to consider a liquidity ratio that includes the information on the cash value of assets and on the availability of market funding in addition to liquidity ratios computed from accounting data.

Regarding the additional determinants of bank default probability, the coefficient of the total risk weighted capital ratio (*T12_RWA*) is significantly negative. This result suggests that, consistent with the economic theory, bank default probability is negatively related to the level of capitalization at risk. This finding indicates that the deterioration of bank capitalization relative to the risk profile of assets could be one of the root causes of the subprime crisis. It confirms the need to define a stronger capital base and to improve risk valuation models to reinforce bank ability to effectively absorb losses during crisis[60]. In addition, the coefficient of the ratio of loan loss provisions to total loans (*LLP_TLO*) is significantly positive. Consequently, bank default probability is inversely related to the quality of bank assets. Assuming that higher loan loss provisions indicate higher credit risk, this result implies that the deterioration of the quality of the loan portfolio significantly increases bank default probability. Furthermore, the coefficient of the cost-to-income ratio (*M_EFCY*) is significantly positive. Consequently, bank default probability is inversely related to the efficiency of bank managers. This finding suggests that lower operating costs and better management efficiency indicate a better likelihood of preventing bank financial distress. Furthermore, the coefficient of the return on assets (*ROA*) is significantly negative. Thus, bank default probability is negatively related to the level of bank profitability. This finding suggests that banks with good earning profiles are less likely to experience financial distress.

Moreover, the coefficient of the proxy of bank size (*LN_TA*) is significantly positive. Consequently, bank default probability is positively related to the size of the bank. This result confirms the necessity of considering bank size to mitigate moral hazard behavior of large banks, which benefit from their too-big-to-fail position to take excessive risk exposures. In addition, the coefficient of the spread of the one-month interbank rate and the central bank policy rate (*IBK1M_CB*) is significantly positive. Consequently, bank default probability is inversely related to the liquidity pressures on the interbank market. The positive sign for the

60 For further details about the improvement of the definition of bank capital and of the risk valuation models, see BIS (2009b) and U.S. Department of the Treasury (2009).

coefficient of this variable indicates that higher liquidity pressures on the interbank market tend to increase bank default probability. This finding highlights the importance of considering the state of the interbank market in the analysis of individual bank failure. Furthermore, perhaps surprisingly, the proxy of revenue diversification (*HHI_INC*) is not significant in the baseline of the estimations. In addition, the annual growth rate of real GDP (*GDP_GWT*) and the index of supervisory regime (*CONTROL*) are not significant. The low predictive power of these two macroeconomic variables illustrates to some extent the high degree of economic integration within U.S. and European countries and the fact that many of the banks have operations in more than one country. Thus, this is likely to limit the ability of country-level macroeconomic variables to explain individual bank financial distress.

2.4.2. In-sample and out-of-sample predictions accuracy

The classification accuracy of the model is assessed by considering in-sample classifications. Such classifications are reported at the bottom of Table 2.7. Note that the percentage of correct classifications is higher than 95%, regardless of the liquidity ratio considered from the CAMELS approach (equations (1.a′)–(1.f′)). More precisely, the percentage of correct predictions of bank financial distress is higher than 62%, and the percentage of correct predictions of non failed banks is higher than 96%. Thus, the model misclassifies 38% of nonfailed banks as in financial distress (type 1 error). In addition, it misclassifies 4% of banks in financial distress as survivors (type 2 error).

The predictive power of the model is assessed by performing out-of-sample tests. As discussed previously, the model is estimated over the 2005–2007 period, and the out-of-sample classifications are performed on 2008. Table 2.8 shows the regression results.

Table 2.8. Liquidity and bank financial distress: Out-of-sample prediction accuracy

	1. a'	1. b'	1. c'	1. d'	1. e'	1. f'
LA_TA	-2.44					
	(-0.87)					
LA_DEPO		-1.51				
		(-1.42)				
LA_DP_STMD			-1.77			
			(-0.82)			
LO_TA				3.18 *		
				(1.74)		
LO_DEPO					-1.10	
					(-1.36)	
LO_DP_STMD						0.11
						(0.20)
I_NSFR	4.53 ***	4.85 ***	4.57 ***	4.60 ***	6.20 ***	4.80 ***
	(5.00)	(5.38)	(4.95)	(5.00)	(4.11)	(5.18)
T12_RWA	-22.98	-21.28	-21.85	-22.17	-22.79	-24.00
	(-1.53)	(-1.46)	(-1.48)	(-1.49)	(-1.40)	(-1.55)
LLP_TLO	53.59 *	43.40	51.00 *	55.09 *	24.74	53.72 *
	(1.70)	(1.30)	(1.68)	(1.74)	(0.56)	(1.67)
M_EFCY	2.08	2.19	2.10	2.39	0.71	1.70
	(0.98)	(1.11)	(1.02)	(1.30)	(0.29)	(0.80)
ROA	-35.02	-38.41	-38.52	-38.63	-43.41	-35.14
	(-1.27)	(-1.43)	(-1.45)	(-1.50)	(-1.59)	(-1.28)
LN_TA	0.45 **	0.55 ***	0.48 **	0.51 ***	0.39 ***	0.38 ***
	(2.10)	(2.45)	(2.08)	(2.47)	(2.37)	(2.35)
HHI_INC	2.17	2.30	2.16	2.44 *	1.34	2.19
	(1.47)	(1.48)	(1.47)	(1.62)	(0.88)	(1.53)
GDWL_TA	-12.85	-18.94	-14.01	-10.34	-19.72	-9.65
	(-1.03)	(-1.19)	(-0.91)	(-0.75)	(-1.15)	(-0.69)
GDP_GWT	64.89 *	61.86	68.61 *	63.60 *	77.04 *	67.50 *
	(1.70)	(1.52)	(1.69)	(1.70)	(1.79)	(1.78)
IBK1M_CB	234.54 ***	259.04 ***	261.29 ***	231.60 ***	316.93 ***	232.67 ***
	(3.76)	(4.05)	(3.65)	(3.78)	(2.77)	(3.25)
CONTROL	0.18	0.17	0.18	0.14	0.24	0.17
	(1.01)	(0.98)	(0.99)	(0.81)	(1.26)	(0.99)
C	-14.12 ***	-15.33 ***	-14.69 ***	-17.25 ***	-15.37 ***	-14.36 ***
	(-3.11)	(-3.14)	(-3.08)	(-3.20)	(-3.01)	(-3.13)
Mc Fadden R²	0.26	0.27	0.26	0.26	0.28	0.26
LR1 Stat and % level to reject:	64.01 ***	66.75 ***	64.62 ***	65.07 ***	67.65 ***	63.38 ***
H0: $b_j = 0$ " $b_j \neq a$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LR2 Stat and % level to reject:	20.41 ***	25.27 ***	20.74 ***	22.95 ***	32.15 ***	27.68 ***
H0: $b_{LB} = 0$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total Obs.	2159	2159	2159	2159	2159	2159
Total Obs. with Y = 1	22	22	22	22	22	22
Out-off sample classification						
Overall correct classification (%)	95.53	95.53	95.53	95.70	95.70	95.70
Y = 1 correct (%)	53.33	53.33	46.67	53.33	46.67	53.33
Y = 0 correct (%)	97.10	97.10	97.27	97.27	97.44	97.27

This table shows the result of estimating equation (1) using a standard logit model for an unbalanced panel of U.S. and European publicly traded commercial banks over the 2005–2007 period. The dependent variable is a binary variable that takes on a value of 1 at time *t* if the bank is bankrupt or quasi-bankrupt at time *t + 1* and a value of 0 otherwise. See Table 2.4 for the definition of the explanatory variables. Equation (1) is estimated by introducing each liquidity ratio from the CAMELS approach individually with the inverse of the net stable funding ratio (equations (1.a′)–(1.f′)). To deal with colinearity issues in all the regressions, *LLP_TLO* is orthogonalised with *ROA* and *M_EFCY* with *ROA*. The quality of the model is assessed with the McFadden R-square and the likelihood ratio test (i.e., *LR1*, to test the joint significance of regressors by comparing the likelihood of the model with that of a model with only an intercept). In addition, another likelihood ratio test is performed (*LR2*) to test the joint significance of regressors by comparing the likelihood of the model with that of a model without *I_NSFR* as explanatory variable. To assess the predictive power of the model, out-of-sample classifications on the year 2008 are reported. The cutoff value is the proportion of *Y* equal to 1 in the whole sample (4.7%). *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

From out-of-sample tests, the results show that the percentage of correct classifications is higher than 95%, regardless of the liquidity ratio considered from the CAMELS approach. In addition, the percentage of correct predictions of bank financial distress is higher than 46%, and the percentage of correct predictions of non failed bank is higher than 97%. Consequently, the model misclassifies 52% of nonfailed banks as in financial distress and 3% of banks in financial distress as survivors. Moreover, the main conclusions obtained on the restricted sample (i.e., excluding the year 2008) are consistent with those obtained on the whole sample. In all cases, the coefficient of *I_NSFR* is significantly positive. The likelihood ratio test for the contribution of the *I_NSFR* variable to the predictive value of models relying on liquidity ratios from the CAMELS approach confirms that the introduction of a liquidity ratio as defined in the Basel III accords significantly adds predictive value to models that rely on liquidity ratios from the CAMELS approach.

2.5. Robustness checks

Several robustness checks were performed. The regression results are shown in Appendix 2.B.

To check the robustness of the results, considering the colinearity of *I_NSFR* with the liquidity ratios from the CAMELS approach (*I_NSFR* is correlated at least –0.15 and at most –0.58 with the liquidity ratios from the CAMELS approach), equation (1) is estimated by orthogonalising the *I_NSFR* variable with each liquidity ratio from the CAMELS approach in all regressions (see Table 2.B.1). The results show that most of the liquidity ratios from the CAMELS approach and the inverse of the Basel III net stable funding ratio are significant, their related coefficients having the expected signs. These results suggest that the liquidity ratio as defined in the Basel III accords captures a large part of the information provided by the liquidity ratios traditionally used in the CAMELS approach. Regarding the additional determinants of bank default probability, results are consistent with those previously obtained.

To determine the robustness of the results for the *I_NSFR* variable, the weight of 0.7 for demand and saving deposits is changed. Alternately three other weights are considered to determine whether the results can be affected by the extent of deposits considered stable. The first weight is 0.5 (*I_NSFR_D05*), the minimum weight set by the Basel Committee on Banking Regulation and Supervision for stable demand and saving deposits. The second one is 0.85 (*I_NSFR_D085*), the maximum weight set by the Basel Committee on Banking Regulation and Supervision for stable demand and saving deposits. The third one is 1 in the extreme case considering all demand and saving deposits stable (*I_NSFR_D1*). Explicit deposit insurance systems and implicit government guarantee of deposits mitigate the risk of run on deposits and strengthen their stability. Equation (1) is estimated by introducing individually the three specifications of the inverse of the Basel III net stable funding ratio with each liquidity indicator from the CAMELS approach (see Table 2.B.2, Table 2.B.3 and Table 2.B.4). In all cases, the results are consistent with those previously obtained. In addition, the conclusions of the likelihood ratio test for the contribution of the alternative specifications of *I_NSFR* to the predictive value of models relying on liquidity ratios from the CAMELS approach are consistent with those previously obtained.

The robustness of our findings is also examined by running regressions separately for U.S. and European banks to determine whether the results are driven by U.S. banks alone, as they account for a large share of the sample. For U.S. banks, all macroeconomic variables (e.g., *GDP_GWT*, *IBK1M_CB*, *CONTROL*) have been removed from equation (1) because their cross-sectional variances are null (see Table 2.B.5 for European banks and Table 2.B.6 for U.S. banks). The results are consistent with those previously obtained for all liquidity ratios, except the ratio of total loans to total deposits and short-term market funding becomes not significant for U.S. banks. Other than that, the conclusions of the likelihood ratio test for the contribution of the *I_NSFR* variable to the predictive value of models relying on liquidity ratios from the CAMELS approach are consistent with those previously obtained for both U.S. and European banks[61].

Furthermore, to examine the robustness of the findings an alternative definition of the inverse of the Basel III net stable funding ratio (*I_NSFR*) is considered for U.S. banks. Indeed, the definition of stable funding might be adjusted in the U.S. case. Harvey and Spong (2001) and Saunders and Cornett (2006) emphasize the importance of core deposits for U.S. banks. Core deposits are defined as the sum of demand deposits, saving deposits and time deposits lower than US$100,000. These deposits are derived to a great extent from a bank's regular customer base and are therefore typically the most stable and least costly source of funding for banks (Harvey and Spong, 2001). Thus, it might be relevant to adopt an alternative definition for stable deposits by considering core deposits for U.S. banks. Consequently, the denominator of the inverse of the net stable funding ratio is modified (*I_NSFR*) by considering the sum of core deposits and other stable funding as a proxy of the available

61 Because there are a relatively low number of observations for banks that are bankrupt or quasi-bankrupt in the Europe or in the United States, no out-of-sample tests have been run separately for U.S. or European banks.

amount of stable funding[62]. This liquidity proxy is defined as the *CFR* variable. For U.S. banks, it is computed as follows:

$$\text{CFR} = \frac{\text{Required amount of stable funding}}{\text{Core deposits + Stable funding}} = \frac{\begin{array}{l} 0 * (\text{cash + interbank assets + short-term marketable assets}) \\ + 0.5 * (\text{long-term marketable assets + customer acceptances}) \\ + 0.85 * \text{consumer loans} \\ + 1 * (\text{commercial loans + other loans + other assets + fixed assets}) \end{array}}{\begin{array}{l} 1 * \text{core deposits} \\ + 0 * (\text{short-term market debt + other short-term liabilities}) \\ + 1 * (\text{long-term liabilities + equity}) \end{array}}$$

A higher ratio implies that the amount of assets that cannot be monetized deviates from the core deposits and other stable funding. In this context, the bank might experience greater difficulties in meeting its current commitments with its current internal liquidity. A positive sign for the coefficient of the *CFR* variable (as for the *I_NSFR* variable) should result in the determination of bank default probability. Regressions are run on the subsample of U.S. banks by replacing in equation (1) the *I_NSFR* variable by the *CFR* variable (see Table 2.B.7). The main conclusions are consistent with those previously obtained by considering the *I_NSFR* variable. These findings confirm the advantage of improving the definition of liquidity to assess bank financial distress.

The stability of the results is also checked by considering an additional criterion in defining a bankrupt bank. Over the 2007–2009 period, 37 banks that failed or were quasi-bankrupt have been identified. However, Cole and White (2010) argue that many banks might be in "technical failure" even if they are never officially bankrupt or if they could not be officially known as such at year-end 2009. Indeed, the fundamentals of these banks might be considerably damaged before their technical failure. As in Cole and White (2010), a bank is considered to be in technical failure if its ratio of nonperforming assets to the sum of equity plus loan loss reserves is higher than 200%[63] over the 2007–2009 period. Annual consolidated financial statements were extracted from Bloomberg over the 2007–2009 period. 10 banks in technical failure have been identified for this time period (5 in 2008 and 5 in 2009)[64]. Table 2.B.8 contains the name, nature, date of technical failure and, if it exists, the date of official bankruptcy for each bank included in the sample. From 2007 to 2009, on average, the ratio of

62 The average share of core deposits to total deposits over the 2005–2008 period is 77% for the U.S. banks included in the sample. However, there is a high heterogeneity: The standard deviation of this ratio is 14%.

63 In other words, a bank is in technical failure if its equity plus loan loss reserves is under half the non performing assets.

64 It is worth noting that 7 of 10 banks were officially bankrupt or quasi-bankrupt over the 2009–2011 period. Indeed, 5 banks failed in 2010 and 1 bank failed in 2011. In addition, the WSB Financial Group Inc. was in technical failure in 2008 and is identified as officially bankrupt in 2009.

nonperforming assets to the sum of equity plus loan loss reserves of banks in technical failure is 278%. For nonfailed banks, this average ratio is 21%. Equation (1) is estimated by considering a larger sample of banks in default or quasi-default. Consequently, the dependent variable that is binary takes on a value of 1 at time *t* if the bank is failed, quasi-bankrupt or in technical failure at time $t + 1$, and a value of 0 otherwise. Regressions are run by considering all banks in the sample (see Table 2.B.9). Out-of-sample tests are also performed (see Table 2.B.10). Then, regressions are run separately for European and U.S. banks (see Table 2.B.11 for European banks and Table 2.B.12 for U.S. banks). In addition, the *CFR* variable is used as alternative definition of the inverse of the Basel III net stable funding ratio (*I_NSFR*) for U.S. banks (see Table 2.B.13). In all cases, the main conclusions are consistent with those previously obtained.

2.6. Concluding remarks

The objective of this study is to assess the advantage of using a liquidity ratio as defined in the Basel III accords to predict bank financial distress. The study questions whether the introduction of a liquidity ratio as defined in the Basel III accords, in addition to the liquidity ratios from the CAMELS approach, contributes to improving the prediction of bank financial distress. By implementing a standard logit model, the aim is to test whether the inverse of the Basel III net stable funding ratio adds predictive value to models relying on liquidity ratios from the CAMELS approach to explain bank default probability. The sample consists of U.S. and European publicly traded commercial banks over 2005–2009. This study contributes to the empirical literature strand on the determinants of individual bank failure as well as to the debate on liquidity regulation implemented in the Basel III regulatory framework, as this issue is important to assess the accuracy of improving the definition of liquidity ratios to predict bank financial distress.

The main results highlight the relevance of considering liquidity in explaining bank default probability. On the whole, the findings point out the relevance of the liquidity indicator as defined in the Basel III accords to predict bank financial distress. The results show that using the inverse of the Basel III net stable funding ratio adds predictive value to models relying on liquidity ratios from the CAMELS approach. These findings shed light on the benefits to considering a liquidity ratio as defined in the Basel III accords in addition to liquidity ratios computed from accounting data, as it performs well in explaining bank financial distress. More generally, these findings suggest that liquidity pressures on banks are significantly damaging. They tend to make banks more fragile following an exogenous and unexpected shock. These results confirm the relevance of monitoring bank liquidity to strengthen their stability, as stressed by the Basel Committee.

These findings support the need to improve the definition of liquidity to predict bank financial distress. Considering only the traditional liquidity ratios from the CAMELS approach ignores additional information provided by the liquidity ratio as defined in the Basel III accords. These findings emphasize that it is essential to consider in addition to the liquidity ratios from the CAMELS approach, a liquidity indicator that includes information on the cash value of assets and on the availability of deposit and market fundings. This finding is increasingly significant in a context in which banks and financial markets are highly connected.

APPENDIX 2.A. Correlation analysis of the determinants of bank financial distress

Table 2.A.1. Correlations among the main determinants of bank financial distress for U.S. and European listed commercial banks from 2005 to 2008

	T12_RWA	LLP_TLO	M_EFCY	ROA	LA_TA	LA_DEPO	LA_DP_STMD	LO_TA	LO_DEPO	LO_DP_STMD	I_NSFR	LN_TA	HHI_INC	GDWL_TA	GDP_GWT	IBK1M_CB	CONTROL
T12_RWA	1																
LLP_TLO	-0.09	1															
	0.00																
M_EFCY	0.09	0.16	1														
	0.00	*0.00*															
ROA	0.08	-0.52	-0.53	1													
	0.00	*0.00*	*0.00*														
LA_TA	0.22	-0.09	0.11	0.04	1												
	0.00	*0.00*	*0.00*	*0.05*													
LA_DEPO	-0.01	-0.04	0.08	-0.04	0.61	1											
	0.74	*0.02*	*0.00*	*0.02*	*0.00*												
LA_DP_STMD	0.11	-0.06	0.13	-0.01	0.83	0.79	1										
	0.00	*0.00*	*0.00*	*0.67*	*0.00*	*0.00*											
LO_TA	-0.23	0.06	-0.13	-0.01	-0.88	-0.59	-0.78	1									
	0.00	*0.00*	*0.00*	*0.67*	*0.00*	*0.00*	*0.00*										
LO_DEPO	-0.20	0.00	-0.09	-0.06	-0.19	0.42	0.09	0.20	1								
	0.00	*0.88*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*									
LO_DP_STMD	-0.19	0.03	-0.10	-0.02	-0.53	-0.10	-0.18	0.55	0.66	1							
	0.00	*0.10*	*0.00*	*0.27*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*								
I_NSFR	-0.32	0.10	-0.11	-0.08	-0.58	-0.15	-0.45	0.51	0.51	0.34	1						
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*							
LN_TA	-0.27	0.05	-0.19	0.02	0.28	0.46	0.44	-0.39	0.33	0.10	0.14	1					
	0.00	*0.00*	*0.00*	*0.28*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*						
HHI_INC	0.17	0.05	0.13	-0.16	-0.15	-0.15	-0.16	0.17	-0.22	-0.08	-0.13	-0.47	1				
	0.00	*0.01*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*					
GDWL_TA	-0.11	0.01	-0.07	0.03	-0.04	-0.04	-0.03	-0.08	-0.10	-0.08	0.03	0.23	-0.09	1			
	0.00	*0.61*	*0.00*	*0.14*	*0.02*	*0.04*	*0.07*	*0.00*	*0.00*	*0.00*	*0.11*	*0.00*	*0.00*				
GDP_GWT	0.05	-0.43	-0.14	0.36	0.05	0.01	0.05	-0.05	-0.03	0.01	-0.09	-0.01	-0.03	-0.06	1		
	0.01	*0.00*	*0.00*	*0.00*	*0.01*	*0.62*	*0.00*	*0.02*	*0.14*	*0.71*	*0.00*	*0.72*	*0.08*	*0.00*			
IBK1M_CB	-0.02	0.11	0.01	-0.10	-0.10	-0.02	-0.05	0.11	0.13	0.19	0.09	-0.01	0.01	0.01	-0.30	1	
	0.20	*0.00*	*0.62*	*0.00*	*0.00*	*0.19*	*0.01*	*0.00*	*0.00*	*0.00*	*0.00*	*0.66*	*0.62*	*0.60*	*0.00*		
CONTROL	0.09	0.01	0.06	-0.03	-0.19	-0.35	-0.33	0.27	-0.32	-0.09	-0.17	-0.50	0.28	0.14	-0.13	0.04	1
	0.00	*0.79*	*0.00*	*0.11*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.06*	

All variables are expressed in percentage, except *LN_TA, HHI_INC* and *CONTROL*. *T12_RWA:* (Tier 1 capital + Tier 2 capital) / total risk weighted assets; *LLP_TLO:* loan loss provisions / total loans; *M_EFCY:* total operating expenses / net income; *ROA:* net income / total assets; *LA_TA:* (cash and near items + interbank assets + government and other short-term trading securities) / total assets; *LA_DEPO:* (cash and near items + interbank assets + government and other short-term trading securities) / total deposits; *LA_DP_STMD:* (cash and near items + interbank assets + government and other short-term trading securities) / (total deposits + short-term market debts); *LO_TA:* total loans / total assets; *LO_DEPO:* total loans / total deposits; *LO_DP_STMD:* total loans / (total deposits + short-term market debts); *I_NSFR:* required amount of stable funding / available amount of stable funding; *LN_TA:* natural logarithm of total assets; *HHI_INC:* normalized Herfindalh-Hirschman index for concentration of bank interest versus noninterest income; *GDWL_TA:* intangible assets / total assets; *GDP_GWT:* annual growth rate of real GDP; *IBK1M_CB:* spread of one month interbank rate and central bank policy rate; *CONTROL*: index of supervisory regime. Figures in italics indicate p-values of the T-statistics that test for null hypothesis of Pearson’s coefficients of correlation equal to 0.

APPENDIX 2.B. Regression results of the robustness checks

Table 2.B.1. Liquidity and bank financial distress: The potential impact of colinearity of *I_NSFR* with the CAMELS liquidity ratios addressed by orthogonalising *I_NSFR* with each CAMELS liquidity ratio

	1. a'	1. b'	1. c'	1. d'	1. e'	1. f'
LA_TA	-6.09 *** (-2.82)					
LA_DEPO		-1.17 ** (-1.96)				
LA_DP_STMD			-1.72 (-1.59)			
LO_TA				5.42 *** (2.93)		
LO_DEPO					0.69 *** (3.07)	
LO_DP_STMD						1.77 *** (6.04)
I_NSFR	4.05 *** (5.53)	4.30 *** (6.40)	4.34 *** (6.23)	4.20 *** (6.15)	4.43 *** (5.26)	4.42 *** (6.55)
T12_RWA	-22.82 *** (-2.36)	-22.84 *** (-2.40)	-23.16 *** (-2.39)	-21.24 ** (-2.26)	-23.32 *** (-2.41)	-22.56 ** (-2.31)
LLP_TLO	54.93 *** (3.70)	53.34 *** (3.62)	54.69 *** (3.65)	55.74 *** (3.68)	54.03 *** (3.44)	55.46 *** (3.68)
M_EFCY	1.75 ** (1.93)	1.95 ** (2.10)	1.54 * (1.67)	1.95 ** (2.23)	1.56 * (1.82)	1.49 ** (2.18)
ROA	-47.70 *** (-4.65)	-48.82 *** (-4.84)	-47.15 *** (-4.61)	-50.38 *** (-4.82)	-46.91 *** (-4.52)	-47.25 *** (-4.65)
LN_TA	0.44 *** (2.70)	0.49 *** (2.92)	0.38 *** (2.34)	0.48 *** (2.85)	0.39 *** (3.15)	0.39 *** (2.95)
HHI_INC	1.63 (1.54)	1.76 * (1.60)	1.70 * (1.62)	1.83 * (1.68)	1.66 (1.59)	1.69 * (1.62)
GDWL_TA	-6.27 (-0.59)	-9.04 (-0.76)	-3.83 (-0.34)	-3.72 (-0.35)	-4.52 (-0.41)	-1.27 (-0.12)
GDP_GWT	31.56 (1.45)	31.90 (1.48)	31.90 (1.40)	32.49 (1.49)	31.68 (1.38)	28.92 (1.31)
IBK1M_CB	213.15 *** (5.45)	225.22 *** (5.51)	216.55 *** (5.24)	210.15 *** (5.38)	220.94 *** (4.97)	178.63 *** (3.96)
CONTROL	0.06 (0.47)	0.06 (0.51)	0.06 (0.44)	0.03 (0.26)	0.06 (0.44)	0.06 (0.45)
C	-6.68 *** (-2.46)	-8.07 *** (-2.77)	-6.97 *** (-2.50)	-12.11 *** (-3.19)	-8.22 *** (-3.03)	-9.17 *** (-3.28)
Mc Fadden R²	0.32	0.32	0.31	0.32	0.31	0.33
LR1 Stat and % level to reject: H0: $b_j = 0$ " $b_j \neq a$	124.33 *** (0.00)	126.04 *** (0.00)	123.21 *** (0.00)	124.82 *** (0.00)	123.30 *** (0.00)	128.28 *** (0.00)
LR2 Stat and % level to reject: H0: $b_{LB} = 0$	31.87 *** (0.00)	41.54 *** (0.00)	35.25 *** (0.00)	35.70 *** (0.00)	36.29 *** (0.00)	41.73 *** (0.00)
Total Obs.	2763	2763	2763	2763	2763	2763
Total Obs. with Y = 1	37	37	37	37	37	37
In sample classification						
Overall correct classification (%)	95.73	95.62	95.80	95.73	95.91	95.73
Y = 1 correct (%)	64.86	64.86	62.16	64.86	64.86	62.16
Y = 0 correct (%)	96.15	96.04	96.26	96.15	96.33	96.18

This table shows the result of estimating equation (1) using a standard logit model for an unbalanced panel of U.S. and European publicly traded commercial banks over the 2005–2008 period. The dependent variable is a binary variable that takes on a value of 1 at time *t* if the bank is bankrupt or quasi-bankrupt at time *t + 1* and a value of 0 otherwise. See Table 2.4 for the definition of the explanatory variables. Equation (1) is estimated by introducing each liquidity ratio from the CAMELS approach individually (equations (1.a′)–(1.f′)). To deal with potential colinearity issues in all the regressions, *I_NSFR* is orthogonalised with each liquidity ratio from the CAMELS approach. In addition, *LLP_TLO* is orthogonalised with *ROA* and *M_EFCY* with *ROA.* The quality of the model is assessed with the McFadden R-square and the likelihood ratio test (i.e., *LR1*, to determine the joint significance of regressors by comparing the likelihood of the model with that of a model with only an intercept). In addition, another likelihood ratio test (LR2) is performed to determine the joint significance of regressors by comparing the likelihood of the model with that of a model without *I_NSFR* as explanatory variable. To assess the classification accuracy of the model, in-sample classifications are reported. The cutoff value corresponds to the proportion of *Y* equal to 1 in the whole sample (4.7%). *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 2.B.2. Liquidity and bank financial distress using an alternative weight of 0.5 for stable deposits in the inverse of the net stable funding ratio

	1. a'	1. b'	1. c'	1. d'	1. e'	1. f'
LA_TA	-3.59 * (-1.71)					
LA_DEPO		-0.83 * (-1.69)				
LA_DP_STMD			-0.63 (-0.52)			
LO_TA				3.48 ** (1.88)		
LO_DEPO					0.14 (0.84)	
LO_DP_STMD						0.73 *** (2.90)
I_NSFR_D05	1.98 *** (2.78)	2.28 *** (3.53)	2.23 *** (3.01)	2.22 *** (3.60)	2.28 *** (3.15)	2.46 *** (3.49)
T12_RWA	-23.83 *** (-2.60)	-24.12 *** (-2.72)	-24.12 *** (-2.65)	-21.54 *** (-2.41)	-24.24 *** (-2.67)	-23.96 *** (-2.54)
LLP_TLO	53.45 *** (3.64)	51.71 *** (3.51)	53.37 *** (3.59)	54.44 *** (3.60)	54.81 *** (3.62)	54.28 *** (3.63)
M_EFCY	1.66 ** (2.10)	1.70 ** (2.07)	1.53 * (1.75)	1.91 *** (2.45)	1.30 * (1.78)	1.30 ** (2.03)
ROA	-46.89 *** (-4.83)	-47.79 *** (-4.99)	-47.27 *** (-4.88)	-50.22 *** (-5.06)	-46.63 *** (-4.72)	-46.22 *** (-4.75)
LN_TA	0.46 *** (3.02)	0.48 *** (3.04)	0.41 *** (2.58)	0.51 *** (3.22)	0.36 *** (3.12)	0.37 *** (2.98)
HHI_INC	1.33 (1.28)	1.53 (1.42)	1.43 (1.38)	1.58 (1.47)	1.47 (1.47)	1.36 (1.31)
GDWL_TA	-10.80 (-0.94)	-12.69 (-0.99)	-9.11 (-0.73)	-7.05 (-0.60)	-6.02 (-0.51)	-4.97 (-0.43)
GDP_GWT	27.48 (1.35)	27.95 (1.36)	28.78 (1.35)	28.29 (1.39)	28.91 (1.34)	25.55 (1.22)
IBK1M_CB	201.09 *** (5.27)	216.23 *** (5.41)	212.25 *** (5.24)	197.23 *** (5.16)	197.89 *** (4.90)	168.81 *** (3.83)
CONTROL	0.03 (0.28)	0.04 (0.34)	0.03 (0.25)	0.00 (0.02)	0.03 (0.26)	0.04 (0.32)
C	-8.62 *** (-2.94)	-9.62 *** (-3.08)	-9.01 *** (-3.00)	-12.51 *** (-3.34)	-9.05 *** (-3.08)	-9.83 *** (-3.22)
Mc Fadden R^2	0.28	0.28	0.27	0.28	0.27	0.28
LR1 Stat and % level to reject: H0: $b_j = 0$ " $b_j \neq a$	108.78 *** (0.00)	108.48 *** (0.00)	106.08 *** (0.00)	109.43 *** (0.00)	106.14 *** (0.00)	111.06 *** (0.00)
LR2 Stat and % level to reject: H0: $b_{LB} = 0$	16.32 *** (0.00)	23.98 *** (0.00)	18.12 *** (0.00)	20.32 *** (0.00)	19.13 *** (0.00)	24.51 *** (0.00)
Total Obs.	2763	2763	2763	2763	2763	2763
Total Obs. with Y = 1	37	37	37	37	37	37
In sample classification						
Overall correct classification (%)	95.33	95.44	95.37	94.93	95.08	95.62
Y = 1 correct (%)	59.46	59.46	59.46	59.46	59.46	62.16
Y = 0 correct (%)	95.82	95.93	95.85	95.41	95.56	96.07

This table shows the result of estimating equation (1) using a standard logit model for an unbalanced panel of U.S. and European publicly traded commercial banks, over the 2005–2008 period. The dependent variable is a binary variable that takes on a value of 1 at time *t* if the bank is bankrupt or quasi-bankrupt at time *t + 1* and a value of 0 otherwise. See Table 2.4 for the definition of the explanatory variables. Equation (1) is estimated by introducing each liquidity ratio from the CAMELS approach individually (equations (1.a′)–(1.f′)). An alternative specification of the inverse of the net stable funding ratio (*I_NSFR*) is introduced by considering a weight of 0.5 instead of 0.7 for demand and saving deposits (*I_NSFR_D05*). To deal with colinearity issues in all the regressions, *LLP_TLO* is orthagonalised with *ROA* and *M_EFCY* with *ROA.* The quality of the model is assessed with the McFadden R-square and the likelihood ratio test (i.e., *LR1*, to determine the joint significance of regressors by comparing the likelihood of the model with that of a model with only an intercept). In addition, another likelihood ratio test (*LR2*) is performed to determine the joint significance of regressors by comparing the likelihood of the model with that of a model without *I_NSFR* as explanatory variable. To assess the classification accuracy of the model, in-sample classifications are reported. The cutoff value is the proportion of *Y* equal to 1 in the whole sample (4.7%). *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 2.B.3. Liquidity and bank financial distress using an alternative weight of 0.85 for stable deposits in the inverse of the net stable funding ratio

	1. a'	1. b'	1. c'	1. d'	1. e'	1. f'
LA_TA	-2.49 (-1.09)					
LA_DEPO		-0.91 (-1.58)				
LA_DP_STMD			-0.30 (-0.26)			
LO_TA				3.34 (1.59)		
LO_DEPO					-0.01 (-0.02)	
LO_DP_STMD						0.69 *** (2.73)
I_NSFR_D085	3.25 *** (2.56)	3.55 *** (3.00)	3.54 *** (2.89)	3.41 *** (2.93)	3.62 *** (2.62)	3.69 *** (3.24)
T12_RWA	-24.03 *** (-2.46)	-24.10 *** (-2.50)	-24.26 *** (-2.49)	-21.63 ** (-2.32)	-24.55 *** (-2.54)	-23.86 *** (-2.41)
LLP_TLO	53.46 *** (3.72)	51.80 *** (3.62)	53.32 *** (3.68)	54.42 *** (3.70)	53.32 *** (3.55)	53.89 *** (3.73)
M_EFCY	1.59 * (1.86)	1.77 ** (2.01)	1.46 * (1.63)	1.93 *** (2.39)	1.36 * (1.70)	1.32 ** (2.01)
ROA	-46.17 *** (-4.62)	-47.24 *** (-4.79)	-46.16 *** (-4.63)	-50.07 *** (-4.93)	-45.56 *** (-4.49)	-45.61 *** (-4.61)
LN_TA	0.42 *** (2.68)	0.47 *** (2.88)	0.37 *** (2.33)	0.49 *** (2.96)	0.35 *** (3.01)	0.35 *** (2.82)
HHI_INC	1.41 (1.36)	1.56 (1.47)	1.49 (1.44)	1.67 (1.55)	1.49 (1.48)	1.44 (1.38)
GDWL_TA	-6.26 (-0.57)	-8.83 (-0.74)	-4.37 (-0.37)	-3.15 (-0.29)	-3.64 (-0.33)	-1.12 (-0.11)
GDP_GWT	30.26 (1.42)	30.69 (1.45)	31.29 (1.40)	31.47 (1.50)	31.07 (1.38)	27.91 (1.29)
IBK1M_CB	199.71 *** (5.16)	212.55 *** (5.30)	206.02 *** (5.07)	194.84 *** (5.00)	203.63 *** (4.62)	167.17 *** (3.76)
CONTROL	0.05 (0.38)	0.05 (0.42)	0.05 (0.36)	0.02 (0.15)	0.05 (0.36)	0.06 (0.40)
C	-9.58 *** (-2.98)	-10.50 *** (-3.13)	-9.90 *** (-3.07)	-13.29 *** (-3.49)	-9.85 *** (-3.12)	-10.63 *** (-3.28)
Mc Fadden R^2	0.29	0.30	0.29	0.30	0.29	0.30
LR1 Stat and % level to reject: H0: $b_j = 0$ " $b_j \neq a$	115.35 *** (0.00)	117.00 *** (0.00)	114.08 *** (0.00)	117.23 *** (0.00)	114.00 *** (0.00)	118.63 *** (0.00)
LR2 Stat and % level to reject: H0: $b_{LB} = 0$	22.89 *** (0.00)	32.51 *** (0.00)	26.12 *** (0.00)	28.11 *** (0.00)	26.99 *** (0.00)	32.08 *** (0.00)
Total Obs.	2763	2763	2763	2763	2763	2763
Total Obs. with Y = 1	37	37	37	37	37	37
In sample classification						
Overall correct classification (%)	95.66	95.55	95.66	95.15	95.62	95.62
Y = 1 correct (%)	62.16	62.16	64.86	62.16	62.16	64.86
Y = 0 correct (%)	96.11	96.00	96.07	95.60	96.07	96.04

This table shows the result of estimating equation (1) using a standard logit model for an unbalanced panel of U.S. and European publicly traded commercial banks, over the 2005–2008 period. The dependent variable is a binary variable that takes on a value of 1 at time *t* if the bank is bankrupt or quasi-bankrupt at time *t + 1* and a value of 0 otherwise. See Table 2.4 for the definition of the explanatory variables. Equation (1) is estimated by introducing each liquidity ratio from the CAMELS approach individually (equations (1.a′)–(1.f′)). An alternative specification of the inverse of the net stable funding ratio (*I_NSFR*) is introduced by considering a weight of 0.85 instead of 0.7 for demand and saving deposits (*I_NSFR_D085*). To deal with colinearity issues in all the regressions, *LLP_TLO* is orthagonalised with *ROA* and *M_EFCY* with *ROA*. The quality of the model is assessed with the McFadden R-square and the likelihood ratio test (i.e., *LR1*, to determine the joint significance of regressors by comparing the likelihood of the model with that of a model with only an intercept). In addition, another likelihood ratio test (*LR2*) is performed to determine the joint significance of regressors by comparing the likelihood of the model with that of a model without *I_NSFR* as explanatory variable. To assess the classification accuracy of the model, in-sample classifications are reported. The cutoff value is the proportion of *Y* equal to 1 in the whole sample (4.7%). *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 2.B.4. Liquidity and bank financial distress using an alternative weight of 1 for stable deposits in the inverse of the net stable funding ratio

	1. a'	1. b'	1. c'	1. d'	1. e'	1. f'
LA_TA	-2.13 (-0.91)					
LA_DEPO		-0.93 * (-1.60)				
LA_DP_STMD			-0.25 (-0.21)			
LO_TA				3.31 (1.55)		
LO_DEPO					-0.07 (-0.22)	
LO_DP_STMD						0.66 *** (2.61)
I_NSFR_D1	3.74 *** (2.63)	4.05 *** (3.03)	4.02 *** (2.96)	3.87 *** (2.93)	4.18 *** (2.57)	4.14 *** (3.28)
T12_RWA	-24.16 *** (-2.44)	-24.13 *** (-2.46)	-24.39 *** (-2.47)	-21.67 ** (-2.30)	-24.82 *** (-2.53)	-23.94 *** (-2.39)
LLP_TLO	53.22 *** (3.73)	51.54 *** (3.64)	53.06 *** (3.70)	54.20 *** (3.73)	52.44 *** (3.49)	53.55 *** (3.75)
M_EFCY	1.55 * (1.78)	1.78 ** (1.99)	1.44 (1.60)	1.93 *** (2.37)	1.37 * (1.64)	1.31 ** (1.98)
ROA	-45.73 *** (-4.51)	-46.93 *** (-4.70)	-45.65 *** (-4.53)	-49.86 *** (-4.85)	-44.87 *** (-4.34)	-45.19 *** (-4.52)
LN_TA	0.39 *** (2.52)	0.45 *** (2.82)	0.36 ** (2.22)	0.47 *** (2.84)	0.34 *** (2.92)	0.34 *** (2.72)
HHI_INC	1.41 (1.36)	1.53 (1.45)	1.48 (1.44)	1.66 (1.55)	1.44 (1.44)	1.43 (1.38)
GDWL_TA	-4.25 (-0.39)	-7.02 (-0.60)	-2.52 (-0.22)	-1.41 (-0.13)	-2.46 (-0.23)	0.51 (0.05)
GDP_GWT	30.74 (1.42)	31.11 (1.46)	31.64 (1.41)	32.01 (1.51)	31.26 (1.37)	28.25 (1.30)
IBK1M_CB	198.15 *** (5.10)	210.43 *** (5.25)	203.38 *** (4.98)	192.97 *** (4.93)	205.27 *** (4.51)	166.16 *** (3.74)
CONTROL	0.05 (0.39)	0.05 (0.41)	0.05 (0.36)	0.02 (0.16)	0.05 (0.36)	0.06 (0.40)
C	-9.77 *** (-3.01)	-10.65 *** (-3.16)	-10.04 *** (-3.08)	-13.42 *** (-3.52)	-9.97 *** (-3.14)	-10.73 *** (-3.29)
Mc Fadden R^2	0.30	0.31	0.30	0.31	0.30	0.31
LR1 Stat and % level to reject: H0: $b_j = 0$ " $b_j \neq a$	117.74 *** (0.00)	119.99 *** (0.00)	116.82 *** (0.00)	119.91 *** (0.00)	116.85 *** (0.00)	121.04 *** (0.00)
LR2 Stat and % level to reject: H0: $b_{LB} = 0$	25.27 *** (0.00)	35.50 *** (0.00)	28.86 *** (0.00)	30.79 *** (0.00)	29.85 *** (0.00)	34.49 *** (0.00)
Total Obs.	2763	2763	2763	2763	2763	2763
Total Obs. with Y = 1	37	37	37	37	37	37
In sample classification						
Overall correct classification (%)	95.58	95.58	95.44	95.22	95.69	95.69
Y = 1 correct (%)	62.16	62.16	64.86	64.86	64.86	67.57
Y = 0 correct (%)	96.04	96.04	95.85	95.63	96.11	96.07

This table shows the result of estimating equation (1) using a standard logit model for an unbalanced panel of U.S. and European publicly traded commercial banks, over the 2005–2008 period. The dependent variable is a binary variable that takes on a value of 1 at time *t* if the bank is bankrupt or quasi-bankrupt at time *t + 1* and a value of 0 otherwise. See Table 2.4 for the definition of the explanatory variables. Equation (1) is estimated by introducing each liquidity ratio from the CAMELS approach individually (equations (1.a′)–(1.f′)). An alternative specification of the inverse of the net stable funding ratio (*I_NSFR*) is introduced by considering a weight of 1 instead of 0.7 for demand and saving deposits (*I_NSFR_D1*). To deal with colinearity issues in all the regressions, *LLP_TLO* is orthagonalised with *ROA* and *M_EFCY* with *ROA*. The quality of the model is assessed with the McFadden R-square and the likelihood ratio test (i.e., *LR1*, to determine the joint significance of regressors by comparing the likelihood of the model with that of a model with only an intercept). In addition, another likelihood ratio test (*LR2*) is performed to determine the joint significance of regressors by comparing the likelihood of the model with that of a model without *I_NSFR* as explanatory variable. To assess the classification accuracy of the model, in-sample classifications are reported. The cutoff value is the proportion of *Y* equal to 1 in the whole sample (4.7%). *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 2.B.5. Liquidity and bank financial distress for European banks only

	1. a'	1. b'	1. c'	1. d'	1. e'	1. f'
LA_TA	-3.24 (-1.44)					
LA_DEPO		-0.65 (-1.32)				
LA_DP_STMD			-0.78 (-0.67)			
LO_TA				3.32 * (1.76)		
LO_DEPO					0.06 (0.34)	
LO_DP_STMD						0.53 ** (2.01)
I_NSFR	2.46 *** (3.10)	2.74 *** (3.69)	2.59 *** (3.47)	2.65 *** (3.56)	2.74 *** (3.73)	2.94 *** (4.12)
T12_RWA	-15.16 (-1.42)	-14.43 (-1.35)	-14.86 (-1.36)	-12.06 (-1.10)	-16.56 (-1.45)	-16.33 (-1.33)
LLP_TLO	67.36 ** (2.26)	58.69 ** (1.94)	65.67 ** (2.24)	68.95 ** (2.09)	65.29 ** (1.96)	65.53 ** (2.00)
M_EFCY	1.97 ** (2.07)	1.93 * (1.82)	2.05 * (1.77)	1.99 ** (2.01)	1.71 * (1.64)	1.64 * (1.86)
ROA	-32.55 (-0.97)	-38.03 (-1.04)	-33.00 (-0.92)	-34.19 (-0.89)	-30.04 (-0.77)	-27.62 (-0.68)
LN_TA	0.22 (1.21)	0.22 (1.19)	0.18 (0.96)	0.29 (1.45)	0.13 (0.93)	0.15 (1.02)
HHI_INC	2.05 (1.39)	2.11 (1.37)	2.11 (1.40)	2.41 (1.52)	2.13 (1.43)	1.95 (1.27)
GDWL_TA	22.90 (0.65)	19.58 (0.49)	24.36 (0.60)	24.75 (0.68)	26.90 (0.73)	26.42 (0.79)
GDP_GWT	34.19 (1.36)	35.24 (1.39)	36.46 (1.39)	34.23 (1.37)	35.68 (1.34)	31.26 (1.18)
IBK1M_CB	122.50 *** (2.70)	131.36 *** (2.84)	130.26 *** (2.75)	115.21 *** (2.50)	122.80 *** (2.69)	103.63 ** (2.14)
CONTROL	-0.06 (-0.45)	-0.05 (-0.36)	-0.06 (-0.47)	-0.08 (-0.63)	-0.08 (-0.56)	-0.08 (-0.59)
C	-6.67 *** (-2.42)	-7.52 *** (-2.57)	-6.96 *** (-2.48)	-10.80 *** (-2.72)	-6.64 *** (-2.55)	-7.49 *** (-2.79)
Mc Fadden R²	0.20	0.20	0.19	0.20	0.19	0.21
LR1 Stat and % level to reject: H0: $b_j = 0$ " $b_j \neq a$	35.73 *** (0.00)	35.63 *** (0.00)	34.43 *** (0.00)	36.16 *** (0.00)	34.00 *** (0.00)	36.40 *** (0.00)
LR2 Stat and % level to reject: H0: $b_{LB} = 0$	7.47 *** (0.01)	9.82 *** (0.00)	8.03 *** (0.00)	8.86 *** (0.00)	9.68 *** (0.00)	11.25 *** (0.00)
Total Obs.	631	631	631	631	631	631
Total Obs. with Y = 1	20	20	20	20	20	20
In sample classification						
Overall correct classification (%)	93.34	92.87	93.34	93.82	93.50	93.34
Y = 1 correct (%)	45.00	50.00	50.00	50.00	45.00	35.00
Y = 0 correct (%)	94.93	94.27	94.76	95.25	95.09	95.25

This table shows the result of estimating equation (1) using a standard logit model for an unbalanced panel of European publicly traded commercial banks over the 2005–2008 period. The dependent variable is a binary variable that takes on a value of 1 at time *t* if the bank is bankrupt or quasi-bankrupt at time *t + 1* and a value of 0 otherwise. See Table 2.4 for the definition of the explanatory variables. Equation (1) is estimated by introducing each liquidity ratio from the CAMELS approach individually (equations (1.a′)–(1.f′)). To deal with colinearity issues in all the regressions, *LLP_TLO* is orthogonalised with *ROA* and *M_EFCY* with *ROA*. The quality of the model is assessed with the McFadden R-square and the likelihood ratio test (i.e., *LR1*, to test the joint significance of regressors by comparing the likelihood of the model with that of a model with only an intercept). In addition, another likelihood ratio test (*LR2*) is performed to determine the joint significance of regressors by comparing the likelihood of the model with that of a model without *I_NSFR* as explanatory variable. To assess the classification accuracy of the model, in-sample classifications are reported. The cutoff value is the proportion of *Y* equal to 1 in the sample of European banks (9.7%). *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 2.B.6. Liquidity and bank financial distress: for U.S. banks only

	1. a'	1. b'	1. c'	1. d'	1. e'	1. f'
LA_TA	6.40 (0.95)					
LA_DEPO		2.03 (0.64)				
LA_DP_STMD			6.65 (0.97)			
LO_TA				-5.31 (-1.02)		
LO_DEPO					-5.98 (-1.65)	
LO_DP_STMD						-2.85 (-0.95)
I_NSFR	11.08 *** (2.38)	10.43 ** (2.27)	11.44 ** (2.01)	10.44 *** (2.48)	13.37 *** (4.05)	11.19 *** (5.10)
T12_RWA	-20.11 (-1.13)	-19.51 (-1.08)	-20.70 (-1.20)	-21.15 (-1.12)	-14.12 (-0.67)	-19.29 (-0.99)
LLP_TLO	48.26 *** (2.70)	46.71 *** (2.64)	48.47 *** (2.71)	46.76 *** (2.66)	51.74 *** (2.43)	46.87 *** (2.51)
M_EFCY	2.24 (1.34)	2.06 (1.14)	0.93 (0.44)	1.66 (0.91)	2.94 * (1.63)	2.41 (1.34)
ROA	-45.16 *** (-4.53)	-42.94 *** (-4.10)	-37.09 *** (-2.62)	-40.14 *** (-3.92)	-46.80 *** (-3.82)	-43.76 *** (-4.73)
LN_TA	0.50 (1.48)	0.48 (1.15)	0.35 (0.82)	0.47 (1.45)	0.66 *** (2.52)	0.57 ** (2.31)
HHI_INC	2.67 ** (2.01)	2.31 (1.48)	2.41 * (1.60)	2.54 * (1.76)	2.25 (1.58)	2.36 (1.54)
GDWL_TA	-0.002 (-0.01)	-3.05 (-0.19)	1.14 (0.07)	-7.13 (-0.53)	-8.94 (-0.59)	-6.69 (-0.46)
C	-19.97 *** (-3.63)	-18.41 *** (-3.61)	-19.47 *** (-3.25)	-13.84 *** (-2.36)	-16.97 *** (-4.18)	-16.87 *** (-3.20)
Mc Fadden R²	0.47	0.46	0.48	0.47	0.48	0.46
LR1 Stat and % level to reject: **H0: $b_j = 0$ " $b_j \neq a$**	92.82 *** (0.00)	91.83 *** (0.00)	94.50 *** (0.00)	92.70 *** (0.00)	94.55 *** (0.00)	92.13 *** (0.00)
LR2 Stat and % level to reject: **H0: $b_{LB} = 0$**	40.65 *** (0.00)	41.22 *** (0.00)	45.04 *** (0.00)	43.20 *** (0.00)	32.84 *** (0.00)	29.71 *** (0.00)
Total Obs.	2132	2132	2132	2132	2132	2132
Total Obs. with Y = 1	17	17	17	17	17	17
In sample classification						
Overall correct classification (%)	96.90	96.81	97.14	97.00	97.23	96.81
Y = 1 correct (%)	76.47	76.47	82.35	76.47	70.59	76.47
Y = 0 correct (%)	97.07	96.97	97.26	97.16	97.45	96.97

This table shows the result of estimating equation (1) using a standard logit model for an unbalanced panel of U.S. publicly traded commercial banks over the 2005–2008 period. The dependent variable is a binary variable that takes on a value of 1 at time *t* if the bank is bankrupt or quasi-bankrupt at time *t + 1* and a value of 0 otherwise. See Table 2.4 for the definition of the explanatory variables. Equation (1) is estimated by introducing each liquidity ratio from the CAMELS approach individually (equations (1.a′)–(1.f′)). All macroeconomic variables (e.g., *GDP_GWT*, *IBK1M_CB*, *CONTROL*) have been removed from equation (1) because their cross sectional variances are null. To deal with colinearity issues in all the regressions, *LLP_TLO* is orthogonalised with *ROA* and *M_EFCY* with *ROA*. The quality of the model is assessed with the McFadden R-square and the likelihood ratio test (i.e., *LR1*, to test the joint significance of regressors by comparing the likelihood of the model with that of a model with only an intercept). In addition, another likelihood ratio test (*LR2*) is performed to determine the joint significance of regressors by comparing the likelihood of the model with that of a model without *I_NSFR* as explanatory variable. To assess the classification accuracy of the model, in-sample classifications are reported. The cutoff value is the proportion of *Y* equal to 1 in the sample of U.S. banks (3%). *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 2.B.7. Liquidity and bank financial distress: *CFR* as the dependent variable for U.S. banks

	1. a'	1. b'	1. c'	1. d'	1. e'	1. f'
LA_TA	-5.18 (-1.29)					
LA_DEPO		-1.67 (-1.02)				
LA_DP_STMD			-0.85 (-0.33)			
LO_TA				1.71 (0.49)		
LO_DEPO					5.98 *** (4.82)	
LO_DP_STMD						6.32 *** (4.14)
CFR	0.59 * (1.60)	0.61 (1.56)	0.64 (1.53)	0.64 * (1.68)	0.49 (1.45)	0.57 ** (2.01)
T12_RWA	-36.79 ** (-2.02)	-38.73 ** (-2.19)	-39.28 ** (-2.20)	-38.60 ** (-2.11)	-40.04 *** (-2.47)	-38.53 ** (-2.18)
LLP_TLO	40.23 *** (2.40)	41.00 *** (2.46)	40.80 *** (2.40)	40.54 *** (2.36)	42.21 *** (2.77)	45.85 *** (2.73)
M_EFCY	1.72 (1.35)	1.75 (1.26)	1.39 (0.92)	1.52 (1.04)	1.64 * (1.67)	2.06 ** (2.01)
ROA	-39.78 *** (-4.83)	-41.40 *** (-4.94)	-39.96 *** (-4.67)	-40.75 *** (-4.85)	-42.78 *** (-5.26)	-43.53 *** (-5.07)
LN_TA	0.63 *** (2.68)	0.64 *** (2.41)	0.55 ** (2.19)	0.57 *** (2.36)	0.46 *** (2.44)	0.60 *** (2.87)
HHI_INC	1.07 (0.82)	1.40 (1.03)	1.34 (1.01)	1.27 (0.97)	0.97 (0.75)	0.90 (0.64)
GDWL_TA	-14.55 (-0.91)	-12.81 (-0.76)	-10.79 (-0.63)	-9.75 (-0.59)	-3.88 (-0.26)	-7.61 (-0.52)
C	-5.31 ** (-2.11)	-5.83 ** (-2.16)	-5.37 ** (-1.98)	-7.00 (-1.38)	-10.62 *** (-5.61)	-11.72 *** (-3.95)
Mc Fadden R²	0.28	0.28	0.27	0.27	0.32	0.33
LR1 Stat and % level to reject: H0: $b_j = 0$ " $b_j \neq a$	55.79 *** (0.00)	54.48 *** (0.00)	53.64 *** (0.00)	53.83 *** (0.00)	64.11 *** (0.00)	65.55 *** (0.00)
LR2 Stat and % level to reject: H0: $b_{LB} = 0$	3.70 ** (0.05)	3.95 ** (0.05)	4.26 ** (0.04)	4.42 ** (0.04)	2.49 (0.11)	3.20 * (0.07)
Total Obs.	2127	2127	2127	2127	2127	2127
Total Obs. with Y = 1	17	17	17	17	17	17
In sample classification						
Overall correct classification (%)	96.00	95.82	96.05	96.05	95.53	95.67
Y = 1 correct (%)	64.71	64.71	58.82	64.71	76.47	64.71
Y = 0 correct (%)	96.26	96.07	96.35	96.30	95.69	95.92

This table shows the result of estimating equation (1) using a standard logit model for an unbalanced panel of U.S. publicly traded commercial banks over the 2005–2008 period. The dependent variable is a binary variable that takes on a value of 1 at time *t* if the bank is bankrupt or quasi-bankrupt at time *t + 1* and a value of 0 otherwise. See Table 2.4 for the definition of the explanatory variables. Equation (1) is estimated by introducing each liquidity ratio from the CAMELS approach individually (equations (1.a′)–(1.f′)). However, the *I_NSFR* variable is replaced by the *CFR* variable (i.e., the ratio of the required amount of stable of funding to the core deposits and the other stable funding). In addition, all macroeconomic variables (e.g., *GDP_GWT, IBK1M_CB*, *CONTROL*) have been removed from equation (1) because their cross sectional variances are null. To deal with colinearity issues in all the regressions, *LLP_TLO* is orthogonalised with *ROA* and *M_EFCY* with *ROA.* The quality of the model is assessed with the McFadden R-square and the likelihood ratio test (i.e., *LR1*, to test the joint significance of regressors by comparing the likelihood of the model with that of a model with only an intercept). In addition, another likelihood ratio test (*LR2*) is performed to determine the joint significance of regressors by comparing the likelihood of the model with that of a model without *I_NSFR* as explanatory variable. To assess the classification accuracy of the model, in-sample classifications are reported. The cutoff value is the proportion of *Y* equal to 1 in the sample of U.S. banks (3%). *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 2.B.8. U.S. and European listed commercial banks in technical failure during the subprime crisis (from mid-2007 to the end of 2009)

Bank name	Country	Type of default	Date of "technical failure"	Date of official bankruptcy
Emporiki Bank of Greece	Greece	"Technical failure" but no official bankruptcy or quasi-bankruptcy	2008	-
Commerzbank AG	Germany	"Technical failure" but no official bankruptcy or quasi-bankruptcy	2008	-
Amcore Financial Inc	United States	FDIC Receivership	2009	2010
Americanwest Bancorporation		Acquired by SKBHC Holdings LLC	2009	2010
Corus Bankshares inc		Acquired by MB Financial Inc	2008	2010
City Bank Lynnwood WA		Acquired by Washington Banking Co	2008	2010
Cowlitz Bancorp		Acquired by Heritage Financial Corp	2009	2010
PAB Bankshares Inc		"Technical failure" but no official bankruptcy or quasi-bankruptcy	2009	-
PSB Group Inc		Acquired by First Michigan Bancorp Inc	2009	2011
WSB Financial Group Inc		Bankruptcy	2008	2009

Source: Bloomberg. Following Cole and White (2010), a bank is in technical failure if its ratio of nonperforming assets to the sum of equity plus loan loss reserves is higher than 200% over the period 2007–2009.

Table 2.B.9. Liquidity and bank financial distress: Technically insolvent banks in addition to bankrupt or quasi-bankrupt banks

	1. a'	**1. b'**	**1. c'**	**1. d'**	**1. e'**	**1. f'**
LA_TA	-2.21					
	(-1.07)					
LA_DEPO		-0.86 *				
		(-1.69)				
LA_DP_STMD			0.20			
			(0.22)			
LO_TA				2.41		
				(1.38)		
LO_DEPO					-0.14	
					(-0.46)	
LO_DP_STMD						0.65 ***
						(2.41)
I_NSFR	4.15 ***	4.37 ***	4.50 ***	4.27 ***	4.60 ***	4.51 ***
	(5.51)	(6.30)	(6.07)	(6.10)	(5.29)	(6.43)
T12_RWA	-19.56 *	-19.77 *	-19.93 *	-18.35 *	-19.96 *	-19.33 *
	(-1.80)	(-1.83)	(-1.86)	(-1.72)	(-1.83)	(-1.78)
LLP_TLO	50.13 ***	48.52 ***	50.02 ***	51.10 ***	48.85 ***	50.69 ***
	(3.75)	(3.64)	(3.68)	(3.72)	(3.44)	(3.76)
M_EFCY	1.23	1.39 *	0.94	1.45 *	1.02	1.03
	(1.45)	(1.62)	(1.14)	(1.77)	(1.24)	(1.58)
ROA	-46.08 ***	-47.05 ***	-45.12 ***	-48.72 ***	-45.05 ***	-45.63 ***
	(-5.10)	(-5.26)	(-4.97)	(-5.28)	(-4.88)	(-5.21)
LN_TA	0.47 ***	0.52 ***	0.40 ***	0.51 ***	0.41 ***	0.41 ***
	(3.16)	(3.51)	(2.83)	(3.33)	(3.76)	(3.57)
HHI_INC	2.40 ***	2.53 ***	2.45 ***	2.58 ***	2.39 ***	2.43 ***
	(2.44)	(2.48)	(2.48)	(2.54)	(2.39)	(2.49)
GDWL_TA	-16.75	-19.91	-13.74	-14.30	-15.74	-12.00
	(-1.35)	(-1.48)	(-1.08)	(-1.15)	(-1.23)	(-0.99)
GDP_GWT	26.67	27.06	26.72	27.69	26.61	24.35
	(1.42)	(1.46)	(1.34)	(1.47)	(1.34)	(1.27)
IBK1M_CB	205.47 ***	216.18 ***	207.88 ***	201.83 ***	217.42 ***	176.43 ***
	(5.39)	(5.45)	(5.27)	(5.32)	(4.98)	(4.13)
CONTROL	0.09	0.09	0.09	0.06	0.09	0.09
	(0.77)	(0.82)	(0.73)	(0.53)	(0.74)	(0.76)
C	-12.10 ***	-12.92 ***	-12.30 ***	-14.63 ***	-12.31 ***	-13.01 ***
	(-3.88)	(-3.97)	(-3.89)	(-3.80)	(-3.87)	(-4.12)
Mc Fadden R²	0.32	0.32	0.32	0.32	0.32	0.33
LR1 Stat and % level to reject:	149.31 ***	151.32 ***	148.10 ***	150.01 ***	148.37 ***	152.46 ***
H0: $b_j = 0$ " $b_j \neq a$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LR2 Stat and % level to reject:	36.34 ***	47.43 ***	41.37 ***	40.73 ***	44.50 ***	48.49 ***
H0: $b_{LB} = 0$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total Obs.	2763	2763	2763	2763	2763	2763
Total Obs. with Y = 1	46	46	46	46	46	46
In sample classification						
Overall correct classification (%)	95.72	95.61	95.72	95.65	95.72	95.94
Y = 1 correct (%)	65.22	65.22	63.04	65.22	63.04	63.04
Y = 0 correct (%)	96.24	96.13	96.28	96.17	96.28	96.50

This table shows the result of estimating equation (1) using a standard logit model for an unbalanced panel of U.S. and European publicly traded commercial banks over the 2005–2008 period. The dependent variable is a binary variable that takes on a value of 1 at time *t* if the bank is bankrupt or technically insolvent at time *t + 1* and a value of 0 otherwise. See Table 2.4 for the definition of the explanatory variables. Equation (1) is estimated by introducing each liquidity ratio from the CAMELS approach individually (equations (1.a′)–(1.f′)). To deal with colinearity issues in all the regressions, *LLP_TLO* with *ROA* and *M_EFCY* are orthagonalised with *ROA*. The quality of the model is assessed with the McFadden R-square and the likelihood ratio test (i.e., *LR1*, to determine the joint significance of regressors by comparing the likelihood of the model with that of a model with only an intercept). In addition, another likelihood ratio test (*LR2*) is performed to test the joint significance of regressors by comparing the likelihood of the model with that of a model without *I_NSFR* as explanatory variable. To assess the classification accuracy of the model, in-sample classifications are reported. The cutoff value is the proportion of *Y* equal to 1 in the whole sample (4.7%). *, **and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 2.B.10. Liquidity and bank financial distress: Out-of-sample prediction accuracy including technically insolvent banks

	1. a'	1. b'	1. c'	1. d'	1. e'	1. f'
LA_TA	-3.67					
	(-1.58)					
LA_DEPO		-1.33 *				
		(-1.66)				
LA_DP_STMD			-1.44			
			(-0.80)			
LO_TA				4.22 ***		
				(2.45)		
LO_DEPO					-0.69	
					(-1.13)	
LO_DP_STMD						0.07
						(0.15)
I_NSFR	4.18 ***	4.60 ***	4.38 ***	4.31 ***	5.48 ***	4.63 ***
	(4.92)	(5.41)	(5.03)	(4.96)	(4.14)	(5.30)
T12_RWA	-8.52	-7.31	-7.51	-7.26	-7.48	-9.08
	(-0.66)	(-0.58)	(-0.59)	(-0.57)	(-0.54)	(-0.67)
LLP_TLO	65.87 **	56.94 **	63.75 **	68.00 **	49.91	65.89 **
	(2.25)	(1.92)	(2.18)	(2.28)	(1.38)	(2.19)
M_EFCY	1.66	1.46	1.27	1.93	0.23	1.01
	(0.91)	(0.79)	(0.63)	(1.16)	(0.10)	(0.50)
ROA	-22.72	-27.59	-25.03	-28.78	-27.12	-22.18
	(-0.69)	(-0.87)	(-0.74)	(-0.95)	(-0.74)	(-0.64)
LN_TA	0.60 ***	0.68 ***	0.59 ***	0.68 ***	0.51 ***	0.50 ***
	(3.00)	(3.21)	(2.80)	(3.27)	(3.26)	(3.21)
HHI_INC	3.39 ***	3.60 ***	3.44 ***	3.69 ***	2.99 **	3.43 ***
	(2.56)	(2.57)	(2.55)	(2.67)	(2.08)	(2.56)
GDWL_TA	-25.35	-30.92	-24.51	-21.61	-27.69	-20.28
	(-1.53)	(-1.58)	(-1.29)	(-1.21)	(-1.41)	(-1.12)
GDP_GWT	52.47	51.43	57.78	52.72	62.80	58.38
	(1.42)	(1.35)	(1.50)	(1.49)	(1.53)	(1.59)
IBK1M_CB	223.29 ***	245.49 ***	245.99 ***	217.81 ***	276.67 ***	225.09 ***
	(3.19)	(3.58)	(3.25)	(3.23)	(2.74)	(2.88)
CONTROL	0.18	0.18	0.18	0.13	0.21	0.18
	(1.13)	(1.19)	(1.12)	(0.88)	(1.26)	(1.11)
C	-16.50 ***	-17.96 ***	-17.16 ***	-20.82 ***	-17.61 ***	-16.94 ***
	(-3.56)	(-3.62)	(-3.56)	(-3.69)	(-3.47)	(-3.54)
Mc Fadden R²	0.27	0.27	0.26	0.27	0.27	0.26
LR1 Stat and % level to reject:	74.72 ***	76.60 ***	73.88 ***	76.56 ***	75.23 ***	72.80 ***
H0: $b_j = 0$ " $b_j \neq a$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LR2 Stat and % level to reject:	18.90 ***	24.96 ***	20.83 ***	21.84 ***	31.37 ***	28.84 ***
H0: $b_{LB} = 0$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total Obs.	2159	2159	2159	2159	2159	2159
Total Obs. with Y = 1	26	26	26	26	26	26
Out-off sample classification						
Overall correct classification (%)	95.86	95.86	95.70	95.53	95.70	95.70
Y = 1 correct (%)	53.33	53.33	46.67	46.67	40.00	40.00
Y = 0 correct (%)	97.44	97.44	97.44	97.27	97.61	97.61

This table shows the result of estimating equation (1) using a standard logit model for an unbalanced panel of U.S. and European publicly traded commercial banks over the 2005–2007 period. The dependent variable is a binary variable that takes on a value of 1 at time *t* if the bank is bankrupt or technically insolvent at time *t + 1* and a value of 0 otherwise. See Table 2.4 for the definition of the explanatory variables. Equation (1) is estimated by introducing each liquidity ratio from the CAMELS approach individually (equations (1.a′) to (1.f′)). To deal with colinearity issues in all the regressions, *LLP_TLO* is orthagonalised with *ROA* and *M_EFCY* with *ROA.* The quality of the model is assessed with the McFadden R-square and the likelihood ratio test (i.e., *LR1*, to test the joint significance of regressors by comparing the likelihood of the model with that of a model with only an intercept). In addition, another likelihood ratio test (*LR2*) is performed to determine the joint significance of regressors by comparing the likelihood of the model with that of a model without *I_NSFR* as explanatory variable. To assess the predictive power of the model, out-of-sample classifications are performed on the year on 2008. The cutoff value is the proportion of *Y* equal to 1 in the whole sample (4.7%). *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 2.B.11. Liquidity and bank financial distress for European banks including technically insolvent banks

	1. a'	1. b'	1. c'	1. d'	1. e'	1. f'
LA_TA	-3.22					
	(-1.58)					
LA_DEPO		-0.69				
		(-1.48)				
LA_DP_STMD			-0.96			
			(-0.86)			
LO_TA				3.33 *		
				(1.84)		
LO_DEPO					0.02	
					(0.15)	
LO_DP_STMD						0.44 *
						(1.76)
I_NSFR	2.20 ***	2.47 ***	2.30 ***	2.42 ***	2.56 ***	2.72 ***
	(2.69)	(3.26)	(2.97)	(3.28)	(3.59)	(3.82)
T12_RWA	-23.66 *	-22.41 *	-22.23 *	-20.62 *	-24.36 *	-24.65 *
	(-1.87)	(-1.82)	(-1.79)	(-1.63)	(-1.84)	(-1.73)
LLP_TLO	57.03 **	47.89 *	56.70 **	58.19 *	55.90 *	56.43 *
	(1.99)	(1.62)	(1.98)	(1.77)	(1.70)	(1.74)
M_EFCY	2.05 **	2.00 **	2.19 **	2.06 **	1.80 *	1.76 **
	(2.29)	(2.02)	(2.02)	(2.17)	(1.76)	(1.98)
ROA	-43.81	-50.11	-44.32	-45.98	-40.70	-38.58
	(-1.23)	(-1.31)	(-1.19)	(-1.09)	(-0.99)	(-0.91)
LN_TA	0.24	0.25	0.21	0.32	0.14	0.17
	(1.34)	(1.36)	(1.14)	(1.57)	(1.08)	(1.16)
HHI_INC	2.06	2.12	2.10	2.45 *	2.12	1.99
	(1.53)	(1.53)	(1.52)	(1.69)	(1.54)	(1.39)
GDWL_TA	10.85	6.63	11.56	13.08	15.00	15.01
	(0.27)	(0.15)	(0.25)	(0.32)	(0.35)	(0.38)
GDP_GWT	38.45 *	39.35 *	41.04 *	38.71 *	40.77 *	37.23
	(1.63)	(1.66)	(1.68)	(1.65)	(1.62)	(1.49)
IBK1M_CB	136.51 ***	145.58 ***	144.82 ***	129.07 ***	138.37 ***	121.70 ***
	(2.95)	(3.08)	(3.03)	(2.75)	(2.99)	(2.51)
CONTROL	-0.07	-0.06	-0.08	-0.10	-0.09	-0.09
	(-0.61)	(-0.50)	(-0.61)	(-0.79)	(-0.72)	(-0.76)
C	-5.46 **	-6.39 ***	-5.85 **	-9.63 ***	-5.48 **	-6.21 ***
	(-2.21)	(-2.43)	(-2.31)	(-2.60)	(-2.30)	(-2.51)
Mc Fadden R^2	0.21	0.21	0.20	0.21	0.20	0.21
LR1 Stat and % level to reject:	40.32 ***	40.45 ***	39.09 ***	40.75 ***	38.29 ***	40.16 ***
H0: $b_j = 0$ " $b_j \neq a$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LR2 Stat and % level to reject:	5.86 ***	8.01 ***	6.22 ***	7.29 ***	8.76 ***	9.84 ***
H0: $b_{LB} = 0$	(0.02)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)
Total Obs.	631	631	631	631	631	631
Total Obs. with Y = 1	22	22	22	22	22	22
In sample classification						
Overall correct classification (%)	93.64	93.00	92.85	93.48	92.37	93.32
Y = 1 correct (%)	54.55	54.55	54.55	54.55	50.00	50.00
Y = 0 correct (%)	95.06	94.40	94.23	94.89	93.90	94.89

This table shows the result of estimating equation (1) using a standard logit model for an unbalanced panel of European publicly traded commercial banks over the 2005–2008 period. The dependent variable is a binary variable that takes on a value of 1 at time *t* if the bank is bankrupt or technically insolvent at time *t + 1* and a value of 0 otherwise. See Table 2.4 for the definition of the explanatory variables. Equation (1) is estimated by introducing each liquidity ratio from the CAMELS approach individually (equations (1.a′)–(1.f′)). To deal with colinearity issues in all the regressions, *LLP_TLO* with is orthogonalised *ROA* and *M_EFCY* with *ROA.* The quality of the model is assessed with the McFadden R-square and the likelihood ratio test (i.e., *LR1,* to test the joint significance of regressors by comparing the likelihood of the model with that of a model with only an intercept). In addition, another likelihood ratio test (*LR2*) is performed to determine the joint significance of regressors by comparing the likelihood of the model with that of a model without *I_NSFR* as explanatory variable. To assess the classification accuracy of the model, in-sample classifications are reported. The cutoff value is the proportion of *Y* equal to 1 in the sample of European banks (9.7%). *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 2.B.12. Liquidity and bank financial distress for U.S. banks including technically insolvent banks

	1. a'	**1. b'**	**1. c'**	**1. d'**	**1. e'**	**1. f'**
LA_TA	7.36 (1.20)					
LA_DEPO		4.12 (1.43)				
LA_DP_STMD			11.90 (1.49)			
LO_TA				-6.10 (-1.43)		
LO_DEPO					-1.04 (-0.20)	
LO_DP_STMD						-4.10 (-1.07)
I_NSFR	13.28 *** (2.82)	13.28 *** (2.78)	15.67 ** (2.25)	12.69 *** (2.88)	12.40 *** (3.02)	13.54 *** (4.99)
T12_RWA	-8.68 (-0.65)	-8.61 (-0.69)	-13.20 (-1.12)	-8.87 (-0.63)	-6.99 (-0.52)	-6.08 (-0.38)
LLP_TLO	43.19 *** (3.10)	41.88 *** (2.81)	43.41 *** (2.90)	41.56 *** (2.97)	42.96 *** (3.12)	41.97 *** (2.83)
M_EFCY	1.42 (1.10)	0.84 (0.60)	-0.79 (-0.44)	0.93 (0.74)	1.85 (1.40)	1.47 (0.93)
ROA	-43.18 *** (-5.20)	-39.06 *** (-4.49)	-28.78 ** (-1.95)	-38.42 *** (-4.78)	-43.93 *** (-5.31)	-42.09 *** (-4.78)
LN_TA	0.49 * (1.75)	0.35 (1.05)	0.19 (0.49)	0.47 * (1.79)	0.61 *** (2.54)	0.57 *** (2.56)
HHI_INC	3.36 *** (2.37)	2.91 * (1.77)	3.07 ** (1.99)	3.23 ** (1.99)	2.84 * (1.68)	3.10 * (1.65)
GDWL_TA	-16.19 (-0.84)	-15.02 (-0.82)	-10.64 (-0.55)	-24.14 (-1.35)	-23.41 (-1.36)	-23.97 (-1.23)
C	-23.45 *** (-4.34)	-21.95 *** (-4.35)	-24.53 *** (-3.61)	-16.74 *** (-3.52)	-21.03 *** (-3.98)	-19.50 *** (-3.39)
Mc Fadden R^2	0.50	0.51	0.54	0.50	0.49	0.50
LR1 Stat and % level to reject: H0: $b_j = 0$ " $b_j \neq a$	132.66 *** (0.00)	133.75 *** (0.00)	142.69 *** (0.00)	132.53 *** (0.00)	130.01 *** (0.00)	132.48 *** (0.00)
LR2 Stat and % level to reject: H0: $b_{LB} = 0$	63.38 *** (0.00)	68.14 *** (0.00)	78.21 *** (0.00)	67.01 *** (0.00)	41.99 *** (0.00)	54.72 *** (0.00)
Total Obs.	2132	2132	2132	2132	2132	2132
Total Obs. with Y = 1	24	24	24	24	24	24
In sample classification						
Overall correct classification (%)	97.32	97.28	97.84	97.28	96.90	96.95
Y = 1 correct (%)	83.33	83.33	95.83	79.17	83.33	79.17
Y = 0 correct (%)	97.48	97.44	97.86	97.48	97.06	97.15

This table shows the result of estimating equation (1) using a standard logit model for an unbalanced panel of U.S. publicly traded commercial banks over the 2005–2008 period. The dependent variable is a binary variable that takes on a value of 1 at time *t* if the bank is bankrupt or technically insolvent at time *t + 1* and a value of 0 otherwise. See Table 2.4 for the definition of the explanatory variables. Equation (1) is estimated by introducing each liquidity ratio from the CAMELS approach individually (equations (1.a′)–(1.f′)). All macroeconomic variables (e.g., *GDP_GWT, IBK1M_CB, CONTROL*) have been removed from equation (1) because their cross sectional variances are null. To deal with colinearity issues in all the regressions, *LLP_TLO* is orthagonalised with *ROA* and *M_EFCY* with *ROA.* The quality of the model is assessed with the McFadden R-square and the likelihood ratio test (i.e., *LR1*, to test the joint significance of regressors by comparing the likelihood of the model with that of a model with only an intercept). In addition, another likelihood ratio test (*LR2*) is performed to determine the joint significance of regressors by comparing the likelihood of the model with that of a model without *I_NSFR* as explanatory variable. To assess the classification accuracy of the model, in-sample classifications are reported. The cutoff value is the proportion of *Y* equal to 1 in the sample of U.S. banks (3%). *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 2.B.13. Liquidity and bank financial distress using *CFR* as the dependent variable, including the technically insolvent U.S. banks

	1. a'	1. b'	1. c'	1. d'	1. e'	1. f'
LA_TA	-4.51					
	(-1.26)					
LA_DEPO		-0.48				
		(-0.31)				
LA_DP_STMD			1.17			
			(0.49)			
LO_TA				0.80		
				(0.27)		
LO_DEPO					6.47 ***	
					(4.33)	
LO_DP_STMD						5.15 ***
						(2.84)
CFR	1.44 ***	1.50 ***	1.56 ***	1.50 ***	1.31 ***	1.41 ***
	(4.37)	(4.68)	(4.84)	(4.57)	(4.23)	(4.29)
T12_RWA	-21.69	-24.12	-26.29	-23.93	-27.86 **	-23.96
	(-1.21)	(-1.41)	(-1.52)	(-1.33)	(-2.01)	(-1.49)
LLP_TLO	37.39 ***	38.23 ***	39.15 ***	38.01 ***	37.68 ***	40.18 ***
	(2.55)	(2.59)	(2.60)	(2.53)	(2.71)	(2.80)
M_EFCY	1.38	1.08	0.57	1.08	1.49 *	1.57
	(1.24)	(0.86)	(0.42)	(0.90)	(1.75)	(1.60)
ROA	-40.34 ***	-40.47 ***	-38.42 ***	-40.62 ***	-44.23 ***	-42.62 ***
	(-5.58)	(-5.34)	(-5.00)	(-5.69)	(-6.19)	(-5.79)
LN_TA	0.62 ***	0.56 ***	0.47 **	0.55 ***	0.43 ***	0.58 ***
	(2.88)	(2.41)	(2.15)	(2.52)	(2.37)	(3.13)
HHI_INC	1.39	1.61	1.56	1.57	1.03	1.20
	(0.97)	(1.10)	(1.08)	(1.09)	(0.78)	(0.81)
GDWL_TA	-27.05	-24.63	-22.83	-23.75	-14.57	-21.58
	(-1.32)	(-1.14)	(-1.02)	(-1.10)	(-0.75)	(-1.05)
C	-7.79 ***	-7.93 ***	-7.49 ***	-8.56 *	-12.98 ***	-12.77 ***
	(-2.70)	(-2.67)	(-2.55)	(-1.72)	(-5.43)	(-4.20)
Mc Fadden R^2	0.34	0.33	0.33	0.33	0.39	0.36
LR1 Stat and % level to reject:	88.10 ***	86.07 ***	86.28 ***	86.05 ***	102.93 ***	95.48 ***
H0: $b_j = 0$ " $b_j \neq a$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LR2 Stat and % level to reject:	18.93 ***	20.57 ***	21.91 ***	20.65 ***	15.03 ***	17.83 ***
H0: $b_{LB} = 0$	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total Obs.	2127	2127	2127	2127	2127	2127
Total Obs. with Y = 1	24	24	24	24	24	24
In sample classification						
Overall correct classification (%)	96.24	96.42	96.28	96.38	96.00	96.05
Y = 1 correct (%)	66.67	62.50	62.50	62.50	70.83	66.67
Y = 0 correct (%)	96.57	96.81	96.67	96.76	96.29	96.38

This table shows the result of estimating equation (1) using a standard logit model for an unbalanced panel of U.S. publicly traded commercial banks over the 2005–2008 period. The dependent variable is a binary variable that takes on a value of 1 at time *t* if the bank is bankrupt or technically insolvent at time *t + 1* and a value of 0 otherwise. See Table 2.4 for the definition of the explanatory variables. Equation (1) is estimated by introducing each liquidity ratio from the CAMELS approach individually (equations (1.a′)–(1.f′)). However, the *I_NSFR* variable is replaced by the *CFR* variable (i.e., the ratio of the required amount of stable of funding to the core deposits and the other stable funding). In addition, all macroeconomic variables (e.g., *GDP_GWT, IBK1M_CB*, *CONTROL*) have been removed from equation (1) because their cross sectional variances are null. To deal with colinearity issues in all the regressions, *LLP_TLO* with *ROA* and *M_EFCY* is orthogonalised with *ROA.* The quality of the model is assessed with the McFadden R-square and the likelihood ratio test (i.e., *LR1*, to test the joint significance of regressors by comparing the likelihood of the model with that of a model with only an intercept). In addition, another likelihood ratio test (*LR2*) is performed to determine the joint significance of regressors by comparing the likelihood of the model with that of a model without *I_NSFR* as explanatory variable. To assess the classification accuracy of the model, in-sample classifications are reported. The cutoff value is the proportion of *Y* equal to 1 in the sample of U.S. banks (3%). *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

CHAPTER 3.

BANK CAPITAL BUFFER AND LIQUIDITY:

EVIDENCE FROM U.S. AND EUROPEAN PUBLICLY TRADED BANKS

This chapter refers to the working paper titled "Bank capital buffer and liquidity: Evidence from U.S. and European publicly traded banks" (Distinguin, Roulet, and Tarazi, 2011). This paper has been presented to the International Finance and Banking Society Conference (IFABS) in Rome, July 2011. We received the award of the Best PhD paper. This paper was listed on SSRN's Top Ten download list for Economics Research Network: Banking & Monetary Policy (Topic). This paper has been submitted for publication to the *Journal of Banking and Finance*.

ABSTRACT.

The theory of financial intermediation highlights various channels through which capital and liquidity are interrelated. Using a simultaneous equations framework, Chapter 3 investigates the relationship between bank capital buffer and liquidity for European and U.S. publicly traded commercial banks from 2000 to 2008. Previous research studying the determinants of bank capital buffer has neglected the role of liquidity. On the whole, banks do not strengthen their capital buffer when they face higher illiquidity as defined in the Basel III accords or when they create more liquidity as measured by Berger and Bouwman (2009). However, considering other measures of illiquidity that focus more closely on core deposits in the United States, the results show that, except for very large institutions, banks do actually build larger capital buffers when they are exposed to higher illiquidity. The empirical investigation supports the need to implement minimum liquidity ratios concomitantly to capital ratios, as stressed by the Basel Committee; however, the findings also shed light on the need to further clarify how to define and measure illiquidity and also on how to regulate very large banking institutions, which behave differently than smaller ones.

JEL classification: G21; G28

Keywords: Bank Capital Buffer; Liquidity; Bank Regulation

3.1. Introduction

Liquidity transformation is traditionally considered the preeminent function of banks, but also the primary source of their vulnerability and a justification for their protection through a public safety net in the form of deposit insurance (Bryant, 1980; Diamond and Dybvig, 1983). Indeed, an important role of banks in the economy is to provide liquidity by funding long-term, illiquid assets with short-term, liquid liabilities. Thus, banks hold illiquid assets and provide cash to the rest of the economy. Therefore, they face risk if some liabilities invested in illiquid assets are claimed at short notice. The subprime crisis well illustrates how quickly and severely illiquidity can crystallize. In particular, it shows how some sources of funding can evaporate, compounding concerns about the valuation of assets and capital adequacy rules (BIS, 2009a).

The existing theoretical and empirical literature considers the causal link of bank capital and liquidity creation. The theoretical literature provides two opposing views on this relationship. Under the first view, bank capital tends to impede liquidity creation through two distinct effects: the "financial fragility structure" and the "crowding-out of deposits". The "financial fragility structure", characterized by lower capital, tends to favor liquidity creation (Diamond and Rajan, 2000, 2001a), while higher capital ratios could crowd out deposits and thereby reduce liquidity creation (Gorton and Winton, 2000). Roughly described, the "financial fragility structure" effect is the outcome of the following process. The bank collects funds from depositors and lends them to borrowers. By monitoring borrowers, the bank obtains private information that gives it an advantage in assessing the profitability of its borrowers. However, this informational advantage creates an agency problem, and the bank might extort rents from its depositors by requiring a greater share of the loan income. If depositors refuse to pay the higher cost, the bank withholds monitoring or loan-collecting efforts. Because depositors know that the bank might abuse their trust, they become reluctant to put their money in the bank. Consequently, the bank must win depositors' confidence by adopting a fragile financial structure with a large share of liquid deposits. A contract with depositors mitigates the bank's hold-up problem because depositors can run on the bank if the bank threatens to withhold efforts. Consequently, financial fragility favors liquidity creation in that it allows the bank to collect more deposits and grant more loans. In contrast, higher capital tends to mitigate the financial fragility and enhances the bargaining power of the bank, which hampers the credibility of its commitment to depositors. Thus, higher capital tends to decrease liquidity creation. In addition, Gorton and Winton (2000) show that a higher capital ratio can reduce liquidity creation through another effect: the "crowding-out of deposits". They maintain that deposits are more effective liquidity hedges for agents than investments in bank equity. Indeed, deposits are totally or partially insured and withdrawable at par value. In contrast, bank capital is not exigible and has a stochastic value that depends on the state of bank fundamentals and the liquidity of the stock exchange. Consequently, higher capital ratios shift investors' funds from relatively liquid deposits to relatively illiquid bank capital. Thus, the higher is the bank's capital ratio, the lower is its liquidity creation. Under the second view, higher capital enhances the ability of banks to create liquidity. Here, liquidity creation increases the bank's exposure to risk, as its losses increase with the level of illiquid assets to satisfy the liquidity demands of customers (Allen and Gale, 2004). Bank capital allows the bank to absorb greater risk (Repullo, 2004). Thus, under the second view, the higher is the bank's capital ratio, the higher is its liquidity creation. Berger and Bouwman (2009) empirically test these recent theories of the relationship between capital and liquidity creation. Using a sample of U.S. commercial banks from 1993 to 2003, they find that the relationship is positive for large banks and negative for small banks.

While theory suggests a causal relationship from capital to liquidity creation, in practice, the issue is more complex and both might be jointly determined[65]. Indeed, the more banks create liquidity, the more they are exposed to the risk of being unable to meet unexpected withdrawals from customers. Thus, banks may need to strengthen their solvency to access external funding more easily or, in extreme cases, to face unexpected losses from selling some assets at fire-sale prices (Matz and Neu, 2007).

Banks must comply with capital standards through minimum requirements for risk weighted capital ratios. However, most banks hold an amount of capital that exceeds the minimum imposed by regulation. From this perspective, various studies investigate why banks buildup such capital buffers. These studies mainly focus on the relationship between a given determinant and bank capital buffer by controlling for other potential determinants. From this perspective, Lindquist (2004) uses Norwegian banks to study the impact of the risk of bank assets on capital buffer. Regulatory capital requirements are only based on credit, market and operational risks and do not cover all types of risk. Furthermore, sophisticated risk

65 Berger and Bouwman (2009) point out this endogeneity issue. Consequently, they interpret their results as correlations between capital and liquidity creation rather than causal relationships. Their study focuses on the determinants of liquidity creation. Capital is one of their independent variables, and they address endogeneity using instrumental variable regressions.

valuation models might underestimate risk. Therefore, banks might hold capital in excess of the minimum required by regulators so they can face unexpected losses from their risky assets. However, Lindquist (2004) does not find any significant link. Jokipii and Milne (2011) also focus on the relationship between risk and bank capital buffer, but they examine the relationship between capital buffer and portfolio risk adjustments. Using U.S. bank holding companies and commercial banks over the 1986–2006 period, they find a positive two-way relationship. Several studies investigate how the business cycle might influence bank capital buffer, as much debate on Basel capital standards has centered on its potential "pro-cyclicality". Ayuso et al. (2004) and Stolz and Wedow (2011) consider Spanish and German banks, respectively. Bikker and Metzemakers (2004) and Jokipii and Milne (2008) focus on banks from 29 OECD countries and from 25 European countries, respectively. Their results globally highlight a significant negative comovement with the cycle. Banks tend to decrease (increase) their capital buffer during upturns (downturns). Other studies consider the impact of market discipline in the determination of bank capital buffer. They empirically test whether market discipline provides enough incentives for banks to strengthen their capital buffer to mitigate their default risk. For example, Flannery and Rangan (2008) study the causes of the bank capital buildup of the 1990s for large U.S. banks. They find that among the relevant factors, market discipline explains the bulk of this buildup. Alfon et al. (2004) and Nier and Baumann (2006), using a sample of UK banks and a large cross-country panel data set from 32 countries, respectively, show that moral hazard is effective and that market discipline encourages banks to strengthen their capital buffer. Fonseca and Gonzalez (2010) consider cross country data from 70 countries and investigate whether the influence of market discipline on capital buffer varies across countries with heterogeneous frameworks for regulation, supervision and institutions. They find that, even if market discipline has a positive impact on bank capital buffer, the relationship depends on several structural factors. Indeed, restrictions on bank activities, effective supervision and bad institutional environment tend to weaken market discipline and reduce incentives for banks to hold capital in excess of the minimum required by regulators. Considering the strand of the empirical literature on the determinants of bank capital buffer, this literature does not seem to consider the role of liquidity in analyzing bank capital buffer.

The purpose of this chapter is to study the relationship between bank capital buffer and liquidity. The aim is to study the contribution of liquidity in explaining bank capital buffer beyond the determinants considered in the literature. Specifically, this study questions whether banks maintain or strengthen their capital buffer when they face higher illiquidity. In this context, banks might strengthen their solvency standards to offset their liquidity constraint and improve their ability to raise external funds. In addition, banks might raise their capital standards to better assume the losses from selling illiquid assets to repay the liabilities claimed on demand. If the hypothesis is rejected—that is, if banks do not adjust and improve their capital standards when facing higher illiquidity—liquidity requirements concomitant to capital standards might be needed to temper the overall riskiness of banks. From this perspective, this study also contributes to the debate on liquidity regulation implemented in the Basel III regulatory framework[66].

This study extends the current literature in several directions. First, it adds to the strand of the existing empirical literature on bank capital buffer, in that liquidity has not yet been considered a determinant of capital buffer. Second, to be consistent with recent empirical findings showing that bank capital and liquidity might be jointly determined, a simultaneous equations model is used in this study. Third, both a liquidity creation indicator in the steps of Berger and Bouwman (2009) and a liquidity indicator in line with the definition of the Basel Committee on Banking Regulation and Supervision (i.e., the net stable funding ratio) are considered in the study. The net stable funding ratio shows to what extent a bank is able to meet its liquidity requirements without borrowing money or selling its assets at a loss. This measure accounts for the imbalances of both sides of bank balance sheets and enables regulators to better assess the ability of banks to meet unexpected customer withdrawals from their liquid assets. The main difference between the liquidity creation indicator and the liquidity indicator as defined in the Basel III accords stems from the liability side of the balance sheets. The liquidity creation indicator considers the maturity of liabilities, whereas the liquidity indicator as defined in the Basel III accords focuses on their stability. Liquid liabilities can be defined as all liabilities that mature within one year. Stable funding are all the liabilities that are expected to stay within the institution. From these two approaches to measure bank liquidity, this study investigates whether bank managers give a higher importance to the maturity of their funding or to their stability in their definition of bank

66 Two regulatory standards for liquidity have been introduced. The "*net stable funding ratio*" identifies the amount of long-term, stable sources of funding an institution uses relative to the liquidity profiles of its assets and the potential for contingent calls on funding liquidity arising from off-balance-sheet commitments and obligations. The standard requires a minimum amount of funding that is expected to be stable over a one year-time horizon based on liquidity factors assigned to assets and off-balance-sheet commitments. The Basel Committee has also introduced the "*liquidity coverage ratio*" to promote the short-term resiliency of the liquidity profile of institutions by ensuring that they have sufficient high-quality liquid resources to survive an acute stress scenario lasting for one month. These proposals have been fully calibrated and were agreed upon on December, 2010 and revised on June 2011 (Basel III Accords).

liquidity. Finally, this study also adds to the literature by assessing the accuracy of improving the regulatory framework by adding liquidity requirements to capital standards.

The main results, obtained for listed U.S. and European banks during the 2000–2008 period, show that banks do not strengthen their capital buffer when they face higher illiquidity as defined in the Basel III accords or when they create more liquidity as measured by Berger and Bouwman (2009). However, considering a different definition of stable liabilities specific to U.S. banks based on the concept of core deposits, the results show that, except for very large institutions, banks do actually build larger capital buffers when they are exposed to higher illiquidity. The findings support the need to implement minimum liquidity ratios concomitant to capital ratios, as stressed by the Basel Committee. Nevertheless, the results also shed light on the need to further clarify how to define and measure illiquidity.

The remainder of this chapter is organized as follows. Section 3.2 presents the dataset and the empirical strategy, while section 3.3 describes the variables considered in the analysis. Results and robustness checks are presented in sections 3.4 and 3.5. Section 3.6 presents concluding remarks.

3.2. Sample and empirical method

3.2.1. Presentation of the sample

The sample includes U.S. and European[67] publicly traded commercial banks over the 2000–2008 period. The focus is on U.S. and European banks because the required data are available on standard databases to ensure an accurate representativeness of the sample of banks in each country. Furthermore, the sample includes only listed banks because the setting requires market data (i.e., market value of assets, dividends) and a detailed breakdown of bank balance sheets to compute liquidity indicators. In standard databases, these informations are more frequently and extensively reported for listed banks.

Annual consolidated financial statements were extracted from Bloomberg. The study also includes data from the World Bank’s 2007 Regulation and Supervisory Database (Barth

67 The sample includes banks from the 27 EU member countries, Norway and Switzerland. However, the required data are available only for banks located in the 20 following countries: Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Liechtenstein, Malta, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

et al., 2007) to compute indicators of regulatory oversight of bank capital and of supervisory oversight.

From 2000 to 2008, 870 listed commercial banks have been identified (645 in the United States and 225 in Europe). To enable the liquidity indicator computation, the sample is restricted to banks for which the breakdown for loans by category and the breakdown for deposits by maturity were available in Bloomberg or in annual reports. The final sample consists of 781 commercial banks (574 in the United States and 207 in Europe). Table 3.1 presents the distribution of banks by country and the representativeness of the sample. The study compares aggregate total assets of banks included in the final sample with aggregate total assets of the whole banking system. Over the 2000–2008 period, the final sample accounts, on average, for 66.4% of the total assets of U.S. commercial banks as reported by the Federal Deposit Insurance Corporation (FDIC) and 60.4% of the total assets of European commercial banks as reported by central banks.

Table 3.1. Distribution of U.S. and European listed commercial banks

	Banks available in Bloomberg	**Banks included in the final sample**	**Total assets of banks in final sample / total assets of the banking system (%)**
United States	**645**	**574**	**66.4**
Europe	**225**	**207**	**60.4**
Austria	8	8	57.3
Belgium	4	3	80.3
Cyprus	4	4	69.7
Denmark	44	38	60.6
Finland	2	2	71.2
France	22	22	62.1
Germany	15	14	40.1
Greece	12	12	80.6
Iceland	2	2	66.3
Ireland	3	3	31.3
Italy	24	22	59.6
Liechtenstein	2	2	50.1
Malta	4	4	32.5
Netherlands	2	2	47.6
Norway	23	20	70.3
Portugal	6	6	55.3
Spain	15	15	64.4
Sweden	4	4	72.6
Switzerland	22	18	74.8
United Kingdom	7	6	61.5

Source: Bloomberg, European Central Bank, Bank of England, National Bank of Switzerland, Sveriges Riskbank, Danmarks Nationalbank, Central Bank of Iceland, FDIC and Finance Norway. To deal with the issue of sample representativeness, the study compares aggregate total assets of banks included in the final sample (i.e., U.S. and European publicly traded commercial banks) with aggregate total assets of the whole banking system. From 2000 to 2008, the ratio of aggregate total assets of banks included in the final sample to aggregate total assets of the whole banking system is computed. This table reports the average value of this ratio country by country.

Table 3.2 presents some general descriptive statistics of the final sample including U.S. and European banks. By using several key accounting ratios, the data highlight that banks are on average focused on traditional intermediation activities. Indeed, loans and deposits account for a large share of bank total assets and total liabilities. The average share of loans in total assets 66.4% and the average ratio of total deposits to total assets is 70.2%. In addition average interest income accounts for nearly three-quarters of total income (72.3%). However, there is a high heterogeneity across banks, as shown by the high standard deviation and extreme values of each ratio[68]. Considering the ratios of total loans to total assets and total deposits to total assets, minimum values are respectively equal to 3.7% and 4.1%. Because after checking these very low minima are not outliers but prevail for several large European universal banks, these observations are kept in the panel. Regarding the quality of bank assets, the average share of loan loss provisions in total loans is 0.5%. Considering profitability, the average return on assets is equal to 0.9%. Last, in terms of capitalization, the average risk weighted capital ratio is higher than the minimum regulatory requirement (8% in most countries) at 13.2%, and the average ratio of Tier 1 capital to total assets is 8.2%.

Table 3.2. Summary descriptive statistics of the sample of U.S. and European listed commercial banks, on average, from 2000 to 2008

	Total assets in US$ billion	Total loans / total assets	Total deposits / total assets	Loan loss provisions / total loans	Tier 1 capital / total assets	Tier 1 and 2 capital / RWA	ROA	Total interest income / total income
Mean	48.9	66.4	70.2	0.5	8.2	13.2	0.9	72.3
Median	1.1	68.3	75.4	0.3	7.7	12.5	0.9	75.9
Max	3768.2	95.1	96.0	7.2	35.2	34.0	6.9	100.0
Min	0.02	3.7	4.1	-1.2	0.1	4.5	-13.3	4.7
Std. Dev.	222.5	14.2	17.0	0.6	3.4	3.3	0.9	15.6

Source: Bloomberg (2000–2008). All variables are expressed in percentage, except *Total assets*. *Total assets* in US$ billion; *Total loans / total assets:* (commercial loans + consumer loans + other loans) / total assets; *Total deposits / total assets:* (demand deposits + saving deposits + time deposits + other time deposits) / total assets; *Loan loss provisions / total loans:* loan loss provisions / (commercial loans + consumer loans + other loans); *Tier 1 capital / total assets:* Tier 1 capital / total assets; *Tier 1* and *2 capital / RWA:* (Tier 1 capital + Tier 2 capital) / total risk weighted assets; *ROA:* net income / total assets; *Total interest income / total income:* (interest income from loans + resale agreements + interbank investments + other interest income or losses) / total income.

68 On average, US commercial banks exhibit significantly higher ratios of loans to total assets (69% for US banks and 65% for European banks), deposits to total assets (77% for US banks and 49% for European banks) and gross interest income to total income (78% for US banks and 58% for European banks) than European banks. This might be explained as follows: U.S. banking groups are allowed to perform activities “closely related to banking”, such as investment banking and insurance, only if they are considered as “well capitalized” by the Federal Reserve (i.e., if they meet the Fed’s highest risk-based capital rating). Therefore, most banking groups are focused on banking business, primarily issuing deposits and making loans. In Europe, banking groups are not subject to such requirements and can more easily develop their market activities.

3.2.2. The model and regression framework

This chapter investigates the contribution of liquidity in explaining bank capital buffer beyond the determinants considered in the existing literature. Nevertheless, previous studies show that bank capital might also be a determinant of bank liquidity creation (Berger and Bouwman, 2009). Thus to deal with endogeneity, this includes a simultaneous equations model. In the first equation (i.e., the capital buffer equation), capital buffer is regressed on a set of factors identified in the previous literature, to which liquidity variables are added using several proxies. In the second equation (i.e., the liquidity equation), liquidity variable is regressed on a set of independent variables identified in previous literature. The empirical model is specified by the following simultaneous equations system (noted as system (1); subscripts *i* and *t* denoting bank and period, respectively):

$$\begin{cases} BUFFER_{it} = \alpha_{it} + \beta\ L_{i,t} + \sum_{k=1}^{K} \gamma_k DB_{ki,t-1} + \sum_{j=1}^{J} \gamma'_j DB_{ji,t} + \varepsilon_{it} \\ L_{i,t} = \delta_{it} + \varphi\ BUFFER_{it} + \sum_{m=1}^{M} \lambda_m DL_{mi,t-1} + \sum_{n=1}^{N} \lambda'_n DL_{ni,t} + \xi_{it} \end{cases} \qquad (1)$$

Previous empirical studies on capital buffer and liquidity respectively highlight potential endogeneity issues with some explanatory variables and specifically with most of the bank level indicators. To address such issues[69] and following Lindquist (2004), in both the capital and the liquidity equations all the explanatory variables which are presumably endogenous in the existing literature are replaced by their one-year lagged value[70]. *BUFFER* and *L* correspond respectively to capital buffer and to liquidity proxy. DB_j and DL_n are respectively the j^{th} and the n^{th} exogenous determinants of capital buffer and liquidity. DB_k and DL_m are respectively the k^{th} and the m^{th} presumably endogenous determinants of capital buffer and liquidity.

System (1) is estimated considering the generalized method of moments (GMM). Considering this estimation method has two advantages. It is robust to the distribution of errors and it is considered as more efficient than two-stage least squares (2SLS) regression

69 Hausman tests are run for endogeneity by considering each equation of the system individually. The tests confirm the presence of endogeneity both in the capital buffer and the liquidity equations.

70 After checking, the one year lagged values of the variables which are considered as presumably endogenous in the existing literature are not weak instruments. However, more lags of these variables are not introduced in the regressions as they are weak instruments.

because it accounts for the heteroskedasticity of errors (Hall, 2005). After testing for cross-section and time fixed versus random effects, cross-section and time fixed effects are included in the regressions.

3.3. Definition of variables

3.3.1. Capital buffer

Capital buffer is defined as the amount of capital a bank holds in excess of the minimum required to meet regulatory standards. This variable is computed as the difference between the total risk weighted capital ratio (i.e., the ratio of Tier 1 and Tier 2 capital to risk weighted assets) and the regulatory minimum requirements (*BUFFER_T12*). In most of the countries of the sample, regulators set the minimum requirement at 8%, except in Cyprus where it is equal to 10% and in the United Kingdom where it is equal to 9% following Jokipii and Milne (2008)[71]. In addition, in Germany, regulatory minimum requirement is set to 12.5% for newly established banks in the first two years of business. However, such banks are not included in the sample of German banks. For deeper insights, an alternative measure of capital buffer is also considered. This measure indicates the amount of Tier 1 capital that a bank holds in excess of the minimum requirement which is set to 4% in all countries (*BUFFER_T1*). Tier 1 capital consists of better quality capital and banks might be managing the different components of regulatory capital differently.

Since bank capital and liquidity creation might be jointly determined, capital buffer is the dependent variable in the capital buffer equation of system (1) and an explanatory variable in the liquidity equation of this system. As discussed above, the theoretical literature provides two opposite views of the impact of capital on liquidity creation. The "financial fragility hypothesis" (Diamond and Rajan, 2000 and 2001a) and the "deposit crowding-out hypothesis" (Gorton and Winton, 2000) predict that higher capital will decrease bank liquidity creation. However, the "risk absorption hypothesis" postulates that higher capital will increase bank liquidity creation. Thus, the expected sign for the coefficient of this variable is ambiguous in the liquidity equation.

71 In the United Kingdom, the Financial Stability Authority considers two capital ratios: the trigger ratio and the higher target ratio. The trigger ratio corresponds to the regulatory minimum risk weighted capital ratio. The higher target ratio is set above the trigger ratio, resulting in higher levels of capital required by the regulators for individual banks. Jokipii and Milne (2008) consider a 9% requirement for UK banks. To deal with this issue and following Jokipii and Milne (2008), regulatory minimum risk weighted capital ratio is set at 9% in this study for UK banks.

3.3.2. Measures of liquidity

In the banking literature, most empirical studies that consider liquidity indicators use ratios computed from accounting data (i.e., consistent with liquidity indicators of the CAMELS rating approach). However, as argued by Poorman and Blake (2005), using such liquidity ratios could be inaccurate under certain conditions. For example, a large regional bank such as the Southeast Bank of Miami, with a ratio of liquid assets to total assets above 30%, bankrupted in September 1991 because of its inability to repay some liabilities claimed on demand with its liquid assets[72]. In addition, given the development of bank market activities, the cash value of assets that could be monetized and the availability of market funding are essential to assess bank liquidity. To deal with such issues, some empirical studies use synthetic liquidity indicators that include, in addition to the information provided by accounting data on the liquidity profile of banks, information about the cash value of assets that could be monetized and about the availability of market funding to determine the liquidity of bank assets and liabilities (Deep and Schaefer, 2004; Berger and Bouwman, 2009; BIS, 2009a). Using this literature emphasizing the use of such synthetic indicators and considering the Basel III international framework for liquidity assessment in banking, this study uses the following two proxies: a liquidity creation indicator (*LC*) and the inverse[73] of the Basel III net stable funding ratio (*I_NSFR*)[74].

The first liquidity measure is the liquidity creation indicator (*LC*) defined by Berger and Bouwman (2009). To compute this indicator, first, all assets and liabilities are classified as liquid, semiliquid or illiquid according to their maturity and their category. The authors

72 The Southeast Bank of Miami had experienced significant problems as a result of concentrated lending in commercial real estate and weak underwriting and credit administration practices. As of August 31, 1991, real estate loans at Southeast Bank of Miami totaled US$3.5 billion, or 45% of the bank's total loan portfolio, and nonperforming assets equaled 10% of loans. Southeast Bank of Miami reported a loss of US$116.6 million for the first quarter and US$139 million for the second quarter of 1991. The announcement of these huge losses caused more depositors to withdraw their funds, and the bank's liquidity problems grew worse. Finally, the bank was closed on September 19, 1991, when it was unable to repay a loan from the Federal Reserve Bank of Atlanta.

73 This study uses the inverse of the Basel III net stable funding ratio. A higher value indicates higher illiquidity.

74 Bank liquidity is affected by on- and off-balance sheets positions. This study uses the liquidity created by banks or their liquidity profile only from on-balance sheet positions because a detailed breakdown of off-balance sheets is not available in standard databases. Holmstrom and Tirole (1998) and Kashyap et al. (2002) indicate that banks can also create liquidity off the balance sheet through loan commitments to customers and similar claims to liquid funds. In addition, the potential contingent calls on funding liquidity arising from off-balance sheet commitments and obligations can generate lack of liquidity and thus increase bank illiquidity. However, banks can hold loan commitments from other financial institutions. These liquidity facilities are likely to negatively affect bank liquidity creation and illiquidity. Consequently, the net effect of off-balance sheet positions on bank liquidity creation and illiquidity is not clear-cut.

assume that some assets are easier to sell than others (e.g., securitizable loans, trading assets). In addition, they assume that some liabilities are more volatile than others, such as commercial papers and short-term deposits. Second, each asset and liability item is weighted accordingly. Appendix B shows the weights applied to bank balance sheets based on Berger and Bouwman (2009). The result of the calculation is an absolute value of created liquidity (i.e., a U.S. dollar or euro amount of actual liquidity created on the balance sheets). Liquidity creation (*LC*) is then calculated as follows:

$$LC = \frac{\begin{array}{c}0.5 * \text{illiquid assets} + 0 * \text{semiliquid assets} - 0.5 * \text{liquid assets} \\ + 0.5 * \text{liquid liabilities} + 0 * \text{semiliquid liabilities} - 0.5 * \text{illiquid liabilities}\end{array}}{\text{Total assets}}$$

All else being equal, a bank creates one dollar of liquidity by investing one dollar of liquid liabilities (e.g., transaction deposits) into one dollar of illiquid assets (e.g., business loans). Similarly, a bank destroys one dollar of liquidity by investing one dollar of illiquid liabilities or equity into one dollar of liquid assets (e.g., short-term government securities). Higher values of liquidity creation indicate higher bank illiquidity, as it invests more liquid liabilities into illiquid assets. In such a case, the bank is more exposed to maturity transformation risk if customers claim their funds on demand while illiquid assets are saleable at fire sale prices.

The second liquidity proxy used in this study is based on the regulatory standards proposed by the Basel Committee on Banking Regulation and Supervision (BIS, 2009a). Following the subprime crisis, in recognition of the need for banks to improve their liquidity management, the Basel Committee on Banking Regulation and Supervision developed an international framework for liquidity assessment in banking (BIS, 2009a). Among the several guidelines, the Basel III accords include the implementation of the "*net stable funding ratio*". This ratio is intended to promote resiliency over long-term time horizons by creating additional incentives for banks to fund their activities with more stable sources of funding on an ongoing structural basis[75]. This liquidity measure is the ratio of the available amount of stable funding to the required amount of stable funding. The available amount of stable

75 The Basel Committee on Banking Regulation and Supervision also introduced the "*liquidity coverage ratio*". This ratio is intended to promote the short-term resiliency of the liquidity profile of banks by ensuring that they have sufficient high-quality liquid resources to survive an acute stress scenario lasting for one month. This thesis focuses on a one-year horizon and does not compute such a ratio, which requires the use of monthly data.

funding is the total amount of an institution's (1) capital, (2) liabilities with effective maturities of one year or greater, and (3) portion of "stable" nonmaturity deposits and of term deposits with maturities of less than one year that would be expected to stay within the institution. The required amount of stable funding is the amount of a particular asset that could not be monetized through sale or used as collateral in a secured borrowing on an extended basis during a liquidity event lasting one year. To calculate the "*net stable funding ratio*", a specific required stable funding factor is assigned to each particular type of asset and a specific available stable funding factor is assigned to each particular type of liability. Appendix C briefly summarizes the composition of asset and liability categories and related stable funding factors. The higher the required amount of stable funding compared with the available amount of stable funding, the more illiquid a bank is considered. Because the regulation on bank liquidity is not yet implemented, this ratio is only an indicator of bank illiquidity as defined in the Basel III accords and does not establish a minimum acceptable amount of stable funding based on the liquidity characteristics of an institution's assets and activities over a one-year time horizon.

The second liquidity measure used in this study is the inverse of the regulatory ratio (BIS, 2009a). The inverse of the net stable funding ratio (*I_NSFR*) is the ratio of the required amount of stable funding to the available amount of stable funding. Appendix D shows the breakdown of bank balance sheets as provided by Bloomberg and its weighting with respect to the Basel III framework to calculate the inverse of the net stable funding ratio. On the asset side, the type and maturity of assets is defined consistent with the definition of BIS (2009a) to apply the corresponding weights. On the liability side, only the maturity of liabilities is considered to apply the corresponding weights. Because the data only provide the breakdown of deposits according to their maturity and not according to the type of depositors, the intermediate weight of 0.7[76] is considered for stable demand deposits and saving deposits (including all deposits with a maturity of less than one year). This study calculates the inverse of the net stable funding ratio (*I_NSFR*) as follows:

76 The Basel Committee considers three different weights (i.e., 0.5 or 0.7 or 0.85) for demand and saving deposits (i.e., all deposits with a maturity of less than 1 year) according to the type of depositors. Here, it is the intermediate weight of 0.7 that is used. In section 3.5, robustness checks are performed by considering other weights.

$$I\_NSFR = \frac{\text{Required amount of stable funding}}{\text{Available amount of stable funding}} = \frac{\begin{array}{l} 0 * (\text{cash + interbank assets + short-term marketable assets}) \\ + 0.5 * (\text{long-term marketable assets + customer acceptances}) \\ + 0.85 * \text{consumer loans} \\ + 1 * (\text{commercial loans + other loans + other assets + fixed assets}) \end{array}}{\begin{array}{l} 0.7 * (\text{demand deposits + saving deposits}) \\ + 0 * (\text{short-term market debt + other short-term liabilities}) \\ + 1 * (\text{long-term liabilities + equity}) \end{array}}$$

Higher values of the two liquidity indicators indicate higher bank illiquidity. Higher levels of liquidity creation (*LC*) mean that banks invest more liquid liabilities in illiquid assets. In addition, a higher inverse net stable funding ratio (*I_NSFR*) implies that the amount of assets that cannot be monetized is deviating from the available amount of stable funding. In this context, a bank faces risk if some liquid liabilities (i.e., unstable funding) invested in illiquid assets (i.e., assets that could not be monetized or that can be sold at loss) are claimed on demand. Rational behavior of banks might to hold more capital to assume the losses incurred by higher illiquidity. Consequently, a positive sign is expected for the coefficients of the variables *LC* and *I_NSFR* in the determination of capital buffer.

3.3.3. Variables affecting capital buffer and liquidity from previous literature

Following the existing literature, this study includes a large set of bank-level indicators and macroeconomic variables that are likely to affect bank capital buffer and liquidity respectively.

Profitability is included in both the capital buffer and the liquidity equations. Because raising additional capital is costly, capital accumulation can more easily rely on funds generated internally (through higher retained earnings, weaker dividend payments and stock repurchase) in line with the “pecking order theory of finance” (Flannery and Rangan, 2008). Thus, a positive relationship is expected between bank profitability and capital buffer. In addition, higher profitability captures the impact of better financial soundness on banks' risk-bearing capacity and on their ability to perform liquidity transformation (Chen et al., 2010; Rauch et al., 2009). Thus, a positive relationship is expected between bank profitability and illiquidity. However, a troubled bank can also take more risk and increase its liquidity transformation in an attempt to increase its expected profitability, specifically if it is considered too-big-to-fail. Thus, the sign of the relationship between bank profitability and illiquidity could also be negative. The return on assets is considered a proxy of bank profitability (*ROA*). On the whole, the expected sign for the coefficient of this variable is positive in the capital buffer equation but ambiguous in the liquidity equation.

Because capital accumulation will also depend on dividend policy, the dividend payout ratio is used in the framework, following Gropp and Heider (2010). A negative relationship might be expected between the dividend payout ratio and capital buffer. The dividend payout ratio, as defined in the Bloomberg database, is the ratio of total common dividends to the difference between net income and minority interests plus preferred dividends (*DIV_PYRT*). Thus, a negative sign for the coefficient of this variable in the determination of capital buffer should result.

The riskiness of bank assets is also included in both the capital buffer and the liquidity equations. The ratio of loan loss provisions to total loans (*LLP_TLO*) is considered a proxy of asset risk. Note that the expected sign for the relationship between this variable and capital buffer is not clear-cut. Because bank capital can be viewed as a security buffer to assume losses from risky and poor quality assets, the banks willing to take higher risk might hold more capital (Berger et al., 2008; Flannery and Rangan, 2008; Gropp and Heider, 2010). However, an increase in this *ex post* measure of risk could lower capital buffer, given that capital is accumulated to face unexpected losses (Ayuso et al., 2004; Fonseca and Gonzalez, 2010; Nier and Baumann, 2006). Regarding the relationship between liquidity and asset risk, lower exposure to risk enables the bank to enhance its market and loan activities by continuously meeting the capital at-risk requirements (Berger and Bouwman, 2009; Deep and Schaefer, 2004; Rauch et al., 2009). Consequently, better asset quality will improve the ability of banks to perform liquidity transformation. Thus, the expected sign for the relationship between asset risk and bank illiquidity is negative. On the whole, the expected sign for the coefficient of this variable is ambiguous in the capital buffer equation but negative in the liquidity equation.

The influence of the cost of equity is also considered as a determinant of capital buffer following previous works (Ayuso et al., 2004; Bikker and Metzemakers, 2004; Jokipii and Milne, 2008; Stolz and Wedow, 2011) using return on equity (*ROE*; i.e., the ratio of net income to total equity) as a proxy of the cost of equity. A negative sign is expected for the coefficient of this variable in the capital buffer equation.

In accordance with Ayuso et al. (2004), this study includes the importance of bank loan activities to determine capital buffer. Banks highly involved in loan activities should face higher capital requirements assuming that loan activities are relatively better taken into account into the capital regulatory requirement than other nontraditional activities. Thus, a negative relationship is expected between the extent of loan activities and capital buffer. The ratio of total loans to total assets (*LO_TA*) is considered a proxy of bank loan activities. In addition, an increase in assets through loans will increase capital requirements (because risk weighted assets are larger) and therefore decrease capital buffer. Consequently, there should be a negative relationship between the growth rate of the loan portfolio and capital buffer. The annual growth rate of net loans (*LO_GWT*) is considered a proxy of the importance of credit expansion. A negative sign is expected for the coefficient of this variable in the capital buffer equation.

Nier and Baumann (2006) indicate that the funding structure of the bank is likely to affect capital buffer. Because uninsured debtholders are likely to face large losses in case of bank failure, they are particularly sensitive to the riskiness of the bank and to its default probability. From this perspective, uninsured debtholders will feel unsafe when the bank is operating with a capital ratio close to the regulatory minimum requirement and will increase their monitoring effort. Following the literature, long-term bondholders and subordinated debtholders are expected to have the strongest incentives to monitor and discipline banks. To avoid higher funding cost, banks that are more reliant on uninsured market debt will hold higher levels of capital. Therefore, the ratio of long-term market funding and subordinated debts to total debts (*MKT_DISC*) is considered to capture such a behavior. A positive sign is expected for the coefficient of this variable in the determination of capital buffer.

Because a bank with a higher charter value can more easily raise capital on the market, it will presumably need to hold less capital buffer. Alternatively, as argued by Gropp and Heider (2010), bank reputation and charter value should also be protected with a large amount of capital. The ratio of the market value to the book value of assets (*MKT_BK_VAL*) is considered a proxy of bank charter value. Thus, the expected sign for the coefficient of this variable in the capital buffer equation is ambiguous.

Berger and Bouwman (2009) shed light on the importance of bank market power in the ability to create liquidity. Market power can affect the availability of funds (Petersen and Rajan, 1995) and the distribution of the loan portfolio (Berger et al. 2005). Greater market power might enable banks to enhance their transformation activities by granting more loans and attracting more funds (i.e., deposits or market funding). Thus, market power is expected to positively affect liquidity creation and hence bank illiquidity. The ratio of total assets of bank i located in country j to the total assets of the banking system in country j (*MKT_POW*) is considered a proxy of bank market power. A positive sign is expected for the coefficient of this variable in the liquidity equation.

Different business models might also affect liquidity. Specifically, traditional intermediation activities such as lending will generate higher illiquidity than trading activities or commission and fee activities. Therefore a positive relationship might be expected between the extent of interest generating activities and bank illiquidity. The ratio of gross interest income to total gross income (*BUSI_MD*) is used to capture this dimension. A positive sign for the coefficient of this variable in the liquidity equation should result.

Bank size is included in both the capital buffer and the liquidity equations. Large banks benefit from economies of scale in screening and monitoring borrowers and from greater diversification. In addition, because of their “too-big-to-fail” position, large banks might hold less capital in excess of regulatory requirements. Hence, a negative relationship is expected between bank size and capital buffer. Large banks could also create more liquidity than smaller banks because they have easier access to the lender of last resort and because they would be the first to benefit from the safety net. Therefore a positive relationship is expected between bank size and illiquidity. The natural logarithm of total assets (*LN_TA*) is considered a proxy of bank size. On the whole, the expected sign for the coefficient of this variable is negative in the capital buffer equation but positive in the liquidity equation.

The business cycle is taken into account in both the capital buffer and the liquidity equations. According to previous studies (Ayuso et al., 2004; Jokipii and Milne, 2008; Lindquist, 2004), capital buffer and economic activity tend to be negatively related. Banks tend to decrease their capital buffer during economic booms and increase it during economic downturns. However, Berger et al. (1995) argue that banks with external growth strategies might increase their capital buffer during economic booms to exploit acquisition opportunities. The macroeconomic environment is also likely to affect bank activities and investment decisions (Chen et al., 2010; Pana et al., 2010). For example, the demand for differentiated financial products is higher during economic booms and might improve banks' ability to expand their loan and securities portfolios at a higher rate. Similarly, economic downturns are exacerbated by the reduction in bank credit supply. On the basis of these arguments, banks are expected to increase their transformation activities and their illiquidity during economic booms. The annual growth rate of real GDP (*GDP_GWT*) is considered a proxy of the economic environment. The expected sign for the coefficient of this variable is ambiguous in the capital buffer equation but is expected to be positive in the liquidity equation.

Rauch et al. (2009) indicate the importance of monetary policy in the explanation of bank liquidity. When the central bank's policy rate is relatively low, credit supply increases, which positively affects bank illiquidity (Mishkin, 1996). In this study, each country's central bank policy rate (*CB*) is considered a proxy of monetary policy. A negative sign is expected for the coefficient of this variable in the liquidity equation.

The impact of liquidity pressures on the interbank market is also considered in the liquidity equation. The spread between the one-month interbank rate and the policy rate of the central bank (*IBK1M_CB*) is used as a proxy of the liquidity pressures on the interbank market. Higher values of the spread reflect higher pressures on the interbank market, which make it more difficult for banks to access these sources of liquidity and, all else being equal, will therefore increase their liquidity risk (i.e., they might be unable to raise external funds). Consequently, higher values of the spread are expected to negatively affect liquidity creation. A negative sign for the coefficient of this variable in the liquidity equation should result.

Last, a dummy variable is introduced in the capital buffer equation to control for the influence of the Basel II regulatory framework in Europe since January 2007. This dummy variable takes on a value of 1 from 2006[77] to 2008 for European banks and a value of 0 otherwise (*DUM_BASEL_2*). Moreover, an indicator of regulatory oversight of bank capital is also introduced (*CAP_REG*) in the capital buffer equation and an indicator of supervisory oversight (*CONTROL*) in the liquidity equation (Laeven and Levine, 2008; Shehzad et al., 2010). Because banking regulation is likely to vary across countries, these variables control for possible country effects. These indexes are computed from the World Bank’s 2007 Regulation and Supervisory Database (Barth et al., 2007). Higher values of the bank capital regulation index[78] reflect stronger regulatory oversight. Under strong regulation, banks are expected to be encouraged to maintain high levels of capital and increase their capital buffer. Thus, a positive sign is expected for this variable in the capital buffer equation. In addition, under stronger supervisory oversight[79], banks are expected to be encouraged to lower their

77 It takes on a value of 1 since 2006 to account for banks’ expectations of regulatory changes in 2007.

78 This index is the total number of affirmative answers to the following questions: (1) Is the minimum capital asset ratio requirement risk weighted in line with the Basel guidelines? (2) Does the minimum ratio vary as a function of market risk? (3) Does the minimum ratio vary as a function of credit risk? (4) Does the minimum ratio vary as a function of operational risk? (5) Is there a simple leverage ratio required? (6) Are market values of loan losses not realized in accounting books deducted from capital? (7) Are unrealized losses in securities portfolios deducted? (8) Are unrealized foreign exchange losses deducted? (9) Are accounting practices for banks in accordance with International Accounting Standards? For each country in the sample, the possible changes in the answers to these questions over the 2000–2008 period were considered. Thus, for a given country, the value of the index might vary over time.

79 The proxy of supervisory regime (*CONTROL*) is a combinaiason of two indicators. The first indicator refers to supervisory agency control and is the total number of affirmative answers to the following questions: (1) Is the

risk exposure and better manage their liquidity (Berger et al., 2011). Thus, a negative sign is expected for the coefficient of this variable in the liquidity equation. Table 3.3 shows descriptive statistics of all explanatory variables.

Table 3.3. Descriptive statistics of explanatory variables, for U.S. and European listed commercial banks, on average from 2000 to 2008

Variables	Mean	Median	Max	Min	Std Dev	Obs
ROA	0.8	0.9	6.9	-15.1	1.0	6440
DIV_PYRT	32.2	32.5	100.0	0.0	23.2	5997
ROE	10.0	11.3	47.9	-100.0	10.5	6440
LLP_TLO	0.5	0.3	7.2	-1.2	0.6	6289
LO_TA	66.4	68.3	95.1	3.7	14.2	6414
LO_GWT	10.7	9.5	93.6	-76.2	14.7	6414
MKT_DISC	10.1	7.1	88.7	0.0	10.3	6414
MKT_BK_VAL	1.6	1.5	7.8	0.0	0.8	6281
LN_TA	7.6	7.0	15.1	2.8	2.1	6414
GDP_GWT	2.3	2.5	9.5	-3.5	1.3	7029
CAP_REG	5.8	6.0	8.0	2.0	0.9	7029
LC	31.6	32.1	75.5	-25.3	12.7	6414
I_NSFR	91.3	90.6	477.2	17.8	21.9	6414
BUFFER_T12	5.3	4.6	28.0	-3.5	3.3	6066
BUFFER_T1	7.6	7.6	7.6	7.6	7.6	6066
MKT_POW	1.7	0.01	74.5	0.0	6.3	6414
BUSI_MD	72.3	75.9	100.0	4.7	15.6	6375
CB	3.0	2.3	22.0	0.25	1.9	7029
IBK1M_CB	0.2	0.1	3.5	-0.4	0.2	7029
CONTROL	11.3	13.0	13.0	4.0	3.0	7029

Source: Bloomberg (2000–2008), World Bank's 2007 Regulation and Supervisory Database. All variables are expressed in percentage, except *LN_TA*, *MKT_BK_VAL*, *CAP_REG* and *CONTROL*. *ROA:* net income / total assets; *DIV_PYRT:* common dividend / (net income – minority interests – preferred dividends); *ROE:* net income / total equity; *LLP_TLO* loan loss provisions / total loans; *LO_TA:* total loans / total assets; *LO_GWT:* annual growth rate of loan portfolio; *MKT_DISC:* (total long-term market funding + subordinated debt) / total debts; *MKT_BK_VAL:* market value of assets/ book value of assets; *LN_TA:* natural logarithm of total assets; *GDP_GWT:* annual growth rate of real GDP; *CAP_REG:* index of regulatory oversight of bank capital; *LC:* liquidity creation / total assets; *I_NSFR:* required amount of stable funding / available amount of stable funding; *BUFFER_T12:* Tier 1 and 2 capital in excess of the regulatory minimum capital requirements; *BUFFER_T1:* Tier 1 capital in excess of the regulatory minimum capital requirements; *MKT_POW:* total assets of bank *i* in country *j* / total assets of the banking system in country *j*; *BUSI_MD:* gross interest income / total income; *CB*: central bank policy rate; *IBK1M_CB:* spread of 1 month interbank rate and central bank policy rate; *CONTROL*: index of supervisory regime.

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minimum capital adequacy requirement greater than 8%? (2) Can the supervisory authority ask banks to increase minimum required capital in the face of higher credit risk? (3) Can the supervisory authority ask banks to increase minimum required capital in the face of higher market risk? (4) Can the supervisory authority ask banks to increase minimum required capital in the face of higher operational risk? (5) Is an external audit compulsory obligation for banks? (6) Can the supervisory authority force a bank to change its internal organization structure? (7) Can the supervisory authority legally declare that a bank is insolvent? (8) Can the supervisory authority intervene and suspend some or all ownership rights of a problem bank? (9) Can the supervisory authority supersede shareholders rights? (10) Can the supervisory authority remove and replace managers? (11) Can the supervisory authority remove and replace directors? The second indicator of the supervisory regime measures deposit insurance agency control and is the total number of affirmative answers to the following questions: (1) Can the deposit insurance agency legally declare that a bank is insolvent? (2) Can the deposit insurance agency intervene and suspend some or all ownership rights of a problem bank? (3) Can the deposit insurance agency remove and replace managers? (4) Can the deposit insurance agency remove and replace directors? (5) Can the deposit insurance agency supersede shareholders rights? For each country in the sample, the possible changes in the answers to these questions over the 2000–2008 period were considered. Thus, for a given country, the value of the index might vary over time.

3.4. Results

To test the impact of liquidity on capital buffer beyond the determinants identified in the previous literature, a simultaneous equations system (system (1)) is estimated. In the capital buffer equation, bank capital buffer is regressed on a set of determinants from previous literature and on a proxy of liquidity. Alternately two definitions of capital buffer are used: the Tier 1 and 2 capital buffer (*BUFFER_T12*) and the Tier 1 capital buffer (*BUFFER_T1*). The aim is to examine whether the results remain the same when considering Tier 1 capital buffer rather than Tier 1 and 2 capital buffer, as banks might be managing the several components of regulatory capital differently. In the liquidity equation, the proxy of liquidity is regressed on a set of determinants outlined in the previous literature. As proxies of liquidity, the two indicators defined previously are used: the liquidity creation indicator (*LC*, in systems (1.a) and (1.a′)) and the inverse of the net stable funding ratio (*I_NSFR*, in systems (1.b) and (1.b′))[80]. To deal with colinearity issues, some of the variables are orthogonalised before introducing them in the regressions[81]. Table 3.A.1 and Table 3.A.2 in Appendix 3.A show the correlation coefficients among the explanatory variables in both the capital buffer and the liquidity equations. In addition, in both the capital buffer and the liquidity equations, the presumably endogenous bank-level indicators are replaced by their one-year lagged value[82]. Table 3.4 shows the regression results.

80 In systems (1.a) and (1.b), capital buffer is the Tier 1 and 2 capital buffer (*BUFFER_T12*). In systems (1.a′) and (1.b′), capital buffer is the Tier 1 capital buffer (*BUFFER_T1*).

81 In the capital buffer equation, *ROE* is orthogonalised with *ROA*. In the liquidity equation, *LN_TA* is orthogonalised with *BUSI_MD* and *MKT_POW*.

82 Previous empirical studies on capital buffer and liquidity highlight potential endogeneity with most bank-level indicators. After testing for endogeneity (Hausman test), which confirms the presence of endogeneity and consistently with these studies, in the capital buffer equation, the following variables presumably endogenous are one-year lagged: *ROA, ROE, LLP_TLO, LO_TA, LO_GWT, MKT_DISC, DIV_PYRT* and *MKT_BK_VAL*. In the liquidity equation, the following variables presumably endogenous are one-year lagged: *ROA, LLP_TLO, MKT_POW* and *BUSI_MD*.

Table 3.4. The contribution of liquidity in the determination of capital buffers

	Tier 1 and 2 capital buffer		Tier 1 capital buffer	
	1. a	**1. b**	**1. a'**	**1. b'**
Capital buffer equation				
LC	-0.04 ** (-2.03)		-0.002 (-0.08)	
I_NSFR		-0.01 (-0.91)		0.01 (0.69)
ROA	0.18 * (1.85)	0.32 *** (3.15)	0.34 *** (3.10)	0.48 *** (4.24)
DIV_PYRT	-0.002 * (-1.67)	-0.003 ** (-1.89)	-0.004 ** (-2.25)	-0.004 ** (-1.91)
ROE	-0.002 (-0.32)	0.01 (1.04)	-0.001 (-0.10)	0.02 * (1.85)
LLP_TLO	0.14 (1.25)	0.11 (0.92)	0.27 ** (2.24)	0.22 * (1.81)
LO_TA	-0.04 *** (-4.57)	-0.05 *** (-5.56)	-0.06 *** (-7.02)	-0.06 *** (-7.40)
LO_GWT	-0.005 *** (-2.65)	-0.01 *** (-3.65)	-0.01 *** (-3.31)	-0.01 *** (-3.92)
MKT_DISC	0.01 *** (3.02)	0.02 *** (2.56)	0.02 *** (2.67)	0.02 *** (2.43)
MKT_BK_VAL	-0.001 ** (-2.02)	-0.001 * (-1.60)	-0.001 * (-1.61)	-0.001 (-1.53)
LN_TA	0.001 (0.44)	-0.001 (-1.11)	-0.002 (-1.15)	-0.003 *** (-2.41)
GDP_GWT	-0.11 *** (-2.39)	-0.11 *** (-2.50)	-0.12 *** (-2.55)	-0.11 ** (-2.30)
CAP_REG	0.003 (0.12)	0.02 (0.62)	0.01 (0.27)	0.02 (0.66)
DUM_BASEL_2	0.004 *** (3.02)	0.001 (0.77)	0.003 ** (2.33)	-0.0004 (-0.26)
Liquidity equation				
BUFFER	-4.70 *** (-9.54)	-6.89 *** (-6.89)	-3.47 *** (-10.21)	-6.03 *** (-8.24)
ROA	0.30 (0.62)	0.59 (0.72)	0.47 (1.13)	0.67 (0.91)
LLP_TLO	-0.23 (-0.46)	-1.06 (-1.17)	-0.22 (-0.54)	-0.49 (-0.63)
MKT_POW	-0.23 ** (-2.02)	0.18 (0.30)	-0.56 *** (-4.21)	-0.34 (-0.56)
BUSI_MD	-0.03 (-1.38)	0.01 (0.24)	-0.03 (-1.21)	0.11 ** (2.00)
GDP_GWT	-0.42 ** (-1.94)	-0.76 (-1.52)	-0.51 *** (-2.69)	-0.23 (-0.52)
CB	1.18 *** (7.83)	2.43 *** (7.35)	1.57 *** (12.80)	2.84 *** (9.83)
IBK1M_CB	0.93 (0.79)	9.24 *** (2.50)	-2.06 * (-1.65)	12.67 *** (3.40)
LN_TA	-0.01 *** (-3.40)	0.002 (0.32)	-0.01 *** (-5.43)	0.0003 (0.05)
CONTROL	0.005 (0.37)	-0.11 *** (-4.37)	0.01 (0.94)	-0.14 *** (-5.51)
Total Obs.	4963	4963	4963	4963

This table shows the results of estimating system (1) using GMM for an unbalanced panel of U.S. and European publicly traded commercial banks over the 2000–2008 period. The *BUFFER* variable is either the Tier 1 and 2 capital buffer (*BUFFER_T12*, in systems (1.a) and (1.b)) or the Tier 1 capital buffer (*BUFFER_T1*, in systems (1.a′) and (1.b′)). The liquidity variable is either the liquidity creation indicator (*LC* in systems (1.a) and (1.a′)) or the inverse of the net stable funding ratio (*I_NSFR* in systems (1.b) and (1.b′)). A higher value of each liquidity proxy indicates higher bank illiquidity. See Table 3.3 for the definition of the explanatory variables. Cross-section and time fixed effects are included in the regressions, and the White cross-section covariance method is used. To deal with colinearity issues in all the regressions, *ROE* is orthagonalised with *ROA* in the capital buffer equation. In the liquidity equation, *LN_TA* is orthagonalised with *BUSI_MD* and *MKT_POW*. In both the capital buffer and the liquidity equations, the presumably endogenous bank-level indicators are replaced by their one-year lagged value. In the capital buffer equation, the following variables are one-year lagged: *ROA*, *ROE*, *LLP_TLO*, *LO_TA*, *LO_GWT*, *MKT_DISC*, *DIV_PYRT* and *MKT_BK_VAL*. In the liquidity equation, the following variables are one-year lagged: *ROA*, *LLP_TLO*, *MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels, respectively.

The *LC* variable has a significant and negative impact only on *BUFFER_T12* as the dependent variable. Banks tend to decrease their Tier 1 and 2 capital buffer when they create more liquidity (i.e., when they mostly fund illiquid assets with liquid liabilities). In contrast, they do not adjust their Tier 1 capital buffer. In addition, the *I_NSFR* variable does not affect capital buffer for both definitions considered here. Thus, banks do not modify their capital buffers when they face higher illiquidity as defined in the Basel III accords (i.e., when they mostly fund illiquid assets with unstable funding). The main difference between *LC* and *I_NSFR* is that in *LC* it is the maturity of liabilities that matters to determine liquidity, whereas in *I_NSFR*, it is the stability of liabilities that counts. Stable funding can be defined as all liabilities that are expected to stay within the institution. Thus, demand and saving deposits are considered completely liquid in *LC*, whereas in *I_NSFR*, only a share of these deposits is considered unstable.

These results show that bank liquidity as defined in the Basel III accords does not affect the determination of capital buffers because the *I_NSFR* variable does not significantly affect bank capital buffers. Thus, banks do not strengthen their solvency standards when they face higher illiquidity. The unexpected and negative sign for the proxy of *LC* might be explained by the fact that bank managers place greater importance on the stability of their funding than on their maturity. Hence, when banks create liquidity, they might be substituting liquid but stable liabilities for capital.

Regarding the other determinants of capital buffers or of liquidity, most of the findings are consistent with those obtained in previous studies. The most relevant factors to explain bank capital buffers are profitability (*ROA*), dividend payout ratio (*DIV_PYRT*), the relative importance of loan activities (*LO_TA*), loan portfolio growth (*LO_GWT*), market discipline (*MKT_DISC*) and economic activity (*GDP_GWT*). Thus, as hypothesized by Flannery and Rangan (2008) and Gropp and Heider (2010), more profitable banks or banks that distribute lower dividends tend to hold higher capital buffers, because they benefit from a better ability to accumulate capital from funds generated internally. In addition, as Ayuso et al. (2004) hypothesize and in line with their results, banks highly involved in loan activities hold weaker capital buffers, because they face higher capital requirements in that risk weights on loans are higher than on trading securities. Moreover consistent with Nier and Baumann (2006), the current results confirm that market discipline provides strong incentives for banks to limit their default risk. In addition, in accordance with previous studies (Ayuso et al., 2004;

Lindquist, 2004; Jokipii and Milne, 2008), capital buffers and economic activity are negatively related. Thus, capital buffers are pro-cyclical, as banks tend to decrease their capital buffers during economic booms and increase them during economic downturns.

Focusing on the determinants of liquidity, capital buffers (*BUFFER_T12* and *BUFFER_T1*) and the central bank policy rate (*CB*) are the most relevant factors. Consistently with the “financial fragility structure” (Diamond and Rajan, 2000, 2001a) and the “crowding-out of deposits” (Gorton and Winton, 2000) theories, higher capital buffers are associated with lower liquidity creation and illiquidity. According to the “financial fragility structure” theory, this result might indicate that banks benefit from their informational advantage, which creates an agency problem. Banks are likely to extort rents from depositors. Consequently, banks must win depositors’ confidence by adopting a fragile financial structure with a large share of liquid deposits. Financial fragility favors liquidity creation because it allows banks to collect more deposits and grant more loans. In addition, from the “crowding-out of deposits” theory, higher capital ratios shift investors’ funds from relatively liquid deposits to relatively illiquid bank capital. Thus, the higher is banks’ capital ratio, the lower is their liquidity creation. In addition, perhaps surprisingly, the current findings highlight that an increase in the central bank policy rate is associated with higher illiquidity. A possible explanation is that a higher interest rate provides incentives for depositors to increase their saving. In this context, they are encouraged to invest in bank deposits or bank debt securities with a higher expected return rather than in other financial assets such as corporate equities (Rauch et al., 2009). Thus, banks could thereby attract more funds and possibly increase their maturity transformation.

In summary, the results show that banks do not strengthen their solvency standards when they face higher illiquidity as defined in the Basel III accords. Under this definition of bank liquidity, the stability of funding matters rather than its maturity. Nevertheless, the definition of stable funding might be adjusted in the U.S. case. Indeed, Harvey and Spong (2001) and Saunders and Cornett (2006) emphasize the importance of core deposits for U.S. banks. Core deposits are defined as the sum of demand deposits, saving deposits and time deposits lower than US$100, 000. These deposits are to a great extent derived from a bank’s regular customer base and are therefore typically the most stable and least costly source of funding for banks (Harvey and Spong, 2001). Thus, it might be relevant to adopt an alternative definition for stable deposits by considering core deposits for U.S. banks.

Consequently, an alternative liquidity proxy is computed by modifying the denominator of the inverse of the net stable funding ratio (*I_NSFR*). More precisely, the sum of core deposits and other stable funding is considered a proxy of the available amount of stable funding[83]. This liquidity proxy is defined as the *CFR* variable. It is computed as follows for U.S. banks:

$$\text{CFR} = \frac{\text{Required amount of stable funding}}{\text{Core deposits + Stable funding}} = \frac{\begin{array}{l} \;\; 0 * (\text{cash + interbank assets + short-term marketable assets}) \\ + 0.5 * (\text{long-term marketable assets + customer acceptances}) \\ + 0.85 * \text{consumer loans} \\ + 1 * (\text{commercial loans + other loans + other assets + fixed assets}) \end{array}}{\begin{array}{l} \;\; 1 * \text{core deposits} \\ + 0 * (\text{short-term market debt + other short-term liabilities}) \\ + 1 * (\text{long-term liabilities + equity}) \end{array}}$$

The impact of liquidity on capital buffers separately for European and U.S. banks: The importance of core deposits for U.S. banks

To delve deeper into the relationship between liquidity and capital buffer, regressions are run separately for European and U.S. banks by also considering the *CFR* variable for U.S. banks. Table 3.5 and Table 3.6 shows the regression results. The *CFR* variable is included in systems (1.c) and (1.c′). In system (1.c), the *BUFFER* variable is the Tier 1 and 2 capital buffer (*BUFFER_T12)*. In systems (1.c′), the *BUFFER* variable is the Tier 1 capital buffer (*BUFFER_T1)*.

83 The average share of core deposits to total deposits over the 2000–2008 period is 79% for the U.S. banks included in the sample. However, there is a high heterogeneity: The standard deviation of this ratio is 13.5%.

Table 3.5. The contribution of liquidity in the determination of capital buffers for European banks

	Tier 1 and 2 capital buffer		Tier 1 capital buffer	
	1. a	**1. b**	**1. a'**	**1. b'**
Capital equation				
LC	-0.21 *** (-2.82)		-0.22 *** (-3.06)	
I_NSFR		-0.01 (-0.44)		-0.04 (-1.35)
ROA	-0.08 (-0.46)	-0.20 (-1.11)	0.23 (1.16)	0.02 (0.11)
DIV_PYRT	0.001 (0.48)	-0.001 (-0.49)	-0.001 (-0.32)	-0.002 (-1.06)
ROE	0.01 (0.63)	0.04 ** (2.20)	0.01 (0.76)	0.03 * (1.67)
LLP_TLO	-0.92 *** (-3.35)	-0.38 * (-1.88)	-0.61 ** (-2.23)	-0.12 (-0.57)
LO_TA	-0.01 (-0.25)	-0.04 (-1.51)	-0.02 (-0.66)	-0.04 (-1.52)
LO_GWT	-0.01 ** (-2.26)	-0.01 ** (-2.28)	-0.003 (-0.98)	-0.005 (-1.27)
MKT_DISC	0.01 (0.64)	0.02 (1.03)	0.005 (0.36)	0.01 (0.57)
MKT_BK_VAL	0.005 *** (2.75)	0.001 (0.71)	0.002 (1.15)	-0.0004 (-0.38)
LN_TA	-0.01 ** (-2.22)	-0.01 ** (-1.97)	-0.01 ** (-2.11)	-0.01 (-1.55)
GDP_GWT	0.02 (0.26)	-0.06 (-1.02)	0.12 * (1.87)	0.03 (0.56)
CAP_REG	0.003 (0.29)	-0.01 (-0.64)	-0.01 (-0.65)	-0.01 (-0.99)
DUM_BASEL_2	0.004 (1.11)	0.005 (1.42)	0.004 (1.11)	0.003 (1.17)
Liquidity equation				
BUFFER	-2.27 *** (-3.99)	-8.87 *** (-4.01)	-2.98 *** (-7.39)	-9.59 *** (-6.44)
ROA	-0.30 (-0.57)	-4.16 ** (-2.01)	0.59 (0.96)	-1.29 (-0.63)
LLP_TLO	-3.88 *** (-7.15)	-7.37 *** (-3.96)	-2.88 *** (-4.89)	-3.61 ** (-1.91)
MKT_POW	-0.16 ** (-2.19)	0.08 (0.13)	-0.13 * (-1.68)	-0.16 (-0.40)
BUSI_MD	-0.05 * (-1.65)	-0.01 (-0.11)	-0.03 (-1.09)	-0.004 (-0.05)
GDP_GWT	0.38 * (1.83)	0.18 (0.25)	0.64 *** (3.07)	1.04 (1.53)
CB	0.26 (1.09)	0.39 (0.39)	0.22 (0.93)	0.47 (0.57)
IBK1M_CB	-0.24 (-0.25)	2.65 (0.63)	-0.18 (-0.22)	2.12 (0.79)
LN_TA	-0.004 * (-1.70)	0.01 (0.91)	-0.003 (-1.27)	0.003 (0.30)
CONTROL	-0.02 (-0.93)	-0.32 * (-1.85)	-0.02 (-1.05)	-0.21 (-1.48)
Total Obs.	1160	1160	1160	1160

This table shows the results of estimating system (1) using GMM for an unbalanced panel of European publicly traded commercial banks over the 2000–2008 period. The *BUFFER* variable is either the Tier 1 and 2 capital buffer (*BUFFER_T12,* in systems (1.a) and (1.b)) or the Tier 1 capital buffer (*BUFFER_T1,* in systems (1.a′) and (1.b′)). The liquidity variable is either the liquidity creation indicator (*LC* in systems (1.a) and (1.a′)) or the inverse of the net stable funding ratio (*I_NSFR* in systems (1.b) and (1.b′)). A higher value of each liquidity proxy indicates higher bank illiquidity. See Table 3.3 for the definition of the explanatory variables. Cross-section and time fixed effects are included in the regressions, and the White cross-section covariance method is used. To deal with colinearity issues in all the regressions, *ROE* is orthagonalised with *ROA* in the capital buffer equation. In the liquidity equation, *LN_TA* is orthagonalised with *BUSI_MD* and *MKT_POW*. In both the capital buffer and the liquidity equations, the presumably endogenous bank-level indicators are replaced by their one-year lagged value. In the capital buffer equation, the following variables are one-year lagged: *ROA, ROE, LLP_TLO, LO_TA, LO_GWT, MKT_DISC, DIV_PYRT* and *MKT_BK_VAL*. In the liquidity equation, the following variables are one-year lagged: *ROA, LLP_TLO, MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels, respectively.

Table 3.6. The contribution of liquidity in the determination of capital buffers for U.S. banks

	Tier 1 and 2 capital buffer			Tier 1 capital buffer		
	1. a	**1. b**	**1. c**	**1. a'**	**1. b'**	**1. c'**
Capital equation						
LC	-0.10 *** (-3.39)			-0.07 *** (-2.41)		
I_NSFR		-0.06 *** (-3.05)			-0.04 ** (-2.05)	
CFR			0.01 (0.63)			0.01 (0.83)
ROA	0.36 *** (2.65)	0.42 *** (3.17)	0.56 *** (4.05)	0.49 *** (3.42)	0.55 *** (3.85)	0.64 *** (4.38)
DIV_PYRT	-0.002 (-1.33)	-0.001 (-0.87)	-0.01 * (-1.78)	-0.002 (-0.90)	-0.001 (-0.37)	-0.002 (-0.56)
ROE	-0.01 (-1.09)	0.01 (0.46)	-0.04 ** (-2.14)	-0.01 (-1.08)	0.01 (0.43)	-0.03 (-1.54)
LLP_TLO	0.33 *** (2.77)	0.29 *** (2.37)	0.28 ** (2.15)	0.31 *** (2.43)	0.28 ** (2.20)	0.26 * (1.83)
LO_TA	-0.04 *** (-3.11)	-0.05 *** (-4.38)	-0.05 *** (-5.88)	-0.05 *** (-3.93)	-0.06 *** (-4.76)	-0.06 *** (-6.28)
LO_GWT	-0.01 *** (-3.79)	-0.01 *** (-3.20)	-0.02 *** (-4.87)	-0.01 *** (-4.42)	-0.01 *** (-3.53)	-0.01 *** (-4.11)
MKT_DISC	0.01 ** (2.13)	0.005 (1.11)	0.02 *** (2.38)	0.01 * (1.75)	0.004 (0.80)	0.02 ** (1.89)
MKT_BK_VAL	-0.001 (-1.18)	-0.001 (-1.59)	0.0003 (0.42)	-0.00002 (-0.04)	-0.0004 (-0.80)	0.001 * (1.62)
LN_TA	-0.00001 (0.00)	-0.001 (-0.69)	-0.005 ** (-2.32)	-0.001 (-0.39)	-0.001 (-0.80)	-0.01 *** (-3.09)
GDP_GWT	0.01 (0.08)	-0.06 (-0.44)	0.04 (0.28)	0.02 (0.15)	-0.02 (-0.14)	0.03 (0.25)
Liquidity equation						
BUFFER	-3.50 *** (-8.36)	-4.91 *** (-9.05)	-4.03 *** (-5.80)	-3.28 *** (-8.46)	-5.00 *** (-9.53)	-4.49 *** (-6.54)
ROA	0.96 ** (1.99)	2.06 *** (3.56)	2.06 *** (2.92)	1.32 *** (2.61)	2.68 *** (4.18)	2.80 *** (3.55)
LLP_TLO	1.04 ** (2.10)	0.48 (0.64)	2.72 ** (2.29)	0.86 * (1.78)	0.33 (0.43)	2.71 ** (2.28)
MKT_POW	-0.86 *** (-3.89)	-1.27 *** (-3.59)	-2.41 *** (-4.01)	-1.05 *** (-4.40)	-1.43 *** (-3.62)	-2.46 *** (-4.07)
BUSI_MD	-0.01 (-0.61)	-0.01 (-0.40)	0.28 *** (3.66)	-0.02 (-0.95)	-0.02 (-0.54)	0.28 *** (3.64)
GDP_GWT	-0.40 (-0.74)	-1.14 (-1.55)	-1.87 (-1.41)	-0.45 (-0.79)	-1.02 (-1.34)	-1.54 (-1.13)
CB	0.58 *** (2.42)	0.81 *** (2.54)	1.02 * (1.63)	0.69 *** (2.54)	0.91 *** (2.40)	1.03 * (1.63)
IBK1M_CB	15.48 ** (2.23)	20.68 ** (2.12)	26.81 * (1.66)	18.51 *** (2.41)	23.61 ** (2.08)	27.86 * (1.70)
LN_TA	-0.01 *** (-3.57)	-0.01 *** (-2.68)	0.03 *** (3.33)	-0.01 *** (-3.74)	-0.01 *** (-2.49)	0.03 *** (3.15)
Total Obs.	3803	3803	3796	3803	3803	3796

This table shows the results of estimating system (1) using GMM for an unbalanced panel of US publicly traded commercial banks over the 2000–2008 period. The *BUFFER* variable is either the Tier 1 and 2 capital buffer (*BUFFER_T12*, in systems (1.a), (1.b) and (1.c)) or the Tier 1 capital buffer (*BUFFER_T1*, in systems (1.a′), (1.b′) and (1.c′)). The liquidity variable is either the liquidity creation indicator (*LC* in systems (1.a) and (1.a')), the inverse of the net stable funding ratio (*I_NSFR* in systems (1.b) and (1.b')) or the core funding ratio (*CFR*, in systems (1.c) and (1.c')). A higher value of each liquidity proxy indicates higher bank illiquidity. See Table 3.3 for the definition of the explanatory variables. Cross-section and time fixed effects are included in the regressions, and the White cross-section covariance method is used. To deal with colinearity issues in all the regressions, *ROE* is orthogonalised with *ROA* in the capital buffer equation. In the liquidity equation, *LN_TA* is orthogonalised with *BUSI_MD* and *MKT_POW*. In both the capital buffer and the liquidity equations, the presumably endogenous bank-level indicators are replaced by their one-year lagged value. In the capital buffer equation, the following variables are one-year lagged: *ROA*, *ROE*, *LLP_TLO*, *LO_TA*, *LO_GWT*, *MKT_DISC*, *DIV_PYRT* and *MKT_BK_VAL*. In the liquidity equation, the following variables are one-year lagged: *ROA*, *LLP_TLO*, *MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels, respectively.

Regarding European banks, the coefficient of *LC* is significantly negative, but the coefficient of *I_NSFR* is not significant for both definitions of capital buffer. As indicated previously, the unexpected and negative sign for the proxy of *LC* might indicate that bank managers place greater importance on the stability of their funding rather than to their maturity. These results emphasize that bank liquidity as defined in the Basel III accords does not affect the determination of capital buffers of European banks. Thus, European banks do not strengthen their solvency standards when they face higher illiquidity as measured by the Basel III definition.

Focusing on U.S. banks, for both definitions of capital buffer, the coefficients of *LC* and *I_NSFR* are significantly negative, but the coefficient of *CFR* is not significant. These results suggest that U.S. banks tend to hold lower capital buffers under higher levels of liquidity creation and under higher illiquidity as defined in the Basel III accords. However, their capital buffers are not affected by changes in illiquidity as measured by the *CFR* variable. These findings suggest that U.S. bank managers might place greater importance on core funding than to stable funding as defined in the Basel III accords. On the whole, U.S. banks do not strengthen their solvency standards when they face higher illiquidity.

The impact of bank size on the relationship between liquidity and capital buffers

By running separate regressions for U.S. and European banks, the results show that, regardless of their institutional environment, banks do not strengthen their capital buffer when they face higher illiquidity. However, depending on their size, the ability of banks to access external funding is presumably different. Large banks might benefit from a reputational advantage, possibly providing them a broader access to financial markets. This is likely to impact the causal link that goes from bank illiquidity to capital[84]. Furthermore, large and small banks might have different scope of activities and contrasting business models. Following the literature, a bank is considered large if its total assets exceed US$1 billion. The sample includes 233 large U.S. banks of a total of 574 U.S. banks and 170 large European

84 Berger and Bouwman (2009) also argue that the “financial fragility structure”, the “deposit crowding-out” and the “risk absorption” effects might affect differently the causal link that goes from bank capital to liquidity creation depending on bank size. They expect that both the “financial fragility structure” and “deposit crowding-out” effects are likely to be relatively strong for small banks. Indeed small banks deal more with entrepreneurial-type small businesses, where the close monitoring highlighted in Diamond and Rajan (2000, 2001a) is important. In addition, small banks tend to be more funded by deposits, so that capital may “crowd out” deposits as in Gorton and Winton (2000). This effect is likely to be relatively weak for large banks that can more easily access market funding.

banks of a total of 207 European banks. The data show that small banks both in Europe and in the United States are on average more focused on traditional intermediation activities than large banks (see Appendix 3.C, Table 3.C.1). Small banks hold significantly more average shares of loans and deposits in total assets than large banks. In addition, large banks exhibit a significantly higher share of market funding in total debts than small banks, possibly because they have easier access to this source of funding or because they target faster growth strategies. Therefore, regressions are run separately for large and small banks, still separating European and U.S. banks (Table 3.7 and Table 3.8).

Table 3.7. The contribution of liquidity in the determination of capital buffers for European banks according to their size

	Tier 1 and 2 capital buffer				Tier 1 capital buffer			
	Large banks		Small banks		Large banks		Small banks	
	1. a	1. b	1. a	1. b	1. a'	1. b'	1. a'	1. b'
Capital buffer equation								
LC	-0.22 ***		-0.39 ***		-0.14 *		-0.18 **	
	(-2.48)		(-5.37)		(-1.67)		(-2.22)	
I_NSFR		0.10		-0.17 ***		0.07		-0.07
		(1.08)		(-2.93)		(0.89)		(-1.59)
ROA	-0.08	0.48	-0.62 *	0.01	0.09	0.62 *	0.82 **	0.98 ***
	(-0.36)	(1.24)	(-1.78)	(0.01)	(0.35)	(1.66)	(2.13)	(3.02)
DIV_PYRT	0.002	-0.01	0.01	0.02	-0.003	-0.01 *	0.03 ***	0.03 ***
	(0.53)	(-1.13)	(0.49)	(1.27)	(-0.94)	(-1.62)	(2.50)	(2.84)
ROE	0.02	0.04	0.01	0.05	0.02	0.05	0.05	0.02
	(0.94)	(1.17)	(0.24)	(0.70)	(1.21)	(1.58)	(0.59)	(0.27)
LLP_TLO	-0.40	0.04	-1.97 ***	-1.33 ***	-0.18	0.09	-1.03 ***	-0.79 ***
	(-1.52)	(0.13)	(-5.77)	(-3.66)	(-0.65)	(0.30)	(-3.13)	(-2.74)
LO_TA	0.02	-0.06	-0.0002	0.001	-0.02	-0.06	-0.04	-0.06
	(0.52)	(-0.92)	(-0.01)	(0.02)	(-0.51)	(-1.13)	(-1.56)	(-1.45)
LO_GWT	-0.02 **	-0.02 *	0.003	-0.01	-0.01	-0.01	-0.02	-0.01
	(-2.24)	(-1.79)	(0.27)	(-0.61)	(-1.51)	(-1.56)	(-1.04)	(-1.33)
MKT_DISC	-0.001	0.05	-0.02	-0.02	0.005	0.03	0.01	0.01
	(-0.08)	(0.73)	(-1.19)	(-0.77)	(0.26)	(0.60)	(0.42)	(0.27)
MKT_BK_VAL	0.003 **	0.01 ***	0.01 **	0.01 ***	0.002 *	0.004 **	-0.00001	0.0005
	(1.91)	(2.75)	(2.31)	(2.92)	(1.68)	(2.12)	(0.00)	(0.22)
LN_TA	-0.01 ***	-0.02 **	-0.001	0.01	-0.01 ***	-0.02 ***	-0.01 ***	-0.004
	(-3.26)	(-2.07)	(-0.39)	(1.52)	(-4.29)	(-2.76)	(-2.55)	(-0.56)
GDP_GWT	-0.001	-0.06	0.18	0.16	0.04	-0.01	0.15	0.18
	(-0.02)	(-0.63)	(1.00)	(0.80)	(0.62)	(-0.15)	(1.15)	(1.29)
CAP_REG	0.01	0.02	0.01	0.01	0.01	0.01	0.01 **	0.01 **
	(0.59)	(0.96)	(0.85)	(1.38)	(0.82)	(0.94)	(2.01)	(1.90)
DUM_BASEL_2	0.003	0.01	0.003	-0.01	0.01 *	0.01 **	-0.01	-0.01 *
	(0.53)	(1.58)	(0.54)	(-1.42)	(1.77)	(2.20)	(-1.22)	(-1.75)
Liquidity equation								
BUFFER	-0.95 **	-3.34 *	-2.48 ***	-5.04 ***	-1.72 ***	-5.01 ***	-2.42 ***	-5.16 ***
	(-2.00)	(-1.87)	(-5.47)	(-4.97)	(-4.30)	(-3.30)	(-6.80)	(-7.06)
ROA	-0.23	-3.06	-1.40	0.27	0.05	-3.22 *	0.55	3.96 *
	(-0.64)	(-1.47)	(-1.30)	(0.12)	(0.14)	(-1.63)	(0.46)	(1.78)
LLP_TLO	-1.32 ***	-1.80	-5.22 ***	-7.42 ***	-1.37 ***	-1.39	-3.84 ***	-5.50 ***
	(-2.63)	(-0.86)	(-5.38)	(-4.47)	(-2.56)	(-0.64)	(-4.00)	(-3.67)
MKT_POW	-0.18 *	0.33	-10.56	27.61	-0.21 *	0.36	-19.34 *	25.30
	(-1.74)	(0.73)	(-1.17)	(1.48)	(-1.74)	(0.76)	(-1.75)	(1.27)
BUSI_MD	-0.04	0.39 ***	-0.02	-0.12	-0.03	0.42 ***	0.05	-0.06
	(-1.37)	(2.83)	(-0.55)	(-1.52)	(-0.83)	(3.12)	(0.88)	(-0.57)
GDP_GWT	0.20	0.10	0.54	1.51	0.38 **	0.53	0.70	2.57 ***
	(1.04)	(0.16)	(1.01)	(1.29)	(1.94)	(0.88)	(1.47)	(2.47)
CB	0.13	0.09	0.15	-0.65	0.22	0.41	0.48	-0.32
	(0.38)	(0.08)	(0.47)	(-0.77)	(0.60)	(0.34)	(1.18)	(-0.44)
IBK1M_CB	-2.64 ***	4.69	-0.13	-1.91	-2.32 **	6.98 *	-6.68 **	-8.58
	(-2.33)	(1.26)	(-0.05)	(-0.31)	(-1.97)	(1.87)	(-2.10)	(-1.43)
LN_TA	-0.01 **	0.03 **	0.004	0.02	-0.01	0.03 ***	0.02 **	0.03 ***
	(-1.91)	(2.16)	(0.77)	(1.18)	(-1.58)	(2.35)	(2.11)	(2.52)
CONTROL	-0.07 *	-0.08	0.06	0.10	-0.04	-0.10	0.13	0.15
	(-1.75)	(-0.52)	(0.70)	(0.52)	(-0.86)	(-0.65)	(1.44)	(0.92)
Total Obs.	936	936	224	224	936	936	224	224

This table shows the results of estimating system (1) using GMM for an unbalanced panel of European publicly traded commercial banks over the 2000–2008 period. The *BUFFER* variable is either the Tier 1 and 2 capital buffer (*BUFFER_T12*, in systems (1.a) and (1.b)) or the Tier 1 capital buffer (*BUFFER_T1*, in systems (1.a′) and (1.b′)). The liquidity variable is either the liquidity creation indicator (*LC* in systems (1.a) and (1.a′)) or the inverse of the net stable funding ratio (*I_NSFR* in systems (1.b) and (1.b′)). A higher value of each liquidity proxy indicates higher bank illiquidity. See Table 3.3 for the definition of the explanatory variables. A bank is considered large if its total assets exceed US$1 billion. Cross-section and time fixed effects are included in the regressions, and the White cross-section covariance method is used. To deal with colinearity issues in all the regressions, *ROE* is orthagonalised with *ROA* in the capital buffer equation. In the liquidity equation, *LN_TA* is orthagonalised with *BUSI_MD* and *MKT_POW*. In both the capital buffer and the liquidity equations, the presumably endogenous bank-level indicators are replaced by their one-year lagged value. In the capital buffer equation, the following variables are one-year lagged: *ROA*, *ROE*, *LLP_TLO*, *LO_TA*, *LO_GWT*, *MKT_DISC*, *DIV_PYRT* and *MKT_BK_VAL*. In the liquidity equation, the following variables are one-year lagged: *ROA*, *LLP_TLO*, *MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels, respectively.

Table 3.8. The contribution of liquidity in the determination of capital buffers, separately for U.S. banks according to their size

	Tier 1 and 2 capital buffer						Tier 1 capital buffer					
	Large banks			Small banks			Large banks			Small banks		
	1. a	1. b	1. c	1. a	1. b	1. c	1. a'	1. b'	1. c'	1. a'	1. b'	1. c'
Capital buffer equation												
LC	-0.11 ***			-0.08 ***			-0.08 ***			-0.03		
	(-3.34)			(-2.40)			(-2.54)			(-0.99)		
I_NSFR		-0.07 ***			-0.03			-0.06 ***			-0.002	
		(-3.26)			(-1.29)			(-2.50)			(-0.07)	
CFR			-0.02			0.03 **			-0.02			0.06 ***
			(-1.19)			(2.02)			(-1.44)			(3.37)
ROA	0.05	0.21	0.24 *	0.94 ***	0.96 ***	1.08 ***	0.07	0.23	0.26 *	1.15 ***	1.16 ***	1.16 ***
	(0.30)	(1.26)	(1.64)	(4.71)	(4.62)	(4.50)	(0.35)	(1.38)	(1.70)	(5.32)	(5.18)	(4.68)
DIV_PYRT	-0.001	0.0004	0.00003	-0.005 *	-0.005 *	-0.01 **	0.0004	0.002	0.01 *	-0.004	-0.004	-0.01 *
	(-0.67)	(0.24)	(0.01)	(-1.69)	(-1.84)	(-2.32)	(0.21)	(0.96)	(1.63)	(-1.37)	(-1.53)	(-1.86)
ROE	0.01	0.02	-0.04 **	-0.07 ***	-0.05 **	-0.08 **	0.01	0.02	-0.04 **	-0.07 ***	-0.05 *	-0.06
	(0.75)	(0.99)	(-1.94)	(-2.72)	(-1.92)	(-1.94)	(0.68)	(1.18)	(-1.97)	(-2.69)	(-1.81)	(-1.49)
LLP_TLO	0.45 ***	0.45 ***	0.33 **	0.37 **	0.30 *	0.40 **	0.45 ***	0.46 ***	0.26 *	0.25	0.22	0.30
	(3.07)	(2.63)	(2.08)	(2.21)	(1.74)	(2.19)	(2.76)	(2.69)	(1.62)	(1.42)	(1.24)	(1.52)
LO_TA	-0.03 *	-0.05 ***	-0.06 ***	-0.05 ***	-0.06 ***	-0.07 ***	-0.05 ***	-0.06 ***	-0.06 ***	-0.06 ***	-0.07 ***	-0.08 ***
	(-1.67)	(-3.05)	(-4.80)	(-3.62)	(-4.48)	(-5.70)	(-3.11)	(-4.07)	(-5.27)	(-4.13)	(-4.76)	(-6.55)
LO_GWT	0.0004	-0.001	-0.01 ***	-0.01 ***	-0.01 ***	-0.02 ***	-0.002	-0.001	-0.01 **	-0.02 ***	-0.01 ***	-0.01 ***
	(0.21)	(-0.44)	(-2.43)	(-4.22)	(-4.09)	(-3.52)	(-0.82)	(-0.64)	(-2.24)	(-4.27)	(-4.09)	(-3.05)
MKT_DISC	0.01 *	0.003	0.02 *	0.01	0.003	0.003	0.02 ***	0.01	0.02 **	0.001	-0.003	-0.01
	(1.76)	(0.64)	(1.63)	(0.86)	(0.37)	(0.23)	(2.81)	(1.22)	(2.09)	(0.10)	(-0.28)	(-0.87)
MKT_BK_VAL	-0.001 *	-0.001 *	-0.0003	0.0001	-0.0001	0.0001	-0.0004	-0.001	0.0007	0.0001	-0.0001	0.00001
	(-1.72)	(-1.68)	(-0.34)	(0.11)	(-0.12)	(0.10)	(-0.92)	(-1.23)	(0.86)	(0.08)	(-0.16)	(0.01)
LN_TA	0.001	-0.0004	-0.001	-0.0005	-0.0003	-0.004	-0.0005	-0.001	-0.003 **	-0.0002	-0.001	-0.01 **
	(1.09)	(-0.50)	(-0.70)	(-0.20)	(-0.17)	(-1.49)	(-0.44)	(-1.44)	(-2.27)	(-0.07)	(-0.30)	(-2.03)
GDP_GWT	-0.15 **	-0.22 ***	-0.14 **	0.10	0.04	0.05	-0.17 **	-0.21 ***	-0.14 **	0.08	0.05	0.08
	(-1.99)	(-2.66)	(-1.89)	(0.82)	(0.33)	(0.38)	(-2.23)	(-2.75)	(-1.91)	(0.64)	(0.40)	(0.62)
Liquidity equation												
BUFFER	-5.42 ***	-5.91 ***	-4.00 ***	-2.64 ***	-3.96 ***	-3.08 ***	-4.33 ***	-5.30 ***	-4.16 ***	-2.75 ***	-4.30 ***	-3.53 ***
	(-7.43)	(-6.82)	(-3.95)	(-5.67)	(-6.51)	(-4.61)	(-7.18)	(-7.53)	(-4.86)	(-5.71)	(-6.59)	(-5.27)
ROA	0.27	1.32 **	0.52	1.78 ***	3.36 ***	3.53 ***	0.13	1.24 **	0.68	2.46 ***	4.59 ***	4.43 ***
	(0.39)	(1.92)	(0.64)	(2.50)	(3.52)	(3.74)	(0.18)	(1.99)	(0.81)	(2.99)	(4.07)	(4.27)
LLP_TLO	2.27 ***	1.81	2.18 **	0.92	-0.02	0.58	1.69 **	1.40	1.92 **	0.71	-0.34	0.47
	(2.78)	(1.50)	(2.16)	(1.48)	(-0.02)	(0.36)	(2.14)	(1.23)	(1.97)	(1.09)	(-0.35)	(0.29)
MKT_POW	-0.001	-0.02	-2.56 ***	-0.06 **	-0.04	-165.82	-0.69 ***	-1.20 ***	-2.68 ***	-135.98	-41.73	-337.19
	(-0.04)	(-0.66)	(-4.25)	(-2.09)	(-1.01)	(-0.65)	(-2.74)	(-3.08)	(-4.54)	(-0.77)	(-0.19)	(-1.27)
BUSI_MD	-0.34	-0.91 ***	0.35 ***	-87.33	55.84	0.20 ***	-0.02	-0.03	0.32 ***	-0.08 ***	-0.05	0.22 ***
	(-1.27)	(-2.37)	(3.99)	(-0.60)	(0.31)	(2.49)	(-0.59)	(-0.95)	(3.68)	(-2.56)	(-1.23)	(2.73)
GDP_GWT	-1.02 ***	-2.09 ***	-4.11 ***	0.92 **	0.60	0.60	-1.37 ***	-2.24 ***	-3.79 **	0.91 *	0.68	0.76
	(-2.43)	(-4.04)	(-2.38)	(1.93)	(1.01)	(0.84)	(-3.60)	(-4.70)	(-2.22)	(1.77)	(1.06)	(1.05)
CB	0.33	0.75 ***	2.02	0.59 ***	0.75 ***	0.62	0.69 ***	0.97 ***	1.97	0.70 ***	0.87 ***	0.68 *
	(1.59)	(2.73)	(1.37)	(2.95)	(2.92)	(1.57)	(3.06)	(3.37)	(1.34)	(3.08)	(2.99)	(1.67)
IBK1M_CB	4.72	10.95 **	-0.86	25.12 ***	36.29 ***	45.61 ***	8.49 *	12.96 **	6.30	27.29 ***	39.29 ***	47.80 ***
	(1.43)	(2.13)	(-0.02)	(4.25)	(4.77)	(4.39)	(1.77)	(1.96)	(0.13)	(4.23)	(4.77)	(4.57)
LN_TA	0.002	0.002	0.01	-0.01 ***	-0.01 **	0.01	0.002	-0.0004	0.01	-0.01 ***	-0.01	0.01
	(0.59)	(0.59)	(0.91)	(-3.20)	(-1.95)	(0.93)	(0.58)	(-0.09)	(0.54)	(-2.47)	(-1.40)	(1.13)
Total Obs.	1690	1690	1683	2113	2113	2113	1690	1690	1683	2113	2113	2113

This table shows the results of estimating system (1) using GMM for an unbalanced panel of US publicly traded commercial banks over the 2000–2008 period. The *BUFFER* variable is either the Tier 1 and 2 capital buffer (*BUFFER_T12*, in systems (1.a), (1.b) and (1.c)) or the Tier 1 capital buffer (*BUFFER_T1*, in systems (1.a′), (1.b′) and (1.c′)). The liquidity variable is either the liquidity creation indicator (*LC* in systems (1.a) and (1.a')), the inverse of the net stable funding ratio (*I_NSFR* in systems (1.b) and (1.b')) or the core funding ratio (*CFR*, in systems (1.c) and (1.c')). A higher value of each liquidity proxy indicates higher bank illiquidity. See Table 3.3 for the definition of the explanatory variables. A bank is considered large if its total assets exceed US$1 billion. Cross-section and time fixed effects are included in the regressions, and the White cross-section covariance method is used. To deal with colinearity issues in all the regressions, *ROE* is orthogonalised with *ROA* in the capital buffer equation. In the liquidity equation, *LN_TA* is orthogonalised with *BUSI_MD* and *MKT_POW*. In both the capital buffer and the liquidity equations, the presumably endogenous bank-level indicators are replaced by their one-year lagged value. In the capital buffer equation, the following variables are one-year lagged: *ROA, ROE, LLP_TLO, LO_TA, LO_GWT, MKT_DISC, DIV_PYRT* and *MKT_BK_VAL*. In the liquidity equation, the following variables are one-year lagged: *ROA, LLP_TLO, MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels, respectively.

In addition, following the subprime crisis, most regulatory authorities emphasize the importance of "systemically important financial institutions". The Federal Reserve qualifies a bank as "significant" if it holds US$50 billion or more in total consolidated assets (FED, 2011)[85]. Using this criterion, regressions were run separately for European and U.S. banks by separating the very large (i.e., significant) banks from the other banks (i.e., the medium and small banks). Table 3.9 and Table 3.10 show the regression results.

85 The term '*significant* is used in the credit exposure reporting provisions of the Dodd-Frank Act, which apply to bank holding companies and foreign banks that are treated as a bank holding company and that have US$50 billion or more in assets (FED, 2011).

Table 3.9. The contribution of liquidity in the determination of capital buffers for European banks differentiating very large banks and medium and small banks

	Tier 1 and 2 capital buffer				Tier 1 capital buffer			
	Very large banks		Medium and small banks		Very large banks		Medium and small banks	
	1. a	1. b	1. a	1. b	1. a'	1. b'	1. a'	1. b'
Capital buffer equation								
LC	-0.10 *		-0.08		-0.09 *		-0.05	
	(-1.82)		(-1.35)		(-1.83)		(-0.92)	
I_NSFR		-0.03 *		0.03		-0.02		0.01
		(-1.85)		(1.10)		(-1.40)		(0.24)
ROA	-0.65 *	-0.73 **	-0.33	-0.24	0.02	-0.07	0.01	0.19
	(-1.71)	(-2.07)	(-1.57)	(-0.92)	(0.08)	(-0.25)	(0.05)	(0.73)
DIV_PYRT	0.01 **	0.01 *	-0.004	-0.01 *	0.01 ***	0.01 **	-0.01	-0.01
	(2.29)	(1.69)	(-0.77)	(-1.81)	(2.70)	(2.21)	(-1.52)	(-1.39)
ROE	0.04 ***	0.03 **	0.02	0.10 ***	0.03 ***	0.03 **	0.04	0.10 ***
	(2.49)	(1.98)	(0.66)	(2.46)	(2.37)	(2.24)	(1.21)	(2.77)
LLP_TLO	0.73 *	0.61	-0.65 ***	-0.43 **	0.47	0.36	-0.39 *	-0.32
	(1.61)	(1.60)	(-2.84)	(-1.95)	(1.35)	(1.15)	(-1.65)	(-1.44)
LO_TA	-0.03 *	-0.02	-0.01	-0.07 **	-0.05 ***	-0.05 ***	-0.05 **	-0.06 **
	(-1.63)	(-1.54)	(-0.40)	(-2.16)	(-3.45)	(-3.65)	(-1.93)	(-2.17)
LO_GWT	-0.01 ***	-0.01	-0.02 ***	-0.03 ***	-0.01 ***	-0.01 ***	-0.02 **	-0.02 *
	(-2.46)	(-1.52)	(-2.41)	(-2.55)	(-3.02)	(-2.73)	(-2.09)	(-1.71)
MKT_DISC	0.01	0.01	0.003	0.02	0.004	-0.001	0.01	0.02
	(1.15)	(0.63)	(0.20)	(1.06)	(0.42)	(-0.07)	(0.81)	(0.90)
MKT_BK_VAL	-0.0004	-0.0001	0.01 ***	0.002	0.001	0.001	0.002	-0.001
	(-0.28)	(-0.07)	(2.49)	(1.10)	(0.70)	(0.58)	(0.86)	(-0.52)
LN_TA	-0.005 **	-0.003	-0.01 *	-0.01 *	-0.005 ***	-0.01 ***	-0.01 ***	-0.02 ***
	(-2.15)	(-1.34)	(-1.65)	(-1.72)	(-2.99)	(-2.55)	(-3.00)	(-3.15)
GDP_GWT	-0.19 ***	-0.22 ***	0.05	0.03	-0.09	-0.10	0.04	0.04
	(-2.51)	(-3.08)	(0.59)	(0.34)	(-1.32)	(-1.40)	(0.51)	(0.48)
CAP_REG	-0.002	-0.001	0.005	-0.005	-0.002	-0.001	-0.002	-0.01
	(-0.34)	(-0.15)	(0.53)	(-0.37)	(-0.50)	(-0.18)	(-0.26)	(-1.00)
DUM_BASEL_2	0.002	0.0004	0.01	0.004	0.004	0.005 *	0.01 ***	0.01
	(0.40)	(0.12)	(1.52)	(0.91)	(1.06)	(1.83)	(2.37)	(1.51)
Liquidity equation								
BUFFER	-0.64	-5.07 **	-2.74 ***	-9.47 ***	-1.12	-4.58 *	-2.80 ***	-10.60 ***
	(-0.68)	(-1.90)	(-4.99)	(-4.37)	(-1.26)	(-1.69)	(-6.61)	(-5.97)
ROA	-0.13	-3.66	-0.93 *	-4.35 ***	0.37	-0.53	-0.34	-1.69
	(-0.09)	(-0.92)	(-1.78)	(-2.47)	(0.28)	(-0.17)	(-0.56)	(-0.86)
LLP_TLO	6.32 ***	15.51 ***	-4.52 ***	-8.25 ***	6.28 ***	14.79 ***	-3.55 ***	-6.09 ***
	(3.97)	(4.09)	(-8.14)	(-5.09)	(4.05)	(3.91)	(-6.45)	(-3.50)
MKT_POW	0.09	0.77 **	-1.24 ***	-4.92 ***	0.11	0.83 **	-1.33 ***	-4.50 ***
	(0.79)	(2.33)	(-6.22)	(-5.75)	(0.91)	(2.24)	(-6.53)	(-5.05)
BUSI_MD	-0.03	-0.24 ***	-0.01	0.43 ***	-0.05	-0.25 ***	-0.02	0.49 ***
	(-1.10)	(-2.59)	(-0.30)	(2.37)	(-1.48)	(-2.73)	(-0.47)	(2.85)
GDP_GWT	-0.15	-2.32 ***	0.46 *	2.23 ***	-0.13	-1.68 **	0.51 *	2.31 ***
	(-0.48)	(-2.69)	(1.75)	(2.56)	(-0.46)	(-2.12)	(1.86)	(2.55)
CB	0.41	-1.31	1.51 ***	3.67 ***	-0.08	-2.16	1.65 ***	4.36 ***
	(0.75)	(-0.71)	(4.51)	(3.64)	(-0.14)	(-1.02)	(4.81)	(4.33)
IBK1M_CB	-15.96 ***	-31.46 ***	1.09	10.65 ***	-15.19 ***	-34.08 ***	0.16	8.06 **
	(-4.00)	(-3.37)	(0.81)	(2.47)	(-4.12)	(-3.82)	(0.12)	(2.13)
LN_TA	-0.01 **	-0.004	-0.005	0.02	-0.01 **	-0.002	-0.01	-0.01
	(-2.27)	(-0.29)	(-0.82)	(0.94)	(-1.98)	(-0.16)	(-1.24)	(-0.28)
CONTROL	-0.01	-0.03	0.004	0.24	-0.02	-0.02	0.01	0.13
	(-0.64)	(-0.39)	(0.06)	(1.04)	(-0.72)	(-0.29)	(0.20)	(0.57)
Total Obs.	367	367	793	793	367	367	793	793

This table shows the results of estimating system (1) using GMM for an unbalanced panel of European publicly traded commercial banks over the 2000–2008 period. The *BUFFER* variable is either the Tier 1 and 2 capital buffer (*BUFFER_T12*, in systems (1.a) and (1.b)) or the Tier 1 capital buffer (*BUFFER_T1*, in systems (1.a′) and (1.b′)). The liquidity variable is either the liquidity creation indicator (*LC* in systems (1.a) and (1.a′)) or the inverse of the net stable funding ratio (*I_NSFR* in systems (1.b) and (1.b′)). A higher value of each liquidity proxy indicates higher bank illiquidity. See Table 3.3 for the definition of the explanatory variables. A bank is considered very large if its total assets exceed US$50 billion (FED, 2011). Cross-section and time fixed effects are included in the regressions, and the White cross-section covariance method is used. To deal with colinearity issues in all the regressions, *ROE* is orthagonalised with *ROA* in the capital buffer equation. In the liquidity equation, *LN_TA* is orthagonalised with *BUSI_MD* and *MKT_POW*. In both the capital buffer and the liquidity equations, the presumably endogenous bank-level indicators are replaced by their one-year lagged value. In the capital buffer equation, the following variables are one-year lagged: *ROA, ROE, LLP_TLO, LO_TA, LO_GWT, MKT_DISC, DIV_PYRT* and *MKT_BK_VAL*. In the liquidity equation, the following variables are one-year lagged: *ROA, LLP_TLO, MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels, respectively.

Table 3.10. The contribution of liquidity in the determination of capital buffers for U.S. banks differentiating very large banks and medium and small banks

	Tier 1 and 2 capital buffer						Tier 1 capital buffer					
	Very large banks			Medium and small banks			Very large banks			Medium and small banks		
	1. a	1. b	1. c	1. a	1. b	1. c	1. a'	1. b'	1. c'	1. a'	1. b'	1. c'
Capital buffer equation												
LC	-0.25 ***			-0.10 ***			-0.19 ***			-0.07 **		
	(-3.71)			(-3.17)			(-2.89)			(-2.22)		
I_NSFR		-0.15 ***			-0.05 **			-0.14 ***			-0.04	
		(-2.51)			(-2.10)			(-2.58)			(-1.38)	
CFR			0.01			0.03 *			0.04			0.04 **
			(0.36)			(1.73)			(1.31)			(2.09)
ROA	-0.91 ***	-0.70	0.39	0.39 ***	0.44 ***	0.56 ***	-0.68 **	-0.53	0.41	0.53 ***	0.57 ***	0.64 ***
	(-2.59)	(-1.40)	(1.10)	(2.90)	(3.23)	(4.07)	(-1.94)	(-1.10)	(1.05)	(3.67)	(3.90)	(4.37)
DIV_PYRT	0.01	-0.002	0.004	-0.003	-0.002	-0.01 **	0.002	-0.01 *	0.01	-0.002	-0.001	-0.003
	(1.58)	(-0.61)	(0.55)	(-1.58)	(-1.21)	(-2.25)	(0.34)	(-1.78)	(0.71)	(-0.94)	(-0.53)	(-1.04)
ROE	0.07	0.03	-0.13 ***	-0.01	0.01	-0.04 **	0.01	-0.03	-0.15 ***	-0.01	0.01	-0.03
	(1.33)	(0.56)	(-2.89)	(-0.92)	(0.59)	(-2.09)	(0.19)	(-0.55)	(-3.02)	(-0.73)	(0.69)	(-1.53)
LLP_TLO	-0.85 ***	-0.57 **	-0.34	0.28 **	0.25 *	0.25 *	-1.01 ***	-0.81 ***	-0.51 *	0.27 **	0.25 *	0.23
	(-3.05)	(-2.24)	(-1.40)	(2.27)	(1.87)	(1.78)	(-4.21)	(-3.40)	(-1.83)	(2.04)	(1.81)	(1.52)
LO_TA	0.001	0.002	-0.02	-0.04 ***	-0.05 ***	-0.06 ***	-0.002	-0.003	-0.05 **	-0.05 ***	-0.06 ***	-0.06 ***
	(0.09)	(0.40)	(-0.85)	(-3.24)	(-3.89)	(-5.82)	(-0.18)	(-0.34)	(-2.02)	(-3.91)	(-4.27)	(-6.31)
LO_GWT	-0.01	-0.001	0.01	-0.01 ***	-0.01 ***	-0.02 ***	0.001	0.004	0.01	-0.01 ***	-0.01 ***	-0.02 ***
	(-1.28)	(-0.30)	(0.77)	(-4.36)	(-3.71)	(-5.72)	(0.21)	(1.09)	(0.96)	(-4.88)	(-3.93)	(-5.03)
MKT_DISC	-0.04	-0.03	0.05 *	0.01 **	0.004	0.02 **	-0.002	-0.02	0.06 ***	0.01	0.003	0.02 *
	(-1.27)	(-0.68)	(1.81)	(2.02)	(0.87)	(2.20)	(-0.08)	(-0.45)	(2.47)	(1.59)	(0.50)	(1.67)
MKT_BK_VAL	-0.001	-0.001	0.002	-0.0004	-0.0004	0.0004	0.001	0.001	0.01 ***	-0.0001	-0.0003	0.001
	(-1.06)	(-0.86)	(1.21)	(-0.96)	(-1.00)	(0.50)	(1.02)	(0.63)	(2.59)	(-0.25)	(-0.58)	(1.55)
LN_TA	-0.01 ***	-0.004	-0.01	-0.002	-0.002	-0.01 ***	-0.01	-0.002	-0.001	-0.002	-0.002	-0.01 ***
	(-2.55)	(-1.29)	(-0.94)	(-0.91)	(-1.42)	(-2.87)	(-1.45)	(-0.53)	(-0.09)	(-1.22)	(-1.57)	(-3.70)
GDP_GWT	-0.91 ***	-0.75 ***	-0.60 ***	0.03	-0.04	0.11	-0.73 ***	-0.63 ***	-0.57 ***	0.04	-0.002	0.12
	(-3.21)	(-3.37)	(-4.99)	(0.24)	(-0.35)	(0.86)	(-2.73)	(-3.23)	(-4.36)	(0.35)	(-0.01)	(0.91)
Liquidity equation												
BUFFER	-7.06 ***	-8.12 ***	-4.39	-3.32 ***	-4.62 ***	-3.93 ***	-4.97 ***	-4.84 ***	-2.77	-3.23 ***	-4.83 ***	-4.31 ***
	(-4.64)	(-4.44)	(-1.34)	(-8.23)	(-8.97)	(-5.80)	(-5.95)	(-4.64)	(-1.11)	(-8.46)	(-9.49)	(-6.36)
ROA	-3.74 **	-4.44 **	-1.03	1.03 **	2.11 ***	2.07 ***	-2.74 **	-3.54 **	1.42	1.45 ***	2.73 ***	2.74 ***
	(-2.33)	(-2.26)	(-0.35)	(2.14)	(3.67)	(2.87)	(-2.21)	(-2.10)	(0.44)	(2.80)	(4.22)	(3.42)
LLP_TLO	-5.63 ***	-4.56 ***	1.41	0.69	0.03	2.81 ***	-5.08 ***	-3.87 ***	4.16	0.60	-0.03	2.62 **
	(-3.84)	(-2.77)	(0.42)	(1.37)	(0.04)	(2.36)	(-4.43)	(-2.65)	(1.20)	(1.20)	(-0.04)	(2.21)
MKT_POW	0.12 *	0.04	-2.90 ***	-0.01	-0.01	-5.22	-0.64 ***	-0.43	-2.66 ***	8.52 *	10.20 *	-4.22
	(1.81)	(0.38)	(-4.08)	(-0.24)	(-0.18)	(-0.49)	(-3.28)	(-1.41)	(-3.72)	(1.67)	(1.66)	(-0.40)
BUSI_MD	-0.47 **	-0.57 **	-0.32	8.57 **	10.03 **	0.28 ***	0.06	-0.10	0.18	-0.01	-0.01	0.28 ***
	(-2.14)	(-2.13)	(-0.98)	(2.00)	(1.98)	(3.69)	(1.03)	(-1.07)	(0.54)	(-0.52)	(-0.27)	(3.60)
GDP_GWT	-6.70 ***	-6.11 ***	-2.68	-0.34	-1.07	-1.56	-4.29 **	-3.44 *	-28.23	-0.36	-0.94	-1.38
	(-2.64)	(-2.48)	(-0.19)	(-0.62)	(-1.47)	(-1.20)	(-2.16)	(-1.80)	(-1.53)	(-0.62)	(-1.23)	(-1.04)
CB	-0.01	-0.20	1.46	0.67 ***	0.91 ***	1.03 *	0.32	0.23	17.27	0.78 ***	1.00 ***	1.12 *
	(-0.01)	(-0.28)	(0.18)	(2.69)	(2.70)	(1.67)	(0.32)	(0.30)	(1.59)	(2.80)	(2.54)	(1.80)
IBK1M_CB	-9.25	-0.64	25.28	18.66 ***	25.54 ***	29.17 *	-4.09	-1.39	-174.85	21.15 ***	28.14 ***	29.20 *
	(-0.70)	(-0.05)	(0.23)	(2.56)	(2.39)	(1.87)	(-0.30)	(-0.10)	(-1.25)	(2.70)	(2.34)	(1.86)
LN_TA	-0.05 ***	-0.03	-0.08 **	-0.02 ***	-0.02 ***	0.04 ***	-0.02 *	0.004	-0.08 ***	-0.02 ***	-0.02 ***	0.04 ***
	(-2.80)	(-1.58)	(-2.01)	(-5.28)	(-3.79)	(3.88)	(-1.68)	(0.28)	(-2.41)	(-5.38)	(-3.68)	(3.63)
Total Obs.	157	157	157	3646	3646	3639	157	157	157	3646	3646	3639

This table shows the results of estimating system (1) using GMM for an unbalanced panel of US publicly traded commercial banks over the 2000–2008 period. The *BUFFER* variable is either the Tier 1 and 2 capital buffer (*BUFFER_T12*, in systems (1.a), (1.b) and (1.c)) or the Tier 1 capital buffer (*BUFFER_T1*, in systems (1.a′), (1.b′) and (1.c′)). The liquidity variable is either the liquidity creation indicator (*LC* in systems (1.a) and (1.a')), the inverse of the net stable funding ratio (*I_NSFR* in systems (1.b) and (1.b')) or the core funding ratio (*CFR*, in systems (1.c) and (1.c')). A higher value of each liquidity proxy indicates higher bank illiquidity. See Table 3.3 for the definition of the explanatory variables. A bank is considered very large if its total assets exceed US$50 billion (FED, 2011). Cross-section and time fixed effects are included in the regressions, and the White cross-section covariance method is used. To deal with colinearity issues in all the regressions, *ROE* is orthogonalised with *ROA* in the capital buffer equation. In the liquidity equation, *LN_TA* is orthogonalised with *BUSI_MD* and *MKT_POW*. In both the capital buffer and the liquidity equations, the presumably endogenous bank-level indicators are replaced by their one-year lagged value. In the capital buffer equation, the following variables are one-year lagged: *ROA, ROE, LLP_TLO, LO_TA, LO_GWT, MKT_DISC, DIV_PYRT* and *MKT_BK_VAL*. In the liquidity equation, the following variables are one-year lagged: *ROA, LLP_TLO, MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels, respectively.

Regarding European banks, for both large and small banks, the results are consistent with those previously obtained (Table 3.7). Banks do not strengthen their capital buffers when they face higher illiquidity. However, because the sample of European banks includes a relatively low number of small banks (i.e., only 37 banks), the results for small European banks might not be as reliable as those for large banks.

For U.S. banks (Table 3.8), the results differ according to the size of banks[86]. Indeed, the coefficient of *I_NSFR* is significantly negative for large banks and not significant for small banks with both definitions of capital buffer. More notably, the coefficient of *CFR* is not significant for large banks, but it is significantly positive for small banks with both definitions of capital buffer. Thus, small banks increase their capital buffer when they face higher illiquidity, as measured by the *CFR* variable. These findings suggest that when small banks face higher illiquidity, they increase they capital buffer, presumably to secure access to external sources of liquidity if necessary[87].

For very large banks, the sample includes 20 very large financial institutions in the United States (i.e., 3% of the sample of U.S. banks and 9% of the sample of large U.S. banks) and 57 very large financial institutions in Europe (i.e., 28% of the sample of European banks and 34% of the sample of large European banks). The main conclusions (Table 3.9 and Table 3.10) are consistent with those previously obtained by separating large and small banks, except that the coefficient of *LC* is no longer significant for medium and small European banks with both definitions of capital buffer. Regarding U.S. banks, apart from the very large financial institutions, banks increase their capital buffers when facing higher illiquidity adjusted for the importance of core deposits. These findings suggest that bank managers might be rationally targeting a liquidity ratio different from the one proposed by Basel III to adjust their capital buffers. For very large banks, there was no significant positive link between capital buffer and illiquidity. Presumably, such institutions might underestimate

86 Regarding the causal link that goes from bank capital to liquidity creation, the results are consistent with those of Berger and Bouwman (2009) for small banks. The results exhibit a negative relationship between bank capital and liquidity creation. For large banks, the results show a negative relationship between capital and liquidity creation while Berger and Bouwman (2009) find that the relationship between bank capital and liquidity creation is not significant or negative but marginally significant.

87 In this study, because a detailed breakdown of bank balance sheets to compute the indicators of liquidity is not available in standard databases, the sample includes only publicly traded banks. This might explain the lack of significance of the measure of illiquidity for small European banks. Indeed, listed banks have a broader access to financial markets compared to unlisted ones. In addition, the sample includes very few small European banks (i.e., 37 small banks in 207 European banks than 341 small US banks in 574 banks). Thus considering also small European unlisted banks, the measure of illiquidity would become significant in the determination of bank capital buffer. For small US banks, the results would still be consistent and strongest considering also unlisted banks.

liquidity risk because of their too-big-to-fail position. If bank executives believe they can systematically have priority access to liquidity for safety net and systemic risk considerations, such institutions will not adjust their capital buffer accordingly. However, such large institutions might also be managing liquidity differently, with more sophisticated off-balance sheet instruments. Because a detailed breakdown of off-balance sheets is not available in standard databases, solely the liquidity profile of banks stemming from their on-balance sheet positions is considered in this study. Therefore, liquidity measures will either underestimate or overestimate a bank's actual exposure to liquidity risk depending on the extent of its net off-balance sheet commitments (i.e., short or long net positions). This could alter results for the largest banks, because they are generally more involved in off-balance sheet activities, and specifically in sophisticated instruments, than smaller banks. If the actual exposure of large banks to liquidity risk is higher than the one captured through their on-balance sheet operations, the results would still be consistent. However, if their actual exposure is lower because they are using off-balance sheet instruments to hedge part of their liquidity risk, the results for the very large banks will merely indicate that such institutions manage their liquidity differently and not necessarily that they are taking advantage of their too-big-to-fail position.

3.5. Robustness checks

Several robustness checks were performed, still considering European and U.S. banks separately according to their size. Appendix 3.B presents regression results.

The regression specification is inspired by the theories of bank liquidity creation. These theories argue that banks create liquidity when illiquid assets are transformed into liquid liabilities but not when they are transformed into illiquid claims such as equity. The theories also emphasize that equity might affect a bank's ability to create liquidity. As Berger and Bouwman (2009) point out, a potential concern about the regression specification is that current bank equity is included in both the liquidity creation indicator and capital buffers. To address this potential concern, following Berger and Bouwman (2009), an alternative liquidity creation measure is computed by excluding equity *LC_EE* (i.e., a weight of 0 instead of –0.5 is applied to equity). This measure does not penalize banks for funding part of their activities with equity capital. As a result, the measured amount of liquidity creation is higher for all banks, and this increase is larger for banks holding more capital (see Table 3.B.1 and Table 3.B.2). Consistently with the previous results, the coefficient of *LC_EE* is significantly negative for large U.S. banks with both definitions of capital buffer. In addition, the results for small U.S. banks are consistent with those previously obtained, the coefficient of *LC_EE* being significantly negative only for *BUFFER_T12* as the dependent variable. For European banks, most of the results are consistent with those previously obtained, except for small banks. The coefficient of *LC_EE* becomes significantly negative for *BUFFER_T1* as the dependent variable.

To determine the robustness of the results for the *I_NSFR* variable, the weight of 0.7 for demand and saving deposits is changed. Alternately three other weights are used to determine whether the results can be affected by the extent of deposits considered stable. The first weight, 0.5 (*I_NSFR_D05*), is the minimum weight set by the Basel Committee on Banking Regulation and Supervision for stable demand and saving deposits. The second, 0.85 (*I_NSFR_D085*), is the maximum weight set by the Basel Committee on Banking Regulation and Supervision for stable demand and saving deposits. The third, 1, is the extreme case considering all demand and saving deposits as stable. Explicit deposit insurance systems and implicit government guarantee of deposits mitigate the risk of run on deposits and strengthen their stability (*I_NSFR_D1)*. Most of the results are consistent with those previously obtained, expect for small European banks and small U.S. banks (see Table 3.B.3 and Table 3.B.4). Regarding small European banks, the coefficients of *I_NSFR_D085* and *I_NSFR_D1* are significantly negative for *BUFFER_T1* as the dependent variable. These results suggest that small European banks decrease both capital buffers when they face higher illiquidity as defined in the Basel III accords. For small U.S. banks, the coefficient of *I_NSFR_D05* is significantly negative for *BUFFER_T12* as the dependent variable. This result suggests that small U.S. banks decrease Tier 1 and 2 capital buffer when they face higher illiquidity as defined in the Basel III accords.

A specification-related robustness check is performed by considering an alternative definition of the dependent variable: the total risk-weighted capital ratio instead of the buffer. Regressions are run only for European banks according to their size (see Table 3.B.5). Because the minimum capital adequacy requirement is set at 8% for all U.S. banks, using the Tier 1 and 2 capital buffer or the total risk weighted capital ratio leads to the same results[88]. Consistent with previous results, the coefficient of *LC* is significantly negative for large and small banks. In addition, the coefficient of *I_NSFR* is significantly negative for small banks.

88 Because the minimum requirement for the Tier 1 risk weighted capital ratio is set to 4% in all countries, the ratio of Tier 1 capital to total risk weighted assets is not considered as an alternative dependent variable. Considering Tier 1 buffer or Tier 1 risk weighted capital ratio leads to the same results.

As an additional robustness check, all negative observations of capital buffers are deleted from the panel to exclude the undercapitalized banks that might disturb the results (Table 3.B.6 and Table 3.B.7). For *BUFFER_T12*, 33 observations have been deleted (i.e., 20 observations for large European banks, 4 for large U.S. banks and 9 for small U.S. banks), and for *BUFFER_T1*, 5 observations have been deleted (i.e., 3 for large U.S. banks and 2 for small U.S. banks). In all cases, the results are consistent with those previously obtained.

The robustness of the findings is also examined by considering other definitions for liquidity proxies. First, an alternative specification of the Berger and Bouwman liquidity creation indicator is used by computing the ratio of illiquid assets to illiquid liabilities (*IA_IL)* as defined by Berger and Bouwman (2009). Second, a liquidity proxy based on the "*liquidity transformation gap*" is used (also called *LT Gap*) as Deep and Schaefer (2004) suggest. The *LT Gap* is the difference between liquid liabilities and liquid assets held by a bank, scaled by its total assets. In their work, they deem all the assets and the liabilities that mature within one year liquid. Using this definition of illiquid assets and liabilities of Deep and Schaefer (2004), the "*liquidity transformation ratio*" (also called *"LT Ratio"*, *LTR*) is computed as the ratio of illiquid assets (i.e., total loans, long term marketable assets, other assets and net fixed assets) to illiquid liabilities (i.e., time deposits, long term market funding and equity). Finally, an alternative specification of the *CFR* variable is used based on the "*financing gap*" of Saunders and Cornett (2006). The "*financing gap*" is the difference between average loans and core deposits. Using this indicator, the core deposit ratio (*CDR*) is the ratio of total loans to total core deposits. As for the *CFR* variable, the core deposits ratio variable is only calculated for U.S. banks, as core deposits can only be identified for U.S. banks (see Table 3.B.8 and Table 3.B.9). In all cases, the results confirm the conclusions previously obtained.

3.6. Concluding remarks

The purpose of this chapter is to study the relationship between bank capital buffer and liquidity. Using previous studies indicating that capital and liquidity are presumably jointly determined, a simultaneous equations model is considered to investigate the impact of liquidity on capital buffer beyond the determinants considered in the existing literature. Specifically, the study questions whether banks maintain or strengthen their capital buffer when they face lower liquidity because regulatory requirements regarding liquidity have not yet been implemented.

The main results show that banks hold lower capital buffers when they create more liquidity (i.e., when they fund larger portions of illiquid assets with liquid liabilities). In contrast, banks do not buildup capital buffer when they face higher illiquidity as defined in the Basel III accords (i.e., when they more extensively fund illiquid assets with unstable liabilities). Nevertheless, the definition of stable funding might be adjusted in the U.S. case. By using an alternative indicator of liquidity adjusted for the importance of core deposits for U.S. banks, the results show that, except for the 20 very large institutions, U.S. banks do actually increase their capital buffer when they face higher illiquidity.

These findings support the need to implement minimum liquidity ratios concomitant to capital ratios, as stressed by the Basel Committee on Banking Regulation and Supervision, but they also cast doubt on the accuracy of the current framework. Adding liquidity ratios to capital ratios might be more relevant for the very large systemic institutions than for smaller banks. Moreover, the definition and measurement of liquidity must be further clarified under a global regulatory framework. Regulators need to determine what type of liquid liabilities should be considered stable for a deeper regulatory definition of the notion of core or stable deposits. These findings also raise questions regarding the implementation of uniform liquidity requirements to all types of banks if very large institutions either behave differently because of their too-big-to-fail position or are able to manage their liquidity differently.

APPENDIX 3.A. Correlation analysis of the determinants of capital buffer and liquidity

Table 3.A.1. Correlations among the main explanatory variables in the capital buffer equation for U.S. and European listed commercial banks from 2000 to 2008

	LC	I_NSFR	ROA	DIV_PYRT	ROE	LLP_TLO	LO_TA	LO_GWT	MKT_DISC	MKT_BK_VAL	LN_TA	GDP_GWT	CAP_REG
LC	1												
I_NSFR	0.66	1											
	0.00												
ROA	-0.01	-0.05	1										
	0.69	*0.00*											
DIV_PYRT	-0.18	-0.07	0.02	1									
	0.00	*0.00*	*0.19*										
ROE	0.05	0.05	0.73	0.02	1								
	0.00	*0.00*	*0.00*	*0.23*									
LLP_TLO	0.04	0.04	-0.18	-0.01	-0.22	1							
	0.01	*0.01*	*0.00*	*0.40*	*0.00*								
LO_TA	0.43	0.52	0.02	-0.16	-0.05	-0.06	1						
	0.00	*0.00*	*0.07*	*0.00*	*0.00*	*0.00*							
LO_GWT	0.11	0.11	0.07	-0.16	0.10	-0.04	0.11	1					
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.01*	*0.00*						
MKT_DISC	-0.09	0.19	-0.19	0.03	-0.05	0.00	0.12	-0.01	1				
	0.00	*0.00*	*0.00*	*0.04*	*0.00*	*0.93*	*0.00*	*0.55*					
MKT_BK_VAL	0.07	-0.09	0.32	0.05	0.50	-0.15	-0.14	0.06	-0.17	1			
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*				
LN_TA	0.05	0.26	-0.09	0.20	0.20	0.09	-0.30	0.01	0.39	0.17	1		
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.42*	*0.00*	*0.00*			
GDP_GWT	-0.01	-0.04	0.18	-0.06	0.25	-0.22	0.00	0.27	-0.07	0.32	-0.02	1	
	0.39	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.76*	*0.00*	*0.00*	*0.00*	*0.17*		
CAP_REG	-0.03	0.01	-0.02	-0.01	-0.03	-0.10	0.22	-0.06	0.03	-0.06	-0.15	0.07	1
	0.04	*0.62*	*0.22*	*0.33*	*0.01*	*0.00*	*0.00*	*0.00*	*0.01*	*0.00*	*0.00*	*0.00*	

All variables are expressed in percentage, except *LN_TA*, *MKT_BK_VAL* and *CAP_REG*. *LC:* liquidity creation / total assets; *I_NSFR:* required amount of stable funding / available amount of stable funding; *ROA:* net income / total assets; *DIV_PYRT:* common dividend / (net income – minority interests – preferred dividends); *ROE:* net income / total equity; *LLP_TLO:* loan loss provisions / total loans; *LO_TA:* total loans / total assets; *LO_GWT:* annual growth rate of loan portfolio; *MKT_DISC:* (total market funding + subordinated debt) / total debts; *MKT_BK_VAL:* market value of assets/ book value of assets; *LN_TA:* natural logarithm of total assets; *GDP_GWT:* annual growth rate of real GDP; *CAP_REG:* index of regulatory oversight of bank capital. Figures in italics indicate -values of the T-statistics that test for null hypothesis of Pearson's coefficients of correlation equal to 0.

Table 3.A.2. Correlations among the main explanatory variables in the liquidity equation for U.S. and European listed commercial banks from 2000 to 2008

	BUFFER_T12	BUFFER_T1	ROA	LLP_TLO	MKT_POW	BUSI_MD	GDP_GWT	CB	IBK1M_CB	LN_TA	CONTROL
BUFFER_T12	1										
BUFFER_T1	0.92	1									
	0.00										
ROA	0.12	0.14	1								
	0.00	*0.00*									
LLP_TLO	-0.09	-0.11	-0.39	1							
	0.00	*0.00*	*0.00*								
MKT_POW	-0.13	-0.21	-0.04	-0.01	1						
	0.00	*0.00*	*0.00*	*0.34*							
BUSI_MD	0.15	0.24	-0.09	-0.01	-0.34	1					
	0.00	*0.00*	*0.00*	*0.27*	*0.00*						
GDP_GWT	0.05	0.06	0.24	-0.32	0.05	0.03	1				
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.01*					
CB	-0.01	0.00	0.13	-0.20	0.06	0.06	0.56	1			
	0.59	*0.84*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*				
IBK1M_CB	-0.03	-0.04	-0.08	0.07	0.09	0.00	-0.16	0.08	1		
	0.02	*0.00*	*0.00*	*0.00*	*0.00*	*0.86*	*0.00*	*0.00*			
LN_TA	-0.28	-0.42	-0.01	0.05	0.54	-0.60	-0.05	-0.01	0.04	1	
	0.00	*0.00*	*0.69*	*0.00*	*0.00*	*0.00*	*0.00*	*0.57*	*0.01*		
CONTROL	0.19	0.27	0.01	-0.05	-0.42	0.50	0.12	-0.04	-0.06	-0.48	1
	0.00	*0.00*	*0.33*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	

All variables are expressed in percentage, except *LN_TA* and *CONTROL*. *BUFFER_T12:* Tier 1 and 2 capital in excess of the regulatory minimum capital requirements; *BUFFER_T1:* Tier 1 capital in excess of the regulatory minimum capital requirements; *ROA:* net income / total assets; *LLP_TLO:* loan loss provisions / total loans; *MKT_POW:* total assets of bank *i* in country *j* / total assets of the banking system in country *j*; *BUSI_MD:* gross interest income / total income; *GDP_GWT:* annual growth rate of real GDP; *CB*: central bank policy rate; *IBK1M_CB:* spread of 1 month interbank rate and central bank policy rate; *CONTROL*: index of supervisory regime. Figures in italics indicate p-values of the T-statistics that test for null hypothesis of Pearson’s coefficients of correlation equal to 0.

APPENDIX 3.B. Regression results of the robustness checks

Table 3.B.1. Using a measure of liquidity creation adjusted for equity for European banks according to their size

	Tier 1 and 2 capital buffer		Tier 1 capital buffer	
	Large banks	**Small banks**	**Large banks**	**Small banks**
Capital equation				
LC_EE	-0.18 ***	-0.38 ***	-0.11 *	-0.18 ***
	(-2.54)	(-5.85)	(-1.60)	(-2.61)
ROA	0.01	-0.36	0.17	0.90 ***
	(0.04)	(-1.07)	(0.64)	(2.54)
DIV_PYRT	0.003	0.01	-0.003	0.03 ***
	(0.83)	(0.99)	(-0.80)	(2.69)
ROE	0.02	0.02	0.02	0.07
	(1.09)	(0.33)	(1.50)	(0.81)
LLP_TLO	-0.33	-2.03 ***	-0.10	-1.09 ***
	(-1.22)	(-6.06)	(-0.33)	(-3.43)
LO_TA	0.02	-0.004	-0.02	-0.04
	(0.65)	(-0.13)	(-0.81)	(-1.56)
LO_GWT	-0.02 **	-0.0002	-0.01 *	-0.02
	(-2.20)	(-0.02)	(-1.67)	(-1.39)
MKT_DISC	-0.005	-0.02	0.004	0.01
	(-0.29)	(-1.08)	(0.22)	(0.56)
MKT_BK_VAL	0.003 *	0.01 **	0.002 *	0.0001
	(1.87)	(2.28)	(1.77)	(0.03)
LN_TA	-0.02 ***	-0.005	-0.02 ***	-0.01 ***
	(-4.16)	(-1.10)	(-4.82)	(-2.94)
GDP_GWT	0.02	0.23	0.05	0.19
	(0.24)	(1.29)	(0.68)	(1.37)
CAP_REG	0.01	-0.002	0.01	0.01
	(1.08)	(-0.27)	(1.21)	(1.36)
DUM_BASEL_2	0.01	0.001	0.01 ***	-0.01
	(1.17)	(0.21)	(2.55)	(-1.42)
Liquidity equation				
BUFFER	-0.71	-2.35 ***	-1.45 ***	-2.16 ***
	(-1.49)	(-4.75)	(-3.61)	(-5.55)
ROA	0.33	-0.74	0.64	0.94
	(0.93)	(-0.64)	(1.50)	(0.75)
LLP_TLO	-1.40 ***	-5.36 ***	-1.36 ***	-4.33 ***
	(-2.93)	(-5.48)	(-2.59)	(-4.46)
MKT_POW	-0.28 ***	-14.37	-0.33 ***	-22.66 **
	(-2.60)	(-1.59)	(-2.68)	(-2.07)
BUSI_MD	-0.03	0.0003	-0.02	0.07
	(-1.05)	(0.01)	(-0.50)	(1.12)
GDP_GWT	0.36 *	0.62	0.53 ***	0.69
	(1.85)	(1.10)	(2.69)	(1.34)
CB	0.45	0.16	0.55	0.46
	(1.23)	(0.43)	(1.44)	(1.06)
IBK1M_CB	-3.63 ***	-1.74	-3.42 ***	-8.89 ***
	(-3.04)	(-0.57)	(-2.77)	(-2.65)
LN_TA	-0.01 ***	0.004	-0.01 **	0.02 **
	(-2.50)	(0.76)	(-2.24)	(1.92)
CONTROL	-0.05	-0.03	-0.02	0.01
	(-1.29)	(-0.37)	(-0.45)	(0.17)
Total Obs.	936	224	936	224

This table shows the results of estimating system (1) using GMM for an unbalanced panel of European publicly traded commercial banks over the 2000–2008 period. The *BUFFER* variable is either the Tier 1 and 2 capital buffer (*BUFFER_T12*) or the Tier 1 capital buffer (*BUFFER_T1*). The liquidity variable is an indicator of liquidity creation calculated by excluding equity (*LC_EE*). See Table 3.3 for the definition of the explanatory variables. A bank is considered large if its total assets exceed US$1 billion. Cross-section and time fixed effects are included in the regressions, and the White cross-section covariance method is used. To deal with colinearity issues in all the regressions, *ROE* is orthagonalised with *ROA* in the capital buffer equation. In the liquidity equation, *LN_TA* is orthagonalised with *BUSI_MD* and *MKT_POW*. In both the capital buffer and the liquidity equations, the presumably endogenous bank-level indicators are replaced by their one-year lagged value. In the capital buffer equation, the following variables are one-year lagged: *ROA, ROE, LLP_TLO, LO_TA, LO_GWT, MKT_DISC, DIV_PYRT* and *MKT_BK_VAL*. In the liquidity equation, the following variables are one-year lagged: *ROA, LLP_TLO, MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels, respectively.

Table 3.B.2. Using a measure of liquidity creation adjusted for equity for U.S. banks according to their size

	Tier 1 and 2 capital buffer		Tier 1 capital buffer	
	Large banks	**Small banks**	**Large banks**	**Small banks**
Capital equation				
LC_EE	-0.11 *** (-3.11)	-0.08 *** (-2.54)	-0.08 *** (-2.41)	-0.04 (-1.10)
ROA	0.04 (0.18)	0.07 (0.35)	0.96 *** (4.39)	1.13 *** (4.98)
DIV_PYRT	-0.0005 (-0.30)	0.0004 (0.21)	-0.005 (-1.59)	-0.004 (-1.25)
ROE	0.02 (1.15)	0.01 (0.68)	-0.05 * (-1.70)	-0.05 * (-1.62)
LLP_TLO	0.43 *** (2.65)	0.45 *** (2.76)	0.38 ** (2.23)	0.27 (1.54)
LO_TA	-0.03 * (-1.77)	-0.05 *** (-3.11)	-0.04 *** (-3.31)	-0.06 *** (-3.85)
LO_GWT	-0.0003 (-0.12)	-0.002 (-0.82)	-0.01 *** (-4.08)	-0.01 *** (-3.98)
MKT_DISC	0.01 * (1.87)	0.02 *** (2.81)	0.01 (0.78)	0.001 (0.11)
MKT_BK_VAL	-0.001 (-1.50)	-0.0004 (-0.92)	0.0004 (0.52)	0.0005 (0.52)
LN_TA	0.001 (0.74)	-0.0005 (-0.44)	-0.002 (-0.61)	-0.001 (-0.46)
GDP_GWT	-0.17 ** (-2.23)	-0.17 ** (-2.23)	0.09 (0.72)	0.08 (0.57)
Liquidity equation				
BUFFER	-5.22 *** (-6.83)	-4.33 *** (-7.18)	-2.32 *** (-5.12)	-2.52 *** (-5.22)
ROA	0.18 (0.25)	0.13 (0.18)	2.40 *** (3.27)	3.13 *** (3.73)
LLP_TLO	1.96 ** (2.30)	1.69 ** (2.14)	0.64 (1.06)	0.52 (0.81)
MKT_POW	-0.39 (-1.47)	-0.69 *** (-2.74)	-161.92 (-1.04)	-210.28 (-1.13)
BUSI_MD	-0.01 (-0.18)	-0.02 (-0.59)	-0.06 * (-1.87)	-0.07 ** (-2.16)
GDP_GWT	-1.21 *** (-2.85)	-1.37 *** (-3.60)	0.78 * (1.69)	0.77 (1.58)
CB	0.43 * (1.82)	0.69 *** (3.06)	0.64 *** (3.03)	0.74 *** (3.16)
IBK1M_CB	6.16 (1.53)	8.49 * (1.77)	25.56 *** (4.31)	27.23 *** (4.28)
LN_TA	0.004 (1.09)	0.002 (0.58)	-0.02 *** (-3.50)	-0.02 *** (-2.90)
Total Obs.	1690	1690	2113	2113

This table shows the results of estimating system (1) using GMM for an unbalanced panel of U.S. publicly traded commercial banks over the 2000–2008 period. The *BUFFER* variable is either the Tier 1 and 2 capital buffer (*BUFFER_T12*) or the Tier 1 capital buffer (*BUFFER_T1*). The liquidity variable is an indicator of liquidity creation calculated by excluding equity (*LC_EE*). See Table 3.3 for the definition of the explanatory variables. A bank is considered large if its total assets exceed US$1 billion. Cross-section and time fixed effects are included in the regressions, and the White cross-section covariance method is used. To deal with colinearity issues in all the regressions, *ROE* is orthagonalised with *ROA* in the capital buffer equation. In the liquidity equation, *LN_TA* is orthagonalised with *BUSI_MD* and *MKT_POW*. In both the capital buffer and the liquidity equations, the presumably endogenous bank-level indicators are replaced by their one-year lagged value. In the capital buffer equation, the following variables are one-year lagged: *ROA, ROE, LLP_TLO, LO_TA, LO_GWT, MKT_DISC, DIV_PYRT* and *MKT_BK_VAL*. In the liquidity equation, the following variables are one-year lagged: *ROA, LLP_TLO, MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels, respectively.

Table 3.B.3. Using alternative weights for stable deposits in the inverse of the net stable funding ratio for European banks according to their size

	Tier 1 and 2 capital buffer						Tier 1 capital buffer					
	Large banks			Small banks			Large banks			Small banks		
	1. a	1. b	1. c	1. a	1. b	1. c	1. a'	1. b'	1. c'	1. a'	1. b'	1. c'
Capital buffer equation												
I_NSFR_D05	0.07			-0.13 ***			0.05			-0.05		
	(1.44)			(-2.86)			(1.21)			(-1.35)		
I_NSFR_D085		0.08			-0.22 ***			0.05			-0.09 *	
		(0.66)			(-3.20)			(0.48)			(-1.86)	
I_NSFR_D1			0.04			-0.26 ***			0.02			-0.12 **
			(0.34)			(-3.53)			(0.18)			(-2.17)
ROA	0.31	0.45	0.37	0.12	-0.08	-0.14	0.42	0.60	0.52	1.10 ***	0.90 ***	0.83 ***
	(1.06)	(1.01)	(0.75)	(0.33)	(-0.23)	(-0.39)	(1.45)	(1.40)	(1.12)	(3.20)	(2.84)	(2.66)
DIV_PYRT	-0.01	-0.01	-0.004	0.02 *	0.01	0.01	-0.01 **	-0.01	-0.01	0.04 ***	0.03 ***	0.02 **
	(-1.31)	(-0.81)	(-0.56)	(1.72)	(0.92)	(0.65)	(-1.95)	(-1.28)	(-1.04)	(3.15)	(2.56)	(2.28)
ROE	0.04 *	0.03	0.02	0.05	0.05	0.07	0.04 **	0.04	0.03	0.04	0.004	-0.002
	(1.60)	(0.76)	(0.46)	(0.72)	(0.80)	(1.01)	(1.96)	(1.19)	(0.91)	(0.55)	(0.07)	(-0.04)
LLP_TLO	0.02	-0.01	-0.09	-1.33 ***	-1.36 ***	-1.39 ***	0.11	0.03	-0.04	-0.82 ***	-0.78 ***	-0.77 ***
	(0.08)	(-0.02)	(-0.21)	(-3.78)	(-3.64)	(-3.67)	(0.39)	(0.09)	(-0.12)	(-2.86)	(-2.65)	(-2.60)
LO_TA	-0.06	-0.04	-0.02	-0.02	0.02	0.04	-0.07 *	-0.04	-0.02	-0.06 *	-0.05	-0.03
	(-1.31)	(-0.50)	(-0.18)	(-0.47)	(0.42)	(0.76)	(-1.71)	(-0.66)	(-0.34)	(-1.73)	(-1.18)	(-0.90)
LO_GWT	-0.02 **	-0.02 *	-0.02	-0.01	-0.005	-0.004	-0.01 *	-0.01	-0.01	-0.02	-0.01	-0.01
	(-2.05)	(-1.62)	(-1.51)	(-0.59)	(-0.56)	(-0.47)	(-1.72)	(-1.41)	(-1.31)	(-1.50)	(-1.21)	(-1.08)
MKT_DISC	0.06	0.02	-0.003	-0.02	-0.03	-0.04	0.04	0.01	-0.01	0.01	0.004	-0.0002
	(1.24)	(0.28)	(-0.03)	(-0.57)	(-1.06)	(-1.33)	(1.13)	(0.16)	(-0.15)	(0.32)	(0.15)	(-0.01)
MKT_BK_VAL	0.01 ***	0.01 ***	0.01 ***	0.01 ***	0.01 ***	0.01 ***	0.004 **	0.004 **	0.004 **	-0.0005	0.001	0.002
	(2.88)	(2.58)	(2.48)	(2.69)	(3.13)	(3.35)	(2.17)	(1.99)	(1.93)	(-0.22)	(0.53)	(0.81)
LN_TA	-0.02 ***	-0.02	-0.01	0.01	0.01 *	0.02 **	-0.02 ***	-0.02 **	-0.02 *	-0.01	-0.002	0.0003
	(-3.01)	(-1.48)	(-1.11)	(1.41)	(1.77)	(2.05)	(-3.73)	(-2.14)	(-1.77)	(-0.92)	(-0.26)	(0.04)
GDP_GWT	-0.05	-0.07	-0.09	0.15	0.18	0.21	-0.01	-0.03	-0.05	0.16	0.19	0.21
	(-0.77)	(-0.67)	(-0.75)	(0.76)	(0.90)	(1.02)	(-0.15)	(-0.29)	(-0.43)	(1.14)	(1.40)	(1.51)
CAP_REG	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.01 *	0.01 **	0.01 **
	(1.15)	(0.88)	(0.84)	(1.32)	(1.44)	(1.49)	(1.08)	(0.89)	(0.87)	(1.79)	(2.01)	(2.12)
DUM_BASEL_2	0.01 **	0.01	0.01	-0.01	-0.01	-0.01 *	0.01 ***	0.01 *	0.01	-0.01	-0.01 *	-0.01 **
	(2.12)	(1.16)	(0.87)	(-1.32)	(-1.55)	(-1.69)	(2.75)	(1.81)	(1.56)	(-1.60)	(-1.85)	(-1.94)
Liquidity equation												
BUFFER	-4.40 **	-3.17 **	-3.14 **	-5.37 ***	-4.84 ***	-4.63 ***	-6.17 ***	-4.70 ***	-4.50 ***	-5.40 ***	-5.01 ***	-4.86 ***
	(-2.20)	(-1.91)	(-2.01)	(-4.66)	(-5.17)	(-5.29)	(-3.64)	(-3.36)	(-3.45)	(-6.19)	(-7.64)	(-8.14)
ROA	-3.77 *	-3.07	-3.10 *	0.33	0.36	0.43	-3.99 *	-3.19 *	-3.20 *	4.55 *	3.72 *	3.55 **
	(-1.66)	(-1.57)	(-1.69)	(0.13)	(0.17)	(0.21)	(-1.84)	(-1.72)	(-1.84)	(1.71)	(1.86)	(1.94)
LLP_TLO	-0.91	-2.19	-2.42	-8.54 ***	-6.81 ***	-6.33 ***	-0.36	-1.88	-2.19	-6.44 ***	-4.94 ***	-4.48 ***
	(-0.37)	(-1.16)	(-1.39)	(-4.45)	(-4.44)	(-4.40)	(-0.14)	(-0.95)	(-1.19)	(-3.61)	(-3.64)	(-3.57)
MKT_POW	0.41	0.24	0.24	34.64	25.14	24.38 *	0.21	0.33	0.35	29.22	22.85	20.74
	(0.71)	(0.65)	(0.74)	(1.45)	(1.55)	(1.66)	(0.37)	(0.85)	(1.03)	(1.13)	(1.34)	(1.38)
BUSI_MD	0.49 ***	0.36 ***	0.35 ***	-0.14	-0.10	-0.09	0.53 ***	0.38 ***	0.36 ***	-0.04	-0.05	-0.05
	(3.09)	(2.86)	(2.98)	(-1.54)	(-1.40)	(-1.32)	(3.36)	(3.12)	(3.19)	(-0.32)	(-0.61)	(-0.57)
GDP_GWT	0.26	0.04	-0.01	1.81	1.38	1.30	0.83	0.44	0.36	3.13 ***	2.27 ***	2.06 ***
	(0.37)	(0.08)	(-0.02)	(1.24)	(1.34)	(1.41)	(1.20)	(0.80)	(0.71)	(2.34)	(2.53)	(2.58)
CB	0.01	0.20	0.16	-0.32	-0.88	-1.03	0.55	0.46	0.39	-0.12	-0.43	-0.51
	(0.01)	(0.21)	(0.19)	(-0.33)	(-1.11)	(-1.39)	(0.38)	(0.44)	(0.42)	(-0.13)	(-0.70)	(-0.92)
IBK1M_CB	6.95 *	4.33	4.31	-3.33	-0.93	-0.26	9.38 **	6.26 *	5.91 *	-10.02	-7.60	-6.77
	(1.65)	(1.26)	(1.34)	(-0.46)	(-0.16)	(-0.05)	(2.24)	(1.82)	(1.85)	(-1.29)	(-1.47)	(-1.48)
LN_TA	0.03 **	0.03 ***	0.03 ***	0.02	0.01	0.01	0.03 **	0.03 ***	0.03 ***	0.04 ***	0.03 ***	0.02 **
	(1.91)	(2.35)	(2.54)	(1.33)	(0.96)	(0.76)	(1.92)	(2.62)	(2.84)	(2.53)	(2.39)	(2.20)
CONTROL	-0.16	-0.06	-0.05	0.08	0.10	0.10	-0.16	-0.08	-0.06	0.11	0.17	0.18
	(-0.85)	(-0.40)	(-0.36)	(0.37)	(0.59)	(0.62)	(-0.86)	(-0.53)	(-0.46)	(0.57)	(1.17)	(1.37)
Total Obs.	936	936	936	224	224	224	936	936	936	224	224	224

This table shows the results of estimating system (1) using GMM for an unbalanced panel of European publicly traded commercial banks over the 2000–2008 period. The *BUFFER* variable is either the Tier 1 and 2 capital buffer (*BUFFER_T12*, in systems (1.a), (1.b) and (1.c)) or the Tier 1 capital buffer (*BUFFER_T1*, in systems (1.a′), (1.b′) and (1.c′)). The liquidity variable is an alternative specification of the inverse of the net stable funding ratio (*I_NSFR*) by changing the weight of 0.7 for demand and saving deposits. Three other weights are used: 0.5 (*I_NSFR_D05* in systems (1.a) and (1.a′)), 0.85 (*I_NSFR_D085* in systems (1.b) and (1.b′)), and 1 (*I_NSFR_D1*) in systems (1.c) and (1.c′)). See Table 3.3 for the definition of the explanatory variables. A bank is considered large if its total assets exceed US$1 billion. Cross-section and time fixed effects are included in the regressions, and the White cross-section covariance method is used. To deal with colinearity issues in all the regressions, *ROE* is orthogonalised with *ROA* in the capital buffer equation. In the liquidity equation, *LN_TA* is orthagonalised with *BUSI_MD* and *MKT_POW*. In both the capital buffer and the liquidity equations, the presumably endogenous bank-level indicators are replaced by their one-year lagged value. In the capital buffer equation, the following variables are one-year lagged: *ROA*, *ROE*, *LLP_TLO*, *LO_TA*, *LO_GWT*, *MKT_DISC*, *DIV_PYRT* and *MKT_BK_VAL*. In the liquidity equation, the following variables are one-year lagged: *ROA*, *LLP_TLO*, *MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels, respectively.

Table 3.B.4. Using alternative weights for stable deposits in the inverse of the net stable funding ratio for U.S. banks according to their size

	Tier 1 and 2 capital buffer						Tier 1 capital buffer					
	Large banks			Small banks			Large banks			Small banks		
	1. a	1. b	1. c	1. a	1. b	1. c	1. a'	1. b'	1. c'	1. a'	1. b'	1. c'
Capital buffer equation												
I_NSFR_D05	-0.07 ***			-0.06 **			-0.05 ***			-0.02		
	(-3.28)			(-2.11)			(-2.57)			(-0.88)		
I_NSFR_D085		-0.08 ***			-0.02			-0.06 ***			0.01	
		(-3.29)			(-0.82)			(-2.49)			(0.38)	
I_NSFR_D1			-0.08 ***			-0.01			-0.06 ***			0.02
			(-3.30)			(-0.46)			(-2.49)			(0.72)
ROA	0.24	0.19	0.18	0.94 ***	0.96 ***	0.95 ***	0.24	0.22	0.21	1.14 ***	1.15 ***	1.14 ***
	(1.40)	(1.19)	(1.16)	(4.56)	(4.58)	(4.51)	(1.46)	(1.34)	(1.32)	(5.11)	(5.16)	(5.11)
DIV_PYRT	-0.0003	0.001	0.001	-0.01 **	-0.004 *	-0.004	0.001	0.003	0.003	-0.01 **	-0.004	-0.003
	(-0.15)	(0.39)	(0.47)	(-2.12)	(-1.68)	(-1.56)	(0.57)	(1.18)	(1.33)	(-1.93)	(-1.32)	(-1.17)
ROE	0.02	0.02	0.01	-0.05 **	-0.05 *	-0.05 *	0.02	0.02	0.02	-0.05 *	-0.05 *	-0.05 *
	(1.13)	(0.87)	(0.74)	(-1.90)	(-1.85)	(-1.75)	(1.09)	(1.17)	(1.13)	(-1.81)	(-1.74)	(-1.63)
LLP_TLO	0.52 ***	0.40 ***	0.35 **	0.27	0.31 *	0.31 *	0.50 ***	0.42 ***	0.39 ***	0.21	0.23	0.23
	(2.93)	(2.41)	(2.20)	(1.54)	(1.79)	(1.82)	(2.86)	(2.53)	(2.37)	(1.16)	(1.27)	(1.28)
LO_TA	-0.04 ***	-0.05 ***	-0.05 ***	-0.05 ***	-0.07 ***	-0.07 ***	-0.06 ***	-0.06 ***	-0.06 ***	-0.06 ***	-0.08 ***	-0.08 ***
	(-2.97)	(-3.15)	(-3.24)	(-3.57)	(-4.95)	(-5.29)	(-4.07)	(-4.11)	(-4.15)	(-3.92)	(-5.21)	(-5.54)
LO_GWT	-0.0003	-0.001	-0.002	-0.01 ***	-0.01 ***	-0.01 ***	-0.001	-0.002	-0.002	-0.01 ***	-0.01 ***	-0.01 ***
	(-0.12)	(-0.69)	(-0.90)	(-3.81)	(-4.18)	(-4.21)	(-0.53)	(-0.76)	(-0.88)	(-3.85)	(-4.17)	(-4.18)
MKT_DISC	0.01 **	-0.001	-0.003	0.01	-0.000001	-0.002	0.02 ***	0.003	-0.001	0.002	-0.01	-0.01
	(2.10)	(-0.14)	(-0.59)	(1.03)	(0.00)	(-0.28)	(2.38)	(0.46)	(-0.08)	(0.26)	(-0.60)	(-0.86)
MKT_BK_VAL	-0.001 **	-0.001	-0.0004	-0.0002	0.0001	0.0003	-0.001	-0.0005	-0.0003	-0.0003	0.0001	0.0003
	(-2.20)	(-1.30)	(-0.97)	(-0.29)	(0.10)	(0.35)	(-1.53)	(-0.93)	(-0.62)	(-0.34)	(0.07)	(0.32)
LN_TA	-0.0001	-0.001	-0.001	0.0005	-0.001	-0.002	-0.001	-0.002	-0.002 *	0.0001	-0.001	-0.002
	(-0.12)	(-0.68)	(-0.77)	(0.22)	(-0.57)	(-0.99)	(-1.28)	(-1.55)	(-1.63)	(0.06)	(-0.67)	(-1.05)
GDP_GWT	-0.18 **	-0.24 ***	-0.26 ***	0.09	0.03	0.02	-0.17 **	-0.23 ***	-0.25 ***	0.08	0.05	0.05
	(-2.01)	(-3.08)	(-3.42)	(0.70)	(0.22)	(0.18)	(-2.14)	(-3.11)	(-3.39)	(0.61)	(0.36)	(0.37)
Liquidity equation												
BUFFER	-6.64 ***	-5.43 ***	-5.01 ***	-4.21 ***	-3.80 ***	-3.67 ***	-5.71 ***	-4.98 ***	-4.68 ***	-4.55 ***	-4.15 ***	-4.01 ***
	(-6.62)	(-6.87)	(-6.87)	(-6.22)	(-6.64)	(-6.74)	(-7.09)	(-7.68)	(-7.75)	(-6.34)	(-6.71)	(-6.80)
ROA	1.46 *	1.24 **	1.18 **	3.63 ***	3.17 ***	2.99 ***	1.33 *	1.20 **	1.17 **	4.88 ***	4.37 ***	4.15 ***
	(1.84)	(1.99)	(2.07)	(3.38)	(3.56)	(3.56)	(1.87)	(2.09)	(2.21)	(3.92)	(4.12)	(4.13)
LLP_TLO	2.33 *	1.48	1.20	-0.22	0.08	0.15	1.65	1.21	1.03	-0.53	-0.22	-0.12
	(1.68)	(1.34)	(1.18)	(-0.22)	(0.10)	(0.19)	(1.28)	(1.14)	(1.04)	(-0.51)	(-0.24)	(-0.14)
MKT_POW	-1.04 ***	-0.01	0.01	16.59	-0.02	-0.01	-1.42 ***	-1.10 ***	-1.01 ***	-87.48	-36.67	-44.47
	(-2.37)	(-0.18)	(0.25)	(0.08)	(-0.60)	(-0.25)	(-3.20)	(-3.00)	(-2.90)	(-0.35)	(-0.17)	(-0.22)
BUSI_MD	-0.05	-0.85 ***	-0.81 ***	-0.07	59.79	52.70	-0.06 *	-0.01	0.01	-0.08 *	-0.03	-0.02
	(-1.35)	(-2.40)	(-2.42)	(-1.58)	(0.34)	(0.31)	(-1.76)	(-0.33)	(0.22)	(-1.87)	(-0.79)	(-0.42)
GDP_GWT	-1.56 ***	-2.36 ***	-2.54 ***	1.42 **	0.18	-0.13	-1.67 ***	-2.52 ***	-2.71 ***	1.49 **	0.26	-0.04
	(-2.64)	(-4.90)	(-5.59)	(2.21)	(0.32)	(-0.24)	(-3.11)	(-5.60)	(-6.27)	(2.17)	(0.43)	(-0.07)
CB	0.63 **	0.81 ***	0.85 ***	0.52 **	0.87 ***	0.95 ***	0.85 ***	1.02 ***	1.05 ***	0.67 **	0.98 ***	1.05 ***
	(2.31)	(2.95)	(3.11)	(1.97)	(3.45)	(3.86)	(2.77)	(3.63)	(3.81)	(2.13)	(3.49)	(3.88)
IBK1M_CB	11.25 **	10.87 **	10.78 **	33.52 ***	36.80 ***	36.65 ***	13.65 **	12.59 **	12.24 **	36.81 ***	39.66 ***	39.39 ***
	(2.23)	(2.05)	(1.99)	(3.95)	(5.12)	(5.32)	(1.96)	(1.95)	(1.92)	(3.95)	(5.14)	(5.38)
LN_TA	0.001	0.003	0.003	-0.01 **	-0.01 *	-0.01	-0.002	0.0003	0.001	-0.01 *	-0.01	-0.005
	(0.34)	(0.75)	(0.92)	(-2.15)	(-1.63)	(-1.27)	(-0.37)	(0.09)	(0.25)	(-1.72)	(-1.04)	(-0.67)
Total Obs.	1690	1690	1690	2113	2113	2113	1690	1690	1690	2113	2113	2113

This table shows the results of estimating system (1) using GMM for an unbalanced panel of US publicly traded commercial banks over the 2000–2008 period. The *BUFFER* variable is either the Tier 1 and 2 capital buffer (*BUFFER_T12*, in systems (1.a), (1.b) and (1.c)) or the Tier 1 capital buffer (*BUFFER_T1*, in systems (1.a′), (1.b′) and (1.c′)). The liquidity variable is an alternative specification of the inverse of the net stable funding ratio (*I_NSFR*) by changing the weight of 0.7 for demand and saving deposits. Three other weights are used: 0.5 (*I_NSFR_D05* in systems (1.a) and (1.a′)), 0.85 (*I_NSFR_D085* in systems (1.b) and (1.b′)), and 1 (*I_NSFR_D1*) in systems (1.c) and (1.c′)). See Table 3.3 for the definition of the explanatory variables. A bank is considered large if its total assets exceed US$1 billion. Cross-section and time fixed effects are included in the regressions, and the White cross-section covariance method is used. To deal with colinearity issues in all the regressions, *ROE* is orthagonalised with *ROA* in the capital buffer equation. In the liquidity equation, *LN_TA* is orthagonalised with *BUSI_MD* and *MKT_POW*. In both the capital buffer and the liquidity equations, the presumably endogenous bank-level indicators are replaced by their one-year lagged value. In the capital buffer equation, the following variables are one-year lagged: *ROA, ROE, LLP_TLO, LO_TA, LO_GWT, MKT_DISC, DIV_PYRT* and *MKT_BK_VAL*. In the liquidity equation, the following variables are one-year lagged: *ROA, LLP_TLO, MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels, respectively.

Table 3.B.5. Considering the ratio of Tier 1 and 2 capital to risk weighted assets as the dependent variable for European banks according to their size

	Large banks		Small banks	
	1. a	1. b	1. a	1. b
Capital equation				
LC	-0.22 *** (-2.49)		-0.39 *** (-5.37)	
I_NSFR		0.09 (1.05)		-0.17 *** (-2.93)
ROA	-0.08 (-0.36)	0.46 (1.22)	-0.62 * (-1.78)	0.01 (0.01)
DIV_PYRT	0.002 (0.54)	-0.01 (-1.11)	0.01 (0.49)	0.02 (1.27)
ROE	0.02 (0.94)	0.04 (1.16)	0.01 (0.24)	0.05 (0.70)
LLP_TLO	-0.40 (-1.51)	0.04 (0.11)	-1.97 *** (-5.77)	-1.33 *** (-3.66)
LO_TA	0.02 (0.53)	-0.06 (-0.89)	-0.0002 (-0.01)	0.001 (0.02)
LO_GWT	-0.02 ** (-2.21)	-0.02 * (-1.77)	0.003 (0.27)	-0.01 (-0.61)
MKT_DISC	-0.002 (-0.10)	0.05 (0.70)	-0.02 (-1.19)	-0.02 (-0.77)
MKT_BK_VAL	0.003 ** (1.92)	0.01 *** (2.74)	0.01 ** (2.31)	0.01 *** (2.92)
LN_TA	-0.01 *** (-3.29)	-0.02 ** (-2.07)	-0.001 (-0.39)	0.01 (1.52)
GDP_GWT	-0.001 (-0.01)	-0.06 (-0.65)	0.18 (1.00)	0.16 (0.80)
CAP_REG	0.01 (0.50)	0.02 (0.90)	0.01 (0.85)	0.01 (1.38)
DUM_BASEL_2	0.003 (0.54)	0.01 (1.60)	0.003 (0.54)	-0.01 (-1.42)
Liquidity equation				
T12_RWA	-0.97 ** (-2.04)	-3.40 ** (-1.89)	-2.48 *** (-5.47)	-5.04 *** (-4.97)
ROA	-0.22 (-0.63)	-3.08 (-1.48)	-1.40 (-1.30)	0.27 (0.12)
LLP_TLO	-1.32 *** (-2.62)	-1.80 (-0.85)	-5.22 *** (-5.38)	-7.42 *** (-4.47)
MKT_POW	-0.18 * (-1.75)	0.33 (0.72)	-10.56 (-1.17)	27.61 (1.48)
BUSI_MD	-0.04 (-1.36)	0.39 *** (2.85)	-0.02 (-0.55)	-0.12 (-1.52)
GDP_GWT	0.20 (1.04)	0.11 (0.18)	0.54 (1.01)	1.51 (1.29)
CB	0.13 (0.38)	0.09 (0.08)	0.15 (0.47)	-0.65 (-0.77)
IBK1M_CB	-2.62 ** (-2.31)	4.83 (1.29)	-0.13 (-0.05)	-1.91 (-0.31)
LN_TA	-0.01 ** (-1.91)	0.03 ** (2.16)	0.004 (0.77)	0.02 (1.18)
CONTROL	-0.07 * (-1.74)	-0.07 (-0.47)	0.06 (0.70)	0.10 (0.52)
Total Obs.	936	936	224	224

This table shows the results of estimating system (1) using GMM for an unbalanced panel of European publicly traded commercial banks over the 2000–2008 period. The capital variable is the Tier 1 and 2 risk weighted capital ratio (*T12_RWA*). The liquidity variable is either the liquidity creation indicator (*LC* in system (1.a)) or the inverse of the net stable funding ratio (*I_NSFR* in system (1.b)). A higher value of each liquidity proxy indicates higher bank illiquidity. See Table 3.3 for the definition of the explanatory variables. A bank is considered large if its total assets exceed US$1 billion. Cross-section and time fixed effects are included in the regressions, and the White cross-section covariance method is used. To deal with colinearity issues in all the regressions, *ROE* is orthagonalised with *ROA* in the capital buffer equation. In the liquidity equation, *LN_TA* is orthagonalised with *BUSI_MD* and *MKT_POW*. In both the capital buffer and the liquidity equations, the presumably endogenous bank-level indicators are replaced by their one-year lagged value. In the capital buffer equation, the following variables are one-year lagged: *ROA, ROE, LLP_TLO, LO_TA, LO_GWT, MKT_DISC, DIV_PYRT* and *MKT_BK_VAL*. In the liquidity equation, the following variables are one-year lagged: *ROA, LLP_TLO, MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels, respectively.

Table 3.B.6. Considering only positive values of Tier 1 and 2 capital buffer, separately for large European banks

	1. a	1. b
Capital equation		
LC	-0.20 *** (-2.38)	
I_NSFR		0.13 (1.10)
ROA	0.02 (0.07)	0.60 (1.39)
DIV_PYRT	0.001 (0.19)	-0.01 (-1.26)
ROE	0.01 (0.70)	0.04 (1.00)
LLP_TLO	-0.09 (-0.41)	0.43 (1.30)
LO_TA	0.01 (0.20)	-0.09 (-1.11)
LO_GWT	-0.01 (-1.60)	-0.01 (-1.39)
MKT_DISC	0.002 (0.10)	0.07 (0.81)
MKT_BK_VAL	0.003 * (1.83)	0.01 *** (2.55)
LN_TA	-0.01 *** (-2.92)	-0.02 (-1.58)
GDP_GWT	-0.03 (-0.49)	-0.07 (-0.76)
CAP_REG	0.01 (0.57)	0.005 (0.23)
DUM_BASEL_2	0.003 (0.59)	0.01 (1.31)
Liquidity equation		
BUFFER_T12	-1.35 ** (-2.31)	-4.86 ** (-2.07)
ROA	-0.11 (-0.28)	-2.21 (-0.96)
LLP_TLO	-1.27 * (-1.82)	-0.04 (-0.02)
MKT_POW	-0.15 (-1.42)	0.09 (0.18)
BUSI_MD	-0.04 (-1.17)	0.37 *** (2.49)
GDP_GWT	0.17 (0.84)	-0.05 (-0.08)
CB	0.16 (0.45)	0.33 (0.26)
IBK1M_CB	-2.41 ** (-2.07)	4.69 (1.09)
LN_TA	-0.01 * (-1.85)	0.03 ** (1.88)
CONTROL	-0.05 (-1.21)	-0.02 (-0.13)
Total Obs.	916	916

This table shows the results of estimating system (1) using GMM for an unbalanced panel of European publicly traded commercial banks over the 2000–2008 period. The *BUFFER* variable is the Tier 1 and 2 capital buffer (*BUFFER_T12*) by deleting the negative values of the variable. The liquidity variable is either the liquidity creation indicator (*LC* in system (1.a)) or the inverse of the net stable funding ratio (*I_NSFR* in system (1.b)). A higher value of each liquidity proxy indicates higher bank illiquidity. See Table 3.3 for the definition of the explanatory variables. A bank is considered large if its total assets exceed US$1 billion. Cross-section and time fixed effects are included in the regressions, and the White cross-section covariance method is used. To deal with colinearity issues in all the regressions, *ROE* is orthagonalised with *ROA* in the capital buffer equation. In the liquidity equation, *LN_TA* is orthagonalised with *BUSI_MD* and *MKT_POW*. In both the capital buffer and the liquidity equations, the presumably endogenous bank-level indicators are replaced by their one-year lagged value. In the capital buffer equation, the following variables are one-year lagged: *ROA*, *ROE*, *LLP_TLO*, *LO_TA*, *LO_GWT*, *MKT_DISC*, *DIV_PYRT* and *MKT_BK_VAL*. In the liquidity equation, the following variables are one-year lagged: *ROA*, *LLP_TLO*, *MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels, respectively.

Table 3.B.7. Considering only positive values of capital buffers for U.S. banks according to their size

	Tier 1 and 2 capital buffer						Tier 1 capital buffer					
	Large banks			Small banks			Large banks			Small banks		
	1. a	**1. b**	**1. c**	**1. a**	**1. b**	**1. c**	**1. a'**	**1. b'**	**1. c'**	**1. a'**	**1. b'**	**1. c'**
Capital buffer equation												
LC	-0.11 ***			-0.08 ***			-0.08 ***			-0.04		
	(-3.31)			(-2.42)			(-2.54)			(-1.03)		
I_NSFR		-0.07 ***			-0.03			-0.05 ***			-0.002	
		(-3.22)			(-1.31)			(-2.44)			(-0.06)	
CFR			-0.01			0.03 **			-0.02			0.06 ***
			(-1.03)			(1.93)			(-1.29)			(3.24)
ROA	0.04	0.21	0.21	0.79 ***	0.84 ***	1.01 ***	0.07	0.24	0.25 *	0.95 ***	0.98 ***	1.04 ***
	(0.20)	(1.24)	(1.45)	(4.05)	(4.11)	(4.24)	(0.39)	(1.42)	(1.63)	(4.67)	(4.58)	(4.31)
DIV_PYRT	-0.001	0.0004	-0.0002	-0.01 **	-0.01 **	-0.01 ***	-0.001	0.002	0.01 *	-0.01 *	-0.01 **	-0.01 **
	(-0.75)	(0.23)	(-0.04)	(-1.94)	(-2.11)	(-2.50)	(-0.32)	(0.94)	(1.65)	(-1.73)	(-1.91)	(-2.12)
ROE	0.01	0.02	-0.05 **	-0.07 ***	-0.06 **	-0.09 **	-0.004	0.02	-0.04 **	-0.08 ***	-0.06 **	-0.08 **
	(0.72)	(0.95)	(-2.22)	(-2.84)	(-2.14)	(-2.20)	(-0.27)	(1.10)	(-2.10)	(-2.89)	(-2.15)	(-1.97)
LLP_TLO	0.46 ***	0.46 ***	0.32 **	0.35 **	0.28 *	0.38 **	0.47 ***	0.48 ***	0.25	0.21	0.18	0.26
	(3.11)	(2.69)	(2.00)	(2.13)	(1.67)	(2.16)	(3.06)	(2.75)	(1.57)	(1.23)	(1.03)	(1.36)
LO_TA	-0.03 **	-0.05 ***	-0.06 ***	-0.05 ***	-0.06 ***	-0.07 ***	-0.06 ***	-0.06 ***	-0.07 ***	-0.06 ***	-0.07 ***	-0.08 ***
	(-1.96)	(-3.27)	(-5.06)	(-3.70)	(-4.57)	(-5.69)	(-3.76)	(-4.36)	(-5.61)	(-4.19)	(-4.94)	(-6.57)
LO_GWT	0.0002	-0.001	-0.01 ***	-0.02 ***	-0.01 ***	-0.02 ***	-0.002	-0.002	-0.01 ***	-0.02 ***	-0.01 ***	-0.01 ***
	(0.08)	(-0.65)	(-2.75)	(-4.40)	(-4.28)	(-3.57)	(-0.95)	(-0.92)	(-2.76)	(-4.52)	(-4.52)	(-3.14)
MKT_DISC	0.01 **	0.003	0.02	0.01	0.002	0.002	0.02 ***	0.01	0.02 *	-0.001	-0.005	-0.01
	(2.03)	(0.59)	(1.48)	(0.77)	(0.25)	(0.17)	(3.14)	(1.10)	(1.78)	(-0.11)	(-0.51)	(-0.98)
MKT_BK_VAL	-0.001 **	-0.001 **	-0.001	0.0002	0.00003	0.0001	-0.001	-0.001	0.0004	0.0004	0.0002	0.0003
	(-1.95)	(-1.90)	(-0.68)	(0.24)	(0.04)	(0.12)	(-1.44)	(-1.50)	(0.43)	(0.43)	(0.23)	(0.25)
LN_TA	0.001	-0.001	-0.001	-0.0002	-0.0001	-0.003	-0.0002	-0.002	-0.003 **	0.000003	-0.001	-0.005 *
	(1.07)	(-0.73)	(-0.67)	(-0.09)	(-0.06)	(-1.29)	(-0.14)	(-1.55)	(-2.21)	(0.00)	(-0.24)	(-1.79)
GDP_GWT	-0.17 **	-0.24 ***	-0.15 **	0.11	0.04	0.06	-0.17 **	-0.22 ***	-0.13 *	0.08	0.04	0.09
	(-2.26)	(-2.91)	(-2.04)	(0.82)	(0.33)	(0.45)	(-2.33)	(-2.89)	(-1.82)	(0.60)	(0.35)	(0.65)
Liquidity equation												
BUFFER	-5.17 ***	-5.66 ***	-3.67 ***	-2.53 ***	-3.80 ***	-2.88 ***	-4.05 ***	-5.06 ***	-3.81 ***	-2.53 ***	-3.93 ***	-3.14 ***
	(-7.74)	(-7.06)	(-3.89)	(-5.68)	(-6.56)	(-4.46)	(-7.95)	(-7.74)	(-4.75)	(-5.65)	(-6.63)	(-5.05)
ROA	0.15	1.24 **	0.40	1.30 **	2.88 ***	3.12 ***	0.12	1.25 **	0.51	1.70 ***	3.64 ***	3.69 ***
	(0.22)	(1.93)	(0.50)	(1.91)	(3.05)	(3.20)	(0.19)	(2.11)	(0.63)	(2.34)	(3.56)	(3.64)
LLP_TLO	2.18 ***	1.79	2.05 **	0.83	-0.12	0.42	1.70 ***	1.43	1.80 **	0.53	-0.59	0.29
	(2.81)	(1.53)	(2.09)	(1.37)	(-0.15)	(0.26)	(2.53)	(1.28)	(1.90)	(0.86)	(-0.67)	(0.18)
MKT_POW	0.0003	-0.02	-2.58 ***	-0.07 **	-0.04	-150.12	-0.76 ***	-1.25 ***	-2.71 ***	-134.90	-42.23	-289.73
	(0.01)	(-0.60)	(-4.29)	(-2.15)	(-0.99)	(-0.59)	(-3.08)	(-3.20)	(-4.58)	(-0.77)	(-0.19)	(-1.11)
BUSI_MD	-0.39	-0.95 ***	0.35 ***	-93.73	48.62	0.19 **	-0.02	-0.03	0.32 ***	-0.09 ***	-0.06	0.19 ***
	(-1.48)	(-2.50)	(3.98)	(-0.64)	(0.27)	(2.28)	(-0.77)	(-0.90)	(3.76)	(-2.70)	(-1.31)	(2.40)
GDP_GWT	-1.13 ***	-2.23 ***	-4.06 ***	0.88 *	0.50	0.46	-1.30 ***	-2.32 ***	-3.72 **	0.88 *	0.57	0.67
	(-2.82)	(-4.44)	(-2.36)	(1.82)	(0.84)	(0.63)	(-3.75)	(-4.93)	(-2.18)	(1.74)	(0.94)	(0.94)
CB	0.37 *	0.78 ***	2.03	0.60 ***	0.77 ***	0.65 *	0.67 ***	1.00 ***	1.96	0.70 ***	0.88 ***	0.68 *
	(1.85)	(2.91)	(1.38)	(2.99)	(2.99)	(1.64)	(3.54)	(3.54)	(1.35)	(3.09)	(3.05)	(1.69)
IBK1M_CB	5.28 *	11.47 **	-2.28	25.55 ***	36.16 ***	45.43 ***	8.02 **	13.44 **	5.04	27.69 ***	39.48 ***	48.05 ***
	(1.64)	(2.23)	(-0.05)	(4.33)	(4.78)	(4.38)	(2.04)	(2.06)	(0.10)	(4.36)	(4.89)	(4.62)
LN_TA	0.001	0.001	0.01	-0.01 ***	-0.01 **	0.01	-0.001	-0.001	0.01	-0.01 ***	-0.01	0.01
	(0.45)	(0.33)	(1.07)	(-3.16)	(-1.93)	(0.97)	(-0.26)	(-0.25)	(0.63)	(-2.43)	(-1.40)	(1.22)
Total Obs.	1686	1686	1679	2108	2108	2108	1688	1688	1681	2112	2112	2112

This table shows the results of estimating system (1) using GMM for an unbalanced panel of US publicly traded commercial banks over the 2000–2008 period. The *BUFFER* variable is either the Tier 1 and 2 capital buffer (*BUFFER_T12,* in systems (1.a), (1.b) and (1.c)) or the Tier 1 capital buffer (*BUFFER_T1,* in systems (1.a′), (1.b′) and (1.c′)). Regressions are run by excluding the negative values of these variables. The liquidity variable is either the liquidity creation indicator (*LC* in systems (1.a) and (1.a')), the inverse of the net stable funding ratio (*I_NSFR* in systems (1.b) and (1.b')) or the core funding ratio (*CFR*, in systems (1.c) and (1.c')). A higher value of each liquidity proxy indicates higher bank illiquidity. See Table 3.3 for the definition of the explanatory variables. A bank is considered large if its total assets exceed US$1 billion. Cross-section and time fixed effects are included in the regressions, and the White cross-section covariance method is used. To deal with colinearity issues in all the regressions, *ROE* is orthogonalised with *ROA* in the capital buffer equation. In the liquidity equation, *LN_TA* is orthogonalised with *BUSI_MD* and *MKT_POW*. In both the capital buffer and the liquidity equations, the presumably endogenous bank-level indicators are replaced by their one-year lagged value. In the capital buffer equation, the following variables are one-year lagged: *ROA*, *ROE*, *LLP_TLO*, *LO_TA*, *LO_GWT*, *MKT_DISC*, *DIV_PYRT* and *MKT_BK_VAL*. In the liquidity equation, the following variables are one-year lagged: *ROA*, *LLP_TLO*, *MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels, respectively.

Table 3.B.8. Using alternative liquidity proxies for European banks according to their size

	Tier 1 and 2 capital buffer				Tier 1 capital buffer			
	Large banks		Small banks		Large banks		Small banks	
	1. a	1. b	1. a	1. b	1. a'	1. b'	1. a'	1. b'
Capital buffer equation								
IA_IL	-0.04 ***		-0.02 *		-0.04 ***		0.01	
	(-3.50)		(-1.67)		(-3.35)		(0.59)	
LTR		-0.02 ***		-0.05 ***		-0.02 ***		-0.02
		(-2.41)		(-3.71)		(-2.39)		(-1.57)
ROA	-0.19	-0.08	0.23	-0.02	-0.04	0.08	1.28 ***	1.07 ***
	(-0.78)	(-0.34)	(0.51)	(-0.05)	(-0.14)	(0.30)	(2.82)	(2.64)
DIV_PYRT	0.002	-0.0001	0.04 **	0.03 **	-0.002	-0.004	0.06 ***	0.05 ***
	(0.63)	(-0.03)	(2.19)	(2.22)	(-0.91)	(-1.51)	(3.41)	(3.49)
ROE	0.01	0.01	0.14	0.03	0.01	0.02	0.11	0.04
	(0.68)	(0.86)	(1.04)	(0.25)	(1.18)	(1.29)	(0.84)	(0.34)
LLP_TLO	0.16	0.18	-1.15 ***	-1.11 ***	0.27	0.32	-0.65 **	-0.81 ***
	(0.55)	(0.66)	(-3.49)	(-3.38)	(0.93)	(1.10)	(-2.12)	(-2.98)
LO_TA	0.03	0.01	-0.07 ***	-0.03	0.01	-0.01	-0.08 ***	-0.05 *
	(1.38)	(0.37)	(-2.63)	(-0.86)	(0.50)	(-0.57)	(-3.06)	(-1.87)
LO_GWT	-0.01 *	-0.01 **	-0.004	-0.01	-0.004	-0.01	-0.03 *	-0.03 **
	(-1.67)	(-1.96)	(-0.23)	(-0.70)	(-0.92)	(-1.10)	(-1.75)	(-1.91)
MKT_DISC	-0.03	-0.001	0.01	-0.05	-0.03	-0.001	0.03	-0.01
	(-1.28)	(-0.04)	(0.15)	(-1.27)	(-1.17)	(-0.07)	(1.17)	(-0.36)
MKT_BK_VAL	0.003 ***	0.003 **	0.003	0.002	0.003 **	0.002 **	-0.002	-0.002
	(2.36)	(2.26)	(1.11)	(0.62)	(2.30)	(1.99)	(-0.50)	(-0.45)
LN_TA	-0.01	-0.01 ***	-0.002	0.004	-0.01 **	-0.01 ***	-0.01 ***	-0.01 *
	(-1.43)	(-3.42)	(-0.33)	(0.82)	(-2.30)	(-4.38)	(-2.71)	(-1.65)
GDP_GWT	-0.12 *	-0.07	-0.03	0.14	-0.06	-0.02	0.01	0.09
	(-1.74)	(-1.02)	(-0.17)	(0.71)	(-0.91)	(-0.31)	(0.11)	(0.69)
CAP_REG	0.002	0.01 *	0.01	0.01	0.003	0.01 *	0.01	0.01 **
	(0.19)	(1.62)	(1.09)	(1.37)	(0.34)	(1.67)	(1.16)	(1.95)
DUM_BASEL_2	-0.001	0.005	0.003	0.001	0.002	0.01 **	-0.005	-0.01
	(-0.16)	(1.44)	(0.52)	(0.21)	(0.52)	(2.28)	(-0.81)	(-1.30)
Liquidity equation								
BUFFER	-13.82 ***	-9.85 ***	-8.97 ***	-10.98 ***	-14.56 ***	-11.69 ***	-7.76 ***	-8.24 ***
	(-3.36)	(-2.75)	(-3.83)	(-3.95)	(-4.29)	(-3.85)	(-3.69)	(-3.71)
ROA	-3.64	-0.30	-0.97	-1.80	-2.19	1.19	9.80	5.71
	(-0.73)	(-0.07)	(-0.15)	(-0.30)	(-0.48)	(0.28)	(1.34)	(0.82)
LLP_TLO	5.49	7.71	-17.35 ***	-15.30 ***	7.31	9.53 *	-11.46 **	-11.94 ***
	(0.89)	(1.37)	(-3.06)	(-3.06)	(1.18)	(1.69)	(-2.02)	(-2.44)
MKT_POW	0.24	-1.31	38.97	62.45	-0.65	-2.05 **	20.74	32.88
	(0.20)	(-1.27)	(0.56)	(0.89)	(-0.55)	(-2.00)	(0.28)	(0.43)
BUSI_MD	-0.14	0.07	-0.01	-0.06	-0.02	0.20	0.46	0.14
	(-0.59)	(0.29)	(-0.04)	(-0.19)	(-0.10)	(0.85)	(1.19)	(0.37)
GDP_GWT	-1.46	-0.12	2.53	4.37	0.26	1.18	4.29	6.86
	(-0.86)	(-0.09)	(0.75)	(0.96)	(0.16)	(0.85)	(1.37)	(1.52)
CB	-3.90	-1.09	2.98	1.27	-3.63	-1.28	1.93	1.47
	(-1.50)	(-0.43)	(1.09)	(0.50)	(-1.44)	(-0.51)	(0.69)	(0.48)
IBK1M_CB	2.03	0.99	5.40	0.73	5.37	4.89	-10.50	-19.38
	(0.33)	(0.17)	(0.26)	(0.03)	(0.93)	(0.86)	(-0.48)	(-0.76)
LN_TA	-0.02	-0.03	0.01	-0.004	-0.03	-0.03	0.05	0.05
	(-0.91)	(-1.03)	(0.25)	(-0.09)	(-1.20)	(-1.13)	(0.92)	(0.92)
CONTROL	-0.14	-0.22	0.86	0.32	-0.01	-0.14	0.82	0.20
	(-0.47)	(-0.73)	(1.46)	(0.59)	(-0.03)	(-0.47)	(1.34)	(0.36)
Total Obs.	936	936	224	224	936	936	224	224

This table shows the results of estimating system (1) using GMM for an unbalanced panel of European publicly traded commercial banks over the 2000–2008 period. The *BUFFER* variable is either the Tier 1 and 2 capital buffer (*BUFFER_T12*, in systems (1.a) and (1.b)) or the Tier 1 capital buffer (*BUFFER_T1*, in systems (1.a′) and (1.b′)). Alternative definitions of the liquidity variable are used in the regressions. *IA_IL* is an alternative definition of the Berger and Bouwman (2009) *LC* indicator. It is the ratio of illiquid assets to illiquid liabilities (in systems (1.a) and (1.a′)). *LTR* is based on the *LT gap* of Deep and Schaefer (2004) and is the ratio of illiquid assets (i.e., total loans, long-term marketable assets, other assets and net fixed assets) to illiquid liabilities (i.e., time deposits, long-term market funding and equity, in systems (1.b) and (1.b′)). See Table 3.3 for the definition of the explanatory variables. A bank is considered large if its total assets exceed US$1 billion. Cross-section and time fixed effects are included in the regressions, and the White cross-section covariance method is used. To deal with colinearity issues in all the regressions, *ROE* is orthagonalised with *ROA* in the capital buffer equation. In the liquidity equation, *LN_TA* is orthagonalised with *BUSI_MD* and *MKT_POW*. In both the capital buffer and the liquidity equations, the presumably endogenous bank-level indicators are replaced by their one-year lagged value. In the capital buffer equation, the following variables are one-year lagged: *ROA, ROE, LLP_TLO, LO_TA, LO_GWT, MKT_DISC, DIV_PYRT* and *MKT_BK_VAL*. In the liquidity equation, the following variables are one-year lagged: *ROA, LLP_TLO, MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels, respectively.

Table 3.B.9. Using alternative liquidity proxies in the determination of capital buffers for U.S. banks according to their size

	Tier 1 and 2 capital buffer						Tier 1 capital buffer					
	Large banks			Small banks			Large banks			Small banks		
	1. a	1. b	1. c	1. a	1. b	1. c	1. a'	1. b'	1. c'	1. a'	1. b'	1. c'
Capital buffer equation												
IA_IL	-0.03 ***			-0.04 ***			-0.02 ***			-0.03 ***		
	(-3.18)			(-3.38)			(-2.80)			(-2.43)		
LTR		-0.04 ***			-0.05 **			-0.04 ***			-0.05 **	
		(-2.99)			(-2.05)			(-2.70)			(-2.07)	
CDR			0.003			0.01 ***			0.001			0.02 ***
			(1.26)			(2.79)			(0.48)			(3.74)
ROA	0.20	0.40 ***	0.26 *	0.67 ***	0.85 ***	1.09 ***	0.18	0.39 ***	0.29 **	0.89 ***	0.91 ***	1.10 ***
	(1.18)	(2.57)	(1.77)	(2.78)	(3.26)	(4.52)	(1.10)	(2.56)	(1.89)	(3.52)	(3.50)	(4.45)
DIV_PYRT	-0.003 *	-0.003	-0.003	-0.01 **	-0.01 **	-0.01 ***	-0.0002	0.004	0.01	-0.01 ***	-0.01 **	-0.01 **
	(-1.63)	(-0.97)	(-0.70)	(-2.22)	(-2.19)	(-2.59)	(-0.08)	(0.89)	(1.47)	(-2.34)	(-2.26)	(-2.06)
ROE	-0.001	-0.01	-0.06 ***	-0.04	-0.06 *	-0.08 **	-0.02	-0.02	-0.05 **	-0.05	-0.06	-0.05
	(-0.04)	(-0.35)	(-2.41)	(-1.31)	(-1.76)	(-1.90)	(-1.05)	(-0.90)	(-2.18)	(-1.41)	(-1.46)	(-1.16)
LLP_TLO	0.54 ***	0.40 *	0.39 ***	0.36 **	0.13	0.32 *	0.42 ***	0.27	0.28 *	0.30 *	0.06	0.22
	(2.89)	(1.79)	(2.40)	(2.14)	(0.57)	(1.61)	(2.48)	(1.31)	(1.76)	(1.73)	(0.25)	(1.01)
LO_TA	-0.04 ***	-0.05 ***	-0.06 ***	-0.02 *	-0.03 ***	-0.06 ***	-0.06 ***	-0.07 ***	-0.07 ***	-0.03 ***	-0.03 ***	-0.07 ***
	(-2.74)	(-4.19)	(-6.01)	(-1.60)	(-2.69)	(-5.13)	(-4.49)	(-5.66)	(-6.72)	(-2.37)	(-2.99)	(-6.06)
LO_GWT	-0.001	-0.01	-0.01 ***	-0.01 ***	-0.01 ***	-0.02 ***	-0.003	-0.01 **	-0.01 ***	-0.01 ***	-0.01 ***	-0.01 ***
	(-0.24)	(-1.59)	(-2.64)	(-2.84)	(-2.82)	(-3.76)	(-1.05)	(-1.89)	(-2.43)	(-3.01)	(-2.65)	(-3.18)
MKT_DISC	0.03 ***	0.03 **	0.02	0.01	0.01	0.01	0.04 ***	0.03 *	0.03 **	0.01	-0.0001	-0.01
	(2.62)	(1.99)	(1.46)	(0.52)	(0.61)	(0.64)	(2.82)	(1.65)	(1.97)	(0.43)	(0.00)	(-0.72)
MKT_BK_VAL	-0.001 ***	-0.002 *	-0.001	0.0004	0.0001	0.0003	-0.001	-0.0001	0.0004	0.001	0.001	0.001
	(-2.34)	(-1.69)	(-0.80)	(0.37)	(0.07)	(0.26)	(-0.79)	(-0.10)	(0.47)	(0.46)	(0.53)	(0.40)
LN_TA	0.001	-0.001	-0.001	-0.003	-0.004	-0.005 *	-0.002	-0.004 **	-0.003 **	-0.003	-0.01	-0.01 **
	(0.77)	(-0.47)	(-0.34)	(-1.16)	(-1.16)	(-1.67)	(-1.31)	(-2.12)	(-2.05)	(-1.11)	(-1.42)	(-2.19)
GDP_GWT	-0.03	0.03	-0.13	0.39 ***	0.37 *	0.07	-0.04	0.01	-0.13 *	0.30 *	0.37 *	0.11
	(-0.28)	(0.25)	(-1.46)	(2.33)	(1.69)	(0.49)	(-0.43)	(0.07)	(-1.72)	(1.81)	(1.71)	(0.77)
Liquidity equation												
BUFFER	-15.41 ***	-4.65 **	-8.55 *	-10.89 ***	-6.54 ***	-7.20 ***	-11.25 ***	-3.04 *	-7.85 **	-10.70 ***	-5.95 ***	-10.04 ***
	(-5.43)	(-2.23)	(-1.80)	(-5.22)	(-3.66)	(-2.53)	(-4.99)	(-1.72)	(-1.92)	(-4.99)	(-3.22)	(-3.54)
ROA	1.44	1.61	-0.81	4.72	2.39	8.55 **	0.36	0.99	-2.17	5.92 *	2.48	12.33 ***
	(0.58)	(1.33)	(-0.21)	(1.51)	(0.88)	(2.09)	(0.16)	(0.88)	(-0.58)	(1.75)	(0.87)	(2.83)
LLP_TLO	5.66	-1.54	5.17	3.03	-2.93	8.31	2.27	-3.03	3.74	2.19	-3.83 *	8.21
	(1.59)	(-0.58)	(1.19)	(1.22)	(-1.33)	(1.14)	(0.73)	(-1.20)	(1.00)	(0.89)	(-1.77)	(1.12)
MKT_POW	-0.23 **	-0.21 **	-9.38 ***	-0.32 **	-0.26 **	-1270.76	-3.99 ***	-3.04 ***	-10.26 ***	-1727.52 **	-1346.38 **	-1882.93 *
	(-2.04)	(-2.21)	(-2.94)	(-2.25)	(-2.16)	(-1.15)	(-3.03)	(-3.70)	(-3.30)	(-2.24)	(-2.03)	(-1.66)
BUSI_MD	-2.68 **	-2.63 ***	2.71 ***	-1343.88 **	-1236.73 **	0.72 **	-0.24 **	-0.16	2.34 ***	-0.42 ***	-0.28 **	0.84 ***
	(-2.04)	(-3.14)	(5.18)	(-2.05)	(-2.05)	(2.06)	(-2.07)	(-1.53)	(4.65)	(-2.88)	(-2.27)	(2.46)
GDP_GWT	1.79	3.70 **	-27.37 ***	8.73 ***	8.46 ***	0.42	1.98	4.31 **	-23.02 **	8.63 ***	8.20 ***	1.19
	(1.07)	(2.11)	(-2.47)	(4.36)	(4.35)	(0.18)	(1.11)	(2.04)	(-2.00)	(4.08)	(4.01)	(0.50)
CB	0.18	-0.07	17.88 *	0.43	-0.97	1.05	0.51	-0.38	17.53 *	0.78	-0.78	1.05
	(0.24)	(-0.07)	(1.85)	(0.49)	(-0.96)	(0.76)	(0.50)	(-0.30)	(1.75)	(0.74)	(-0.72)	(0.76)
IBK1M_CB	21.23 *	24.68	-407.41	31.86	14.81	129.02 ***	27.06	28.01	-347.70	35.22	8.70	132.64 ***
	(1.61)	(1.30)	(-1.15)	(1.19)	(0.58)	(3.49)	(1.38)	(1.12)	(-0.94)	(1.20)	(0.33)	(3.60)
LN_TA	0.0001	-0.01	0.02	-0.02	-0.004	0.11 **	-0.01	-0.01	0.01	-0.02	-0.002	0.12 **
	(0.01)	(-0.44)	(0.17)	(-1.11)	(-0.26)	(2.02)	(-0.79)	(-0.44)	(0.07)	(-1.00)	(-0.13)	(2.14)
Total Obs.	1690	1690	1683	2113	2113	2113	1690	1690	1683	2113	2113	2113

This table shows the results of estimating system (1) using GMM for an unbalanced panel of US publicly traded commercial banks over the 2000–2008 period. The *BUFFER* variable is either the Tier 1 and 2 capital buffer (*BUFFER_T12,* in systems (1.a), (1.b) and (1.c)) or the Tier 1 capital buffer (*BUFFER_T1,* in systems (1.a′), (1.b′) and (1.c′)). Alternative definitions of the liquidity variable are used in the regressions. *IA_IL* is an alternative definition of the Berger and Bouwman (2009) *LC* indicator. It is the ratio of illiquid assets to illiquid liabilities (in systems (1.a) and (1.a′)). *LTR* is based on the *LT gap* of Deep and Schaefer (2004) and is the ratio of illiquid assets (i.e., total loans, long-term marketable assets, other assets and net fixed assets) to illiquid liabilities (i.e., time deposits, long-term market funding and equity, in systems (1.b) and (1.b′)). *CDR* is based on the financing gap of Saunders and Cornett (2006) and is the ratio of total loans to total core deposits (in systems (1.c) and (1.c′)). A higher value of each liquidity proxy indicates higher bank illiquidity. See Table 3.3 for the definition of the explanatory variables. A bank is considered large if its total assets exceed US$1 billion. Cross-section and time fixed effects are included in the regressions, and the White cross-section covariance method is used. To deal with colinearity issues in all the regressions, *ROE* is orthogonalised with *ROA* in the capital buffer equation. In the liquidity equation, *LN_TA* is orthogonalised with *BUSI_MD* and *MKT_POW*. In both the capital buffer and the liquidity equations, the presumably endogenous bank-level indicators are replaced by their one-year lagged value. In the capital buffer equation, the following variables are one-year lagged: *ROA, ROE, LLP_TLO, LO_TA, LO_GWT, MKT_DISC, DIV_PYRT* and *MKT_BK_VAL*. In the liquidity equation, the following variables are one-year lagged: *ROA, LLP_TLO, MKT_POW* and *BUSI_MD*. *, ** and *** indicate statistical significance respectively at the 10%, 5% and 1% levels, respectively.

APPENDIX 3.C. Summary descriptive statistics for U.S. and European listed commercial banks by size from 2000 to 2008

Table 3.C.1. Summary descriptive statistics separately for U.S. and European listed commercial banks according to their size, on average, from 2000 to 2008

	Total assets in US$ billion	Total loans / total assets	Total deposits / total assets	Loan loss provisions / total loans	Tier 1 capital / total assets	Tier 1 and 2 capital / RWA	ROA	Total interest income / total income
Large U.S. banks								
Mean	36.0	65.1	73.7	0.5	8.1	13.1	1.0	73.4
Median	2.7	67.1	74.9	0.3	7.5	12.5	1.1	75.2
Max	2187.6	93.2	93.5	5.9	28.5	31.3	5.7	99.5
Min	1.00	4.8	28.0	-0.6	0.1	5.1	-13.3	16.6
Std. Dev.	174.9	12.6	9.5	0.7	3.1	3.0	0.9	12.8
Small U.S. banks								
Mean	0.5	68.5	80.0	0.4	9.0	13.9	0.9	80.2
Median	0.4	69.8	81.2	0.3	8.5	13.0	1.0	81.7
Max	1.0	93.0	96.0	6.8	35.2	34.0	6.9	99.8
Min	0.0	6.9	39.0	-0.7	0.9	5.8	-13.3	20.6
Std. Dev.	0.2	11.3	7.5	0.6	3.2	3.6	0.9	10.3
Test statistic & %level	-10.58 (0.00)	9.79 (0.00)	25.49 (0.00)	-5.91 (0.00)	9.75 (0.00)	7.05 (0.00)	-2.49 (0.01)	20.15 (0.00)
Large European banks								
Mean	168.7	63.6	47.4	0.5	6.5	11.5	0.7	57.0
Median	15.6	67.0	48.1	0.4	5.8	11.3	0.7	58.8
Max	3768.2	95.1	93.6	7.2	26.0	27.2	4.1	99.2
Min	1.00	3.7	4.1	-1.1	0.8	4.5	-5.8	4.7
Std. Dev.	400.3	19.4	17.6	0.6	3.1	2.0	0.7	16.0
Small European banks								
Mean	0.4	68.5	68.8	0.7	10.8	14.3	1.2	68.5
Median	0.4	68.4	70.2	0.6	11.1	13.5	1.2	71.1
Max	1.0	93.0	92.4	4.4	23.1	30.2	4.1	98.4
Min	0.0	6.3	23.1	-1.2	3.3	8.8	-4.4	9.5
Std. Dev.	0.3	16.0	11.5	0.8	4.2	3.6	0.9	14.4
Test statistic & %level	-7.50 (0.00)	4.16 (0.00)	20.70 (0.00)	4.79 (0.00)	20.44 (0.00)	17.01 (0.00)	10.84 (0.00)	11.74 (0.00)

Source: Bloomberg (2000–2008). All variables are expressed in percentage, except *Total assets*. *Total assets* in US$ billion; *Total loans / total assets:* (commercial loans + consumer loans + other loans) / total assets; *Total deposits / total assets:* (demand deposits + saving deposits + time deposits + other time deposits) / total assets; *Loan loss provisions / total loans:* loan loss provisions / (commercial loans + consumer loans + other loans); *Tier 1 capital / total assets:* Tier 1 capital / total assets; *Tier 1 2 capital / RWA:* (tier 1 capital + tier 2 capital) / total risk weighted assets; *ROA:* net income / total assets; *Total interest income / total income:* (interest income from loans + resale agreements + interbank investments + other interest income or losses) / total income. A bank is considered large if its total assets exceed US$1 billion. T-statistics test for null hypothesis of identical means; *, ** *** indicate statistical significance at the 10%, 5% and 1% level, for bilateral test.

CONCLUSION

Through their essential function of liquidity provision, banks face maturity transformation risk and are inherently fragile institutions. Recent financial crises have relaunched the debate on banking regulation, specifically on bank liquidity and exposure to maturity transformation risk. Liquidity shortages have occurred in recent historical events following the Asian crisis at the end of the 1990s and the subprime crisis in mid-2007. In recognition of the need for banks to improve their liquidity management, the Basel Committee on Banking Regulation and Supervision has developed an international framework for liquidity assessment in banking. Among the several guidelines, the Basel III accords include the implementation of liquidity ratios concomitant to capital standards to strengthen the stability of banks. Nevertheless, these accords do not address to what extent these two regulatory frameworks might be completing one another. However, before implementing such a regulation on bank liquidity, it seems essential to consider why focusing on solvency standards might not be sufficient to ensure bank stability and how liquidity can also play a crucial role. Thus, this thesis analyzes the advantages of adding liquidity standards in the current banking regulatory framework to strengthen bank stability. The thesis focuses on three main issues, addressing them empirically.

Before analyzing the advantages of adding liquidity standards in the body of banking regulation, Chapter 1 presents existing measures of bank liquidity creation (Berger and Bouwman, 2009) and maturity transformation risk (BIS, 2009a; Harvey and Spong, 2001; Saunders and Cornett 2006) and highlights stylized facts, for Europe and the United States, on the extent of liquidity creation banks perform and their exposure to maturity transformation risk according to their business model. A statistical analysis is performed to emphasize how the differences in the nature of bank activities are likely to affect the structure of banks' balance sheets and the extent of their liquidity creation and their exposure to maturity transformation risk. Moreover, considering a multivariate regression framework, the study focuses on the sensitivity of bank maturity transformation risk to several factors considering banks' business model. Beyond the variables emphasized in previous literature, the focus in on the impact of bank access to additional sources of liquidity depending on the importance of (1) potentially securitizable loans and (2) short-term, potentially unstable market debts. The aim is to analyze the strengths and weaknesses of banks for liquidity risk management according the orientation of their activities.

Considering listed commercial U.S. and European banks separately over the 2000–2008 period, the results show that European banks perform higher levels of liquidity creation and face much higher exposure to maturity transformation risk than do U.S. banks. In addition, the findings emphasize that large U.S. banks perform higher levels of liquidity creation and face much higher exposure to maturity transformation risk than do small U.S. banks. On the whole, results are similar for large U.S. banks and European banks, which are mainly large banks in the sample. This implies that it is not banks' business models that explain the differences in liquidity creation and of maturity transformation risk profile but rather banks' size. Small banks benefit from the stability of their large deposit base and face a lower exposure to maturity transformation risk. European and large U.S. banks are more involved in debt markets, and they are more funded by volatile market funding. Therefore, they face a higher exposure to maturity transformation risk.

Moreover, the results show that the loan securitization is crucial in maturity transformation risk management for all types of U.S. banks. This finding can be explained in two ways. First, securitization markets are much more developed in the United States than in Europe. Second, European banks are universal compared to U.S. banks, which are more focused on retail activities. Therefore, European banks might have access to additional sources of liquidity provided by other activities than loan activities. Consequently, the loan securitization might not be a key component of the liquidity management framework for European banks, which can manage their maturity transformation risk by accessing these additional liquidity sources. Conversely, loan securitization might be essential for U.S. banks, which might benefit from the higher liquidity of their loan portfolio to decrease their exposure to maturity transformation risk. Finally, the results show that European banks and large U.S. banks are widely penalized by the potential instability of their short-term market funding. This might be explained by the fact that European banks and large U.S. banks are more involved in debt markets than are small U.S. banks. Thus, small banks might benefit from the stability of their large deposit base to match structural unbalances with their long-term loans. The small deposit base of European banks and large U.S. banks does not provide a sufficient cushion of stable funding to mitigate their exposure to maturity transformation risk.

These findings raise numerous challenges for banks to modify their business strategies. On the whole, the results support the need to improve the stability of bank liabilities specifically for European banks and large U.S. banks, as stressed by the Basel Committee (2009a). Banks can consider several ways to increase their stable funding base, such as (1) new marketing strategies and higher interest payment on deposits to attract more retail deposits; (2) the development of their private banking activities to benefit from the liquidity provided by wealth management and (3) the issuance of covered bonds and contingent convertible bonds to increase the proportion of stable long-term market debts. However, this might raise concerns about the possible emergence of destructive competition for stable deposits and the wide increase of the proportion of long-term market debts.

These findings also raise challenges for regulators to encourage banks to improve their stable funding base. First, they might consider if and how banks can include the funding provided by retail customers through life insurance and mutual fund shares activities on their balance sheets. Second, they might deal with the opportunity to set incentive mechanisms for bondholders to prevent unexpected funding roll-offs. In addition, regulatory authorities might consider if and how they can implement market funding insurance systems to improve the stability of market funding. Finally, these findings raise questions regarding the implementation of uniform liquidity requirements to all types of banks if European banks and large U.S. banks are widely sensitive to the instability of their market funding.

Chapter 2 investigates the advantages of using a liquidity ratio as defined in the Basel III accords to predict bank financial distress. During the subprime crisis, a large number of banks failed or required resolution following lack of liquidity even if they received extensive liquidity supports. Following this crisis, the proposals to implement liquidity ratios in addition to capital standards relaunched the debate on the broad role played by liquidity in the occurrence of bank financial distress. Thus far, most empirical studies on the determinants and/or the prediction of bank default (Early Warning Models) consider indicators from the CAMELS approach, which are computed from accounting data such as liquid assets to total assets or total loans to total deposits (Demirgüc-Kunt, 1990; Gonzalez-Hermosillo, 1999; Demyanyk and Hasan, 2009; Demyanyk and Van Hemert, 2009; Torna, 2010). Among the several guidelines, the Basel III accords include the implementation of the net stable funding ratio. This measure accounts for the imbalances of both sides of bank balance sheets and enables regulators to better assess the ability of banks to meet unexpected withdrawals from customers with their liquid assets. From this perspective, the study questions whether the introduction of the net stable funding ratio can contribute to improve the prediction of bank financial distress. The purpose of this study is to examine the advantages of considering a liquidity ratio as defined in the Basel III accords in addition to the liquidity indicators from the CAMELS approach to predict bank financial distress. Using a standard logit model, the aim is to determine whether the Basel III net stable funding ratio adds predictive value to models relying on liquidity ratios from the CAMELS approach to explain bank default probability. The empirical analysis is conducted in the context of the most recent financial crisis, the subprime crisis, which was characterized by important liquidity shortages.

The results emphasize the relevance of the liquidity indicator as defined in the Basel III accords to predict bank financial distress. The results show that using such an indicator adds predictive value to models relying on liquidity ratios from the CAMELS approach.

These findings suggest that liquidity pressures on banks are significantly damaging. They tend to make banks more fragile following an exogenous and unexpected shock. These results confirm the relevance of monitoring bank liquidity to strengthen their stability, as stressed by the Basel Committee. More notably, these findings shed light on the benefits of considering, in addition to liquidity ratios computed from accounting data, a liquidity ratio as defined in the Basel III accords because it performs well in explaining bank financial distress. These results support the need to improve the definition of liquidity to predict bank financial distress.

Finally, consistently with the theory of financial intermediation that highlights various channels through which capital and liquidity are interrelated, Chapter 3 investigates the relationship between bank capital buffer and liquidity. Through their essential role of liquidity provision, banks face the risk of being unable to access external funding or the risk of losses by selling illiquid assets to meet the unexpected withdrawals from customers. Prudential policies place great importance on the role of capital in minimizing the impact of losses and improving the ability of banks to access external funding. There is a large consensus in the literature that capital ratios have exhibited an upward trend since the beginning of the 1990s. Previous research studying the determinants of bank capital buffer has neglected the role of liquidity. However, the more banks create liquidity, the higher is their exposure to maturity transformation risk. Thus, along with the other factors considered in the literature, the reason banks hold capital buffers might be their exposure to maturity transformation risk. The study questions whether banks maintain or strengthen their capital buffer when they face lower liquidity. Indeed, banks might strengthen their solvency standards to (1) offset their liquidity constraint and improve their ability to raise external funds or 2) better assume the losses from selling illiquid assets to repay the liabilities claimed on demand. If the hypothesis is rejected (i.e., if banks do not adjust and improve their capital standards when facing higher illiquidity), liquidity requirements concomitant to capital standards might be needed to temper the overall riskiness of banks. To be consistent with recent empirical findings (Berger and Bouwman, 2009) indicating that bank capital and liquidity can be jointly determined, this study includes a simultaneous equations model.

On the whole, the results show that banks do not strengthen their capital buffer when they face higher illiquidity as defined in the Basel III accords or when they create more liquidity as measured by Berger and Bouwman (2009). However, considering other measures of illiquidity that focus more closely on core deposits in the United States, the results show that, except for very large institutions, banks do actually build larger capital buffers when they are exposed to higher illiquidity.

These findings support the need to implement minimum liquidity ratios concomitant to capital ratios, as stressed by the Basel Committee (BIS, 2009a). Nevertheless, adding liquidity ratios to capital ratios might be more relevant for the very large systemic institutions than for smaller banks.

These findings raise several challenges for regulatory authorities, as they cast doubt on the accuracy of the current framework. First, regulatory authorities might reconsider the definition and measurement of liquidity under a global regulatory framework. They need to focus on what type of liabilities can be considered stable for a deeper regulatory definition of the notion of core or stable deposits. Second, considering very large institutions' too-big-to-fail position and their ability to manage their liquidity differently, regulatory authorities might need to reconsider the way of implementing uniform liquidity requirements to all types of banks. They might need to consider very large banking institutions, which behave differently than smaller ones, separately.

As an answer to the initial interrogation, the empirical investigations prompt the need to improve the prudential regulatory framework by implementing liquidity standards concomitant to capital ratios to strengthen bank stability. However, within a global regulatory framework, regulators should be more concerned with the type of liabilities that can be considered stable. In addition, they might need to further consider the implications of the differences in (1) liquidity profiles and (2) liquidity management between large and small banks. According to this research, these aspects should be of particular relevance for future revisions and amendments of the prudential regulatory framework.

APPENDIX A. Comments on the consultative document BCBS 165 "International framework for liquidity risk measurement, standards and monitoring"

In this note, I suggest some comments on the consultative document BCBS 165 (BIS, 2009a), highlighting the necessity to (1) compute liquidity indicators that rely on hypotheses under stress time scenarios, which correspond to previous crises; (2) strengthen market confidence on the indicators of bank liquidity risk; and (3) consider the macroeconomic impact of holding large buffers of high-quality liquid assets.

A.1. Comments on several paragraphs of the "Introduction"

Paragraph 1. One of the most notable differences in the subprime crisis from other crises was the "run" on market funding rather than on deposits. Supervisors and regulators were not set up to deal with such a situation (e.g., Goldman Sachs and Morgan Stanley were converted into bank holding companies to access government liquidity supports). Going forward, the aim is improve the management of bank liquidity (e.g., by considering the proportion of market funding or the proportion of unencumbered high-quality liquid assets).

Paragraph 2. Even if liquidity transformation is the preeminent function of banks, the mismatch between assets and liabilities must be under control. Nevertheless, the coverage of maturity transformation risk is different from the coverage of other financial risks. There are two underlying facts: (1) Banks can never entirely avoid maturity transformation risk because of their financial intermediation function (i.e., because banks are liquidity insurers, they are exposed to depositors' panic); and (2) banks need a central bank as lender of last resort to address severe or prolonged liquidity crisis.

Paragraph 3. With the development of loan securitization, banks were not encouraged to correctly assess the credit quality of their borrowers. The "originate-to-distribute model" has led to a large increase in risks in the financial system. Consequently, banks must be encouraged, by keeping at least part of the risk themselves, to better face their intermediation function by improving the quality of their loan portfolios.

Paragraph 4. Standardizing too many regulation guidelines could lead to procyclical imbalances, because it may encourage banks to adopt similar strategies. Thus, when a shock occurs, all banks are likely to be affected in the same way. Standardization of banking regulation can improve the transparency and coherence of risk management policies across countries. However, a key issue is at what point too much standardization can become damaging for the stability of the financial system as a whole.

Paragraph 5. Requirements for banks to hold a buffer of high-quality liquid assets could be costly (e.g., the cost of reallocation of the asset portfolio, the opportunity cost of holding assets with weak returns). In addition, it may affect the successful channel of savings to investments and the way to finance production, and thus banks' role of liquidity provision. Hence, regulators must consider the consequences of holding more liquid assets instead of financing loans to customers.

Paragraph 7. Before implementing additional liquidity ratios, it should be considered to what extent maturity transformation risk is consistent with capital standards. In the literature, it is commonly admitted that banks hold capital in excess compared with regulatory requirements. Because current risk-weighted assets only include credit, market and operational risks, banks could hold excess capital partly to be hedged against maturity transformation risk.

Regulatory standards – summary

Paragraph 9. These two liquidity ratios indicate to what extent a bank is able to face to its liquidity requirements without borrowing money or sell its assets at a loss. However, beyond a sufficient excess above 100% (e.g., 110%), they should not be required to indicate the ratio to avoid peer competition. The purpose is to limit a shrink in the whole liquidity provided by the banking sector to the economy.

The liquidity coverage ratio

Paragraph 11. The definition of high-quality liquid assets must not consider loan securitization. Consequently, only level 1 assets can be considered in the measure; level 2 and 3 assets are not qualified.

Monitoring tools - summary

Paragraph 15.b. The concentration of bank funding must be considered at a bank level. In addition, supervisors should appreciate whether a given bank is dominant on a particular market segment. They may assess bank market power to detect if a given bank is likely to become market maker. The key issue is to estimate the bank systemic dimension and the consequences if it stops lending on the Interbank market and on the commercial paper market.

Paragraph 15.c. Even if unencumbered assets are eligible to prime brokers or central banks, they must be of the highest quality, marketable and with short-term maturity to be subject to low discounts (i.e., to maximize their cash value). Indeed, during crisis, because of the "flight to quality", banks may experience difficulties in selling or pledging as collateral a poor-quality asset.

Paragraph 15.d. Bank market data are useful indicators of individual bank current or future difficulties. However, attention must be paid to ensure that market data are reliable (e.g., London Interbank Offered Rate levels were no longer so at the worst time in the subprime crisis). In addition, it is important to have multiple inputs into the risk assessment process, by using the best available data. It is also important not to depend on any one model or methodology to estimate bank losses. It is precisely the combination of rigorous, data-driven analyses and individual judgment that make the risk measure successful. The interactive and iterative nature of the process helps refine each method of assessment.

A.2. Comments on several paragraphs of the "Regulatory Standards"

The liquidity coverage ratio

Paragraph 18. Good management-information systems are critical to the ability of banks for managing their risks. Assessing risk exposure across an organization as a whole is essential to understand the potential effect of exposure to the risks that are correlated. These risks may be related to distinct business lines as well as to different legal entities and to several regulatory jurisdictions.

Paragraphs 20 and 25.a. The list of eligible high-quality liquid assets must be determined based on their liquidity under stress time scenario, irrespective of their liquidity under normal time scenario. In addition, they can only be so if accepted with reasonable terms by central banks during crisis.

Paragraph 21. Similar comments as for paragraph 9. The liquidity coverage ratio must be equal or greater than 100%. However, to restore their confidence on banks, financial markets could require a higher limit (e.g., 110%) to account for a sufficient buffer against unexpected liquidity shortages.

Paragraph 26. Banks should be explicitly constrained to diversify their portfolio of high-quality liquid assets to limit their liquidation at fire-sale prices if the other banks need to sell similar assets simultaneously. If banks must increase their stocks of high-quality liquid assets, the higher demand for these assets may lead to an increase in prices and possible asset price bubble buildup. In addition, it may provide incentives for governments to increase their indebtedness, if banks are willing to buy such highly rated debt securities.

Paragraphs 27 and 28. Similar comments as for paragraph 15.c.

Paragraph 29. All high-quality liquid assets are not held in the same proportion according to bank business model and size. The key issues are the impact on their profitability and the global economic performance incurred by possible reduction in credit supply. Going forward, regulators should encourage banks to carefully monitor their borrowers and to grant high-quality loans rather than hold high-quality liquid assets.

Paragraph 32. Banks should be constrained to formally disclose how they manage the implementation of their liquidity management framework and how they manage their stock of high-quality liquidity assets. Emergency plans must precisely define the circumstances when assets must be sold, the main procedures and the main persons in charge of the decisions. The aim is to ensure prompt liquidation of assets to limit losses and maximize their cash value.

Paragraph 33. Regulators should require banks to frequently and precisely disclose their regulatory liquidity ratios. In addition, reports must be as standardized as possible to facilitate comparisons between banks (i.e., in line with 10K reports, FDIC call reports data and Pillar III reports).

Paragraphs 36 and 37. Haircuts on corporate bonds and covered bonds (e.g., the 20%, 40%) must be calibrated in a worldwide basis as banks are likely to pledge collateral at foreign central banks through their local subsidiaries. However, each bank should consider the worst case between the regulatory haircut and the haircut that prevails at the central bank where the asset is likely to be pledged as collateral. Furthermore, in addition to considering bid-ask yield spread, regulatory haircuts must be gradual according to bond ratings and maturities to avoid "cliff effects", especially in light of the limits of the reliability of rating data during the subprime crisis.

Paragraph 38. In the determination of expected cash flows, the stochastic value (i.e., possibly linked to the dimension of the crisis, to the state of the real economy and to the credit quality of borrowers) of some cash flows must be considered, the assumptions and the coefficients being calibrated under stress time scenario. This scenario must be based on severe but plausible events, including low-probability events with potentially great adverse effects.

Paragraph 41. The definition of stable retail deposits must be done at bank level. It must be consistent with bank past experience for the proportion of deposit withdrawals during previous crises. The deposits that cannot be considered stable are those that have in the past suffered withdrawals in excess of the 7.5% ratio. In addition, the distinction between insured and uninsured deposits is only relevant in a system in which deposit insurance is explicit. Consequently, the definition of stable deposits must be adjusted to the specificities of national banking systems. For example, in the United States, all core deposits (e.g., demand deposits, saving deposits, time deposits lower than US$100,000) can be considered stable. The share of time deposits higher than US$100,000 should be considered volatile.

Paragraph 47. Same comments as for paragraph 41. for market funding, requiring back testing on their volatility during previous crises as it is likely to vary according to the type of the crisis, the type of funding and the bank considered (e.g., the case of Northern Rock in mid-2007).

Paragraph 66. The standardized 10% rate for drawdown of loan commitments (to retail clients) must be back-tested at bank level. It must be based on historical rates of drawdown of loan commitments during previous crises.

Paragraph 70. By excluding from the metric operating costs, regulators assume that banks automatically consider these parameters to determine their ability to meet their engagements. In a prudential approach, regulators should not exclude any cost, by using a pro forma amount of operating costs.

Paragraph 77. By considering only the financial revenues (i.e., by excluding the nonfinancial revenues that are likely to delay during crisis), the revenues included to calculate the cash inflows are assessed in a prudential approach.

Paragraphs 79 and 80. More generally, the discount of all assets (i.e., the haircut) when they are monetized must be funded with stable funding (e.g., stable short-term funding and long-term funding).

Paragraph 81. Similar comments as for paragraphs 9 and 21.

Paragraph 82. During crisis, bank net profit could also be considered as an available source of cash. Instead of distributing dividends and increasing capital reserves, banks could use their current income to settle a part of their engagements.

A.3. Comments on several paragraphs of the "Monitoring Tools"

Funding concentration

Paragraph 104. Funding concentration must be balanced with the maturity and the liquidity of assets. The purpose is to detect possible imbalances between the maturity or the liquidity of assets and liabilities. If there is no mismatch, maturity transformation risk is nonexistent. The problem is more consistent with the benefits of diversification that may improve the stability of funding.

Paragraph 105. Depending on their business model and size, banks do have not similar access to a given source of funding. Therefore, regulators must be careful about bank accessibility to the various sources of funding without introducing barriers. Hence, there should be an exemption to the 1% limit when the given funding is stable under all circumstances.

Paragraphs 111 and 116. Funding denominated in foreign currency does not expose banks to higher maturity transformation risk if they access lending facilities of foreign central banks thought their local subsidiaries or if they can obtain market funding denominated in the right foreign currency.

Available unencumbered assets

Paragraph 118. Banks must report the amounts of available unencumbered assets by type and location. They also should report the amounts of marketable versus nonmarketable unencumbered assets and the breakdown according to the maturity of assets. Indeed, haircuts should be higher for nonmarketable assets or for long-term assets.

Paragraphs 120 and 121. Frequent reports of unencumbered assets and their collateral value may not capture the risk of the increase in haircuts during crisis. The key question is the determination of haircuts that prevail under a stress time scenario. Regulators may consider whenever possible the level of haircuts and the increase in haircuts during previous crises.

Market related monitoring tools

Paragraph 125. By monitoring the trends in the main financial markets (e.g., equity, bond, currency, commodity markets), supervisors should try to detect possible asset price bubble buildup. In addition, they should consider to what extent banks contribute to exacerbating the bubble and how they could limit the bullish trend.

Paragraph 127. Similar comments as for paragraph 15.d.

Paragraphs 130 and 135. To emphasize the importance of the management of systemic risk and to increase the protection against moral hazard behaviors and accommodative assumptions on liquidity risk valuation models, it is necessary that external auditors confirm the robustness of the methodologies used to estimate bank liquidity risk and the procedures for back testing. The aim is to ensure an adequate definition and calibration for indicators of liquidity risk before using them for regulatory purposes.

APPENDIX B. Balance sheets weighting used to calculate the liquidity creation indicator

Assets	Liquidity level	Weights
Cash and near cash items	Liquid	-0.5
Interbank assets	Semiliquid	0
Short-term marketable assets	Liquid	-0.5
Commercial loans	Illiquid	0.5
Consumer loans	Semiliquid	0
Other loans	Semiliquid	0
Long-term marketable assets	Semiliquid	0
Fixed assets	Illiquid	0.5
Other assets	Illiquid	0.5
Custumer acceptances	Semiliquid	0
Liabilities		
Demand deposits	Liquid	0.5
Saving deposits	Liquid	0.5
Time deposits	Semiliquid	0
Other term deposits	Semiliquid	0
Short-term borrowings	Liquid	0.5
Other short-term liabilities	Liquid	0.5
Long-term borrowings	Semiliquid	0
Other long-term liabilities	Semiliquid	0
Subordinated debentures	Illiquid	-0.5
Prefered equity	Illiquid	-0.5
Minority interests	Illiquid	-0.5
Shareholder common capital	Illiquid	-0.5
Retained earnings	Illiquid	-0.5

APPENDIX C. Summary of the balance sheets weighting used to calculate net stable funding ratio as defined in the Basel III accords

Available funding source	Availability factor
Tier 1 and 2 Capital Instruments **Other preferred shares and capital instruments in excess of Tier 2 allowable amount having an effective maturity of one year or greater** **Other liabilities with an effective maturity of 1 year or greater**	1
Less stable deposits of retail and small business customers (nonmaturity or residual maturity < 1yr)	0.85
Less stable deposits of retail and small business customers that are not covered by effective deposit insurance, high-value deposits, internet deposits and foreign currency deposits (nonmaturity or residual maturity < 1yr)	0.7
Wholesale funding provided by nonfinancial corporate customers (nonmaturity or residual maturity < 1yr)	0.5
All other liabilities and equity not included above	0
Required funding source	**Required factor**
Cash **Short-term unsecured actively traded instruments (< 1 yr)** **Securities with exactly offsetting reverse repo** **Securities with remaining maturity < 1 yr** **Nonrenewable loans to financials with remaining maturity < 1 yr**	0
Debt issued or guaranteed by sovereigns, central banks, BIS, IMF, EC, non-central government, multilateral development banks	0.05
Unencumbered non-financial senior unsecured corporate bonds (or covered bonds) rated at least AA, maturity ≥ 1 yr	0.2
Unencumbered listed equity securities or nonfinancial senior unsecured corporate bonds (or covered bonds) rated at least A-, maturity ≥ 1 yr **Gold** **Loans to nonfinancial corporate clients having a maturity < 1 yr**	0.5
Loans to retail clients having a maturity < 1 yr	0.85
All other assets	1

Source: BIS (2009a).

APPENDIX D. Balance sheets weighting used to calculate the inverse of the Basel III net stable funding ratio

Required amount of stable funding		
Assets	**Corresponding definition of BIS**	**Weights**
Cash and near cash items	Cash	0
Interbank assets	Nonrenewable loans to financials with remaining maturity < 1 yr	0
Marketable securities and other short-term investments	Short-term unsecured actively traded instruments (with remaining maturity < 1 yr)	0
Commercial loans	All other assets	1
Consumer loans	Loans to retail clients (with remaining maturity < 1 yr)	0.85
Other loans	All other assets	1
Long-term investments	Unemcumbered listed equity or nonfinancial senior unsecured corporate bonds rated at least A- (with remaining maturity > 1 yr)	0.5
Fixed assets	All other assets	1
Other assets	All other assets	1
Customer acceptances	Unemcumbered listed equity or nonfinancial senior unsecured corporate bonds rated at least A- (with remaining maturity > 1 yr)	0.5
Available amount of stable funding		
Liabilities	**Corresponding definition of BIS**	**Weights**
Demand deposits	Deposits of retail and small business customers (nonmaturity or residual maturity < 1yr)	0.7
Saving deposits		0.7
Time deposits	Other liabilities with an effective maturity > 1 yr	1
Other term deposits	Other liabilities with an effective maturity > 1 yr	1
Short-term borrowings	All other liabilities or equity not included above	0
Other short-term liabilities	All other liabilities or equity not included above	0
Long-term borrowings	Other liabilities with an effective maturity > 1 yr	1
Other long-term liabilities	Other liabilities with an effective maturity > 1 yr	1
Subordinated debentures	Tier 1 and 2 capital instruments, other preferred shares and capital instruments in excess of Tier 2 allowable amount having an effective maturity > 1 yr	1
Prefered equity		1
Minority interests		1
Shareholder common capital		1
Retained earnings		1

The inverse of the net stable funding ratio (*I_NSFR*) is the ratio of the required amount of stable funding to the available amount of stable funding. It is based on the net stable funding ratio as defined in the Basel III accords (BIS, 2009a). For further details about the weighting of bank balance sheet items as suggested by BIS (2009a) to compute this ratio, see Appendix C.

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TABLE OF CONTENTS

Abstract

The objective of this thesis is to analyze the advantages of adding liquidity standards in the current banking regulatory framework to strengthen bank stability. Chapter 1 reviews the existing literature and presents stylized facts focusing on the extent of banks' liquidity creation and maturity transformation risk. The chapter also investigates the sensitivity of maturity transformation risk to several factors depending on banks' business models. The findings raise several challenges for both banks and regulators to improve the profile of banks' maturity transformation risk. Chapter 2 examines whether the introduction of a liquidity measure as defined in the Basel III accords can contribute to improve the prediction of bank financial distress. The results show that the Basel III net stable funding ratio adds predictive value to models relying on liquidity ratios from the CAMELS approach to explain bank default probability. The findings support the need to improve the definition of liquidity to predict bank financial distress. Chapter 3 investigates the relationship between bank capital buffer and liquidity. The purpose is to examine whether banks maintain or strengthen their capital buffer when they face lower liquidity. The empirical investigation supports the need to implement minimum liquidity ratios concomitant to capital ratios, as stressed by the Basel Committee; however, the findings raise challenges for regulators with regard to the need to further clarify how to define and measure illiquidity and also on how to consider very large banking institutions, which behave differently than smaller ones.

Keywords: [Banks, Financial Risks, Regulation]

Résumé

L'objectif de cette thèse est d'analyser les avantages de compléter le cadre règlementaire par des contraintes sur la gestion de la liquidité afin de renforcer la stabilité financière des banques. Dans le chapitre 1, nous effectuons une revue de la littérature et présentons des faits stylisés pour mettre en évidence l'ampleur de la création de liquidité et l'exposition des banques au risque de transformation. Nous considérons également la sensibilité du risque de transformation à différents facteurs en fonction de l'orientation des activités des banques. Nos résultats suggèrent de nombreuses réflexions pour les banques et les régulateurs afin d'améliorer le profil d'exposition des firmes bancaires à ce risque. Dans le chapitre 2, nous examinons dans quelle mesure l'introduction de ratios de liquidité comme définis par les accords de Bâle III contribue à améliorer la prédiction de la détérioration de la situation financière des banques. Nous montrons que le « net stable funding ratio » comme défini par les accords de Bâle III améliore le pouvoir explicatif des modèles incluant uniquement les ratios de liquidités CAMELS pour expliquer la probabilité de défaut des banques. Dans le chapitre 3, nous étudions la relation entre l'excès de capital et la liquidité des banques. Nous examinons dans quelle mesure les banques maintiennent ou renforcent leur excès de capital lorsque qu'elles sont davantage exposées au risque de liquidité. Nos résultats mettent en évidence le besoin d'instaurer des exigences pour maintenir des ratios minimum de liquidité en plus de celles sur les ratios de capitaux, comme préconisé par le Comité de Bâle. Nos résultats suggèrent différentes questions relatives au besoin de mieux clarifier comment définir et mesurer l'illiquidité des banques et aussi comment considérer les très grandes banques qui se comportent différemment des plus petites.

Mots clés : [Banques, Risque Financiers, Régulation]