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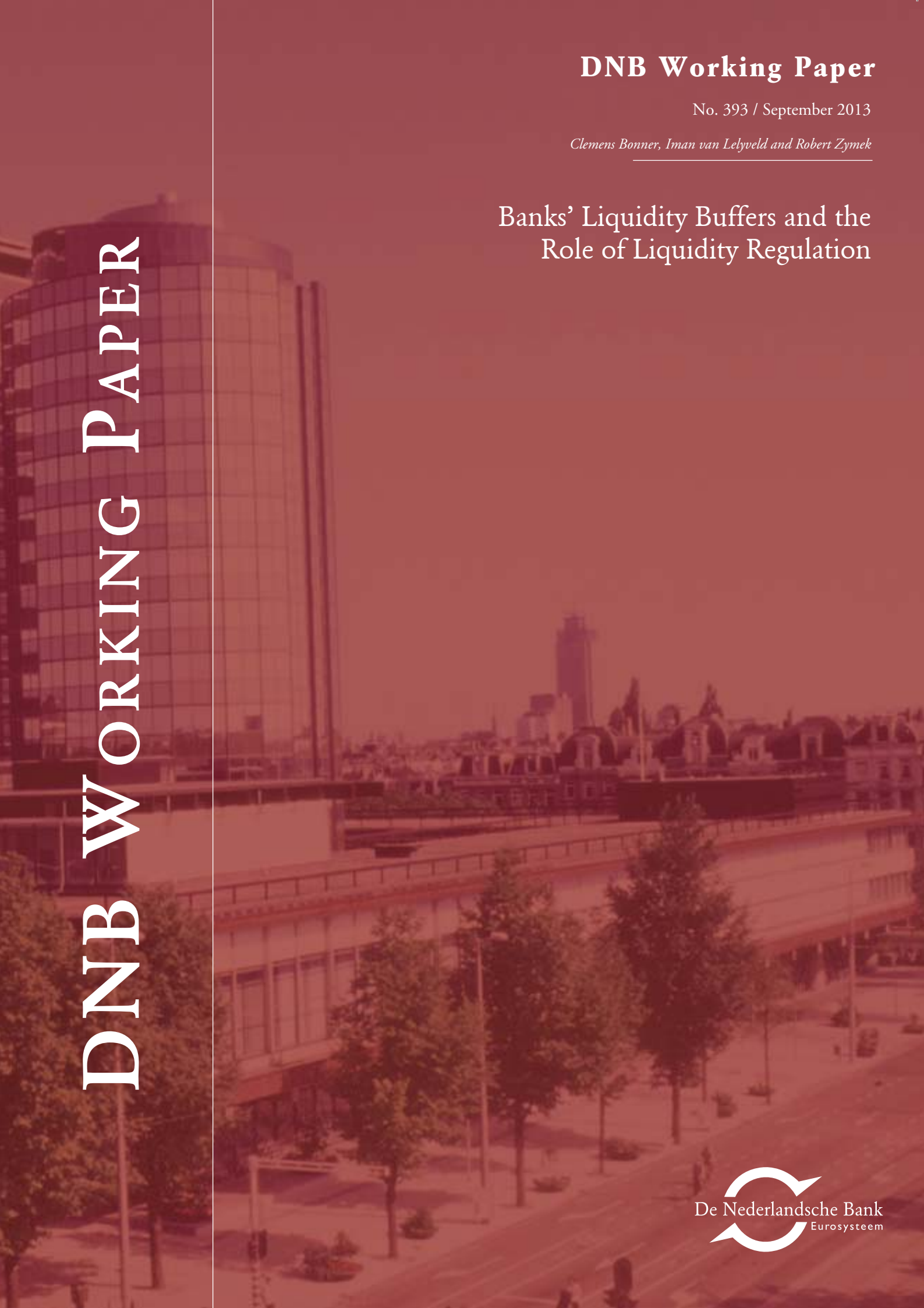

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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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Banks' Liquidity Buffers and the Role of Liquidity Regulation

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Abstract

We assess the determinants of banks' liquidity holdings using balance sheet data for nearly 7000 banks from 30 OECD countries over a ten-year period. We highlight the role of several bank-specific, institutional and policy variables in shaping banks' liquidity risk management. Our main question is whether the presence of liquidity regulation substitutes or complements banks' incentives to hold liquid assets. Our results reveal that in the absence of liquidity regulation, the determinants of banks' liquidity buffers are a combination of bank-specific (business model, profitability, deposit holdings, size) and country-specific (disclosure requirements, concentration of the banking sector) variables. While most incentives are substituted by liquidity regulation, a bank's disclosure requirement and size remain significant. A key takeaway from our analysis is that the complementary nature of disclosure and liquidity requirements provides a strong rationale for considering them jointly in the design of regulation.

Keywords: Liquidity, Regulation, Disclosure, Business Models
JEL classification: G20, G21, G28

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1. Introduction

Until recently, liquidity risk was not the main focus of banking regulators. The 2007-2009 crisis showed, however, how rapidly market conditions can change exposing severe liquidity risks in institutions, many times unrelated to capital levels. Now, there is wide agreement that insufficient liquidity buffers were a root cause of this crisis and the on-going disruptions of the world financial system, making the improvement of liquidity risk analysis and supervision a key issue for the years to come.[1]

Consequently, efforts are underway internationally as well as in individual countries to establish or reform (existing) liquidity risk frameworks, most notably by the Basel Committee for Banking Supervision (BCBS). The BCBS's new regulatory framework (henceforth Basel III) proposes a short- and long-term liquidity requirement to reinforce the resilience of banks to liquidity risks.[2] The Liquidity Coverage Ratio (LCR) is a short-term ratio requiring financial institutions to hold enough liquid assets to withstand a 30-day stress period. The second measure, the Net Stable Funding Ratio (NSFR) aims at improving banks' longer-term, structural funding. BCBS (2013) also requires institutions to disclose certain elements regarding their fulfilment of these minimum requirements. Recently the European Systemic Risk Board (ESRB) has recommended national supervisory agencies to intensify the supervision of liquidity and funding risks as well.[3]

Despite the impact of these initiatives, little research has been done to understand the fundamental determinants of banks' incentives to hold liquid assets and whether these determinants are affected by liquidity regulation. We attempt to fill this gap by providing, to the best of our knowledge, the first global analysis of the determinants of banks' liquid asset holdings across countries. At the very heart of our analysis lies the question whether the presence of liquidity regulation substitutes or complements banks' internal incentives to hold liquid assets.

Closest to our work are the papers by Aspachs et al. (2005) and Delechat et al. (2012). However, both studies use limited datasets, the former a panel of 57 UK-resident banks and the latter a sample of Central American banks, and focus solely on the determinants of banks' liquidity holdings rather than the additional impact of liquidity regulation.[4]

We collect yearly balance sheet data for nearly 7000 banks from 30 OECD

[1] See for example Brunnermeier (2009) and BCBS (2008).

[2] See BCBS (2010) and BCBS (2013).

[3] Please see ESRB (2013) for further information.

[4] Dinger (2009) and Gennaioli et al. (2013) are other recent study dealing with banks' liquidity holdings. The former analyzes the impact of transnational banks on system-wide liquidity risks while the latter analyzes the holdings of public bonds and the role of these bonds during sovereign debt crises.

countries over a ten-year period.[5] While we do control for bank-specific, macroeconomic and financial development factors, we are particularly interested in the impact of banks' business models, the strength of existing deposit insurance systems, the concentration of the banking sector and banks' disclosure practices. All four variables have recently received considerable attention from policymakers and academics in the context of reform proposals to strengthen the resilience of banks to liquidity risks.[6]

Our results reveal that without liquidity regulation, banks' liquidity buffers are determined by a combination of bank-specific (business model, profitability, deposit holdings, size) and country-specific (disclosure requirements, concentration of the banking sector) factors. The presence of liquidity regulation substitutes most of these factors, making them insignificant determinants of liquidity buffers. An institution's disclosure requirement and size, on the other hand, remain significant.

A key take away from our analysis is that when implementing the LCR as well as Pillar 2 liquidity frameworks in national legislation, policymakers need to take into account that the need for and the reaction to liquidity regulation differs across business models as well as jurisdictions and therefore care needs to be taken in tailoring the new liquidity requirements to fit the context in which they will take their effect.[7] Specifically, regulators should pay attention to disclosure requirements when specifying Pillar 2 liquidity frameworks as well as the accompanying guidelines to the Basel III liquidity rules. The complementarity of disclosure and liquidity requirements provides strong arguments for regulators to jointly harmonize disclosure and Basel III liquidity requirements across countries. The non-linear effect of size on liquidity holdings suggests that in the presence of a liquidity requirement, regulators seem to pay particular attention to the liquidity holdings of very large institutions. While this seems rational in itself, care needs to be taken not to run the risk of neglecting some institutions, which are, under certain circumstances, still large enough to pose a serious risk to the banking system as such.[8] A straightforward way to avoid this risk is to not just look at size when defining global systemically important banks (G-SIBs).

While our study delivers novel insights into banks' liquidity holdings, some

[5]Please note that we face the usual trade-off between broad country coverage and data granularity. While we decided in favor of broad country coverage, Bonner and Eijffinger (2012) and Bonner (2012) are examples of using more granular data.

[6]See BCBS (2013) for disclosure, Demirgüç-Kunt and Detragiache (2002) for deposit insurance coverage, BCBS (2011) as well as CRDIV (2012) for business models and Aspachs et al. (2005) for concentration.

[7]See for instance Bonner and Eijffinger (2012) or Bech and Keister (2012) who argue that jurisdictions which implement monetary policy using the overnight interest rate face different challenges when implementing the LCR than jurisdictions for which this is not the case.

[8]Lehman Brothers is a good example in this regard, as it was not amongst the largest while still being systemically important institution.

caveats need to be mentioned. First, data availability does not allow us to directly draw the link from banks' liquidity risk exposure to their risk bearing capacity. Our dependent variable measures banks' risk bearing capacity directly, while banks' business model, their profitability, deposit holdings and regulatory environment are only proxies of banks' risk profile and therefore potentially subject to a measurement bias. Second, our measure of liquidity holdings is very narrowly defined which induces the risk of omitting certain variables, such as highly liquid government securities. However, not all government securities are equally liquid which implies that including them could lead us to mismeasure liquidity buffers. Against this background, we are focussing on the variable *cash and due from banks*, which is, by definition, permanently liquid in all markets. Finally, when measuring the impact of liquidity regulation, we cannot distinguish between binding and non-binding liquidity requirements. Given, however, the large panel structure of our dataset we expect that national regulation is binding at some point for some banks.

The remainder of this paper is organized as follows: Section 2 provides the conceptual background of liquidity risk as well as its management and regulation. Section 3 presents our data, to be followed by our results in Section 4, while Section 5 concludes.

2. Conceptual Background

2.1. Market Liquidity vs Funding Liquidity

A first requirement to study banks' liquid buffers is to find an adequate definition of liquidity. The financial economics literature distinguishes between two concepts of liquidity: market liquidity and funding liquidity.[9]

Market liquidity describes a particular characteristic of an asset: a high degree of market liquidity implies the ability to offset or eliminate a position in a given asset at or close to the current market price. This feature of the asset may not be constant over time. An asset which is currently market liquid may not necessarily have been market liquid in the past, nor need it be continuously market liquid in the future. Factors such as market concentration or the prevalence and distribution of asymmetric information may affect the degree of market liquidity.

Funding liquidity describes a particular characteristic of a financial agent: it refers to its ability to meet obligations as they come due. Unlike market liquidity, funding liquidity is a binary concept. At any point in time, a financial institution is either funding liquid or not. Nevertheless, the two concepts are linked.[10] Suppose a bank only holds assets which are perfectly market-liquid. In this case the

[9] See Drehmann and Nikolaou (2009).

[10] Please see Brunnermeier (2009).

bank will also be funding liquid, as long as it is solvent. Market liquidity, however, may vary over time, and an institution's funding liquidity may thus change accordingly. Suppose a sufficiently large portion of the bank's assets suddenly become perfectly market illiquid, while the bank remains solvent. The bank will no longer be able to honor its short-term obligations and will become distressed. This is, in fact, a stylized description of the difficulties encountered by a large number of financial institutions when, in July 2007, the previously highly liquid market for mortgage-backed securities dried up.

For the purpose of this study, we require a measure of market-liquid assets held by banks to guarantee constant funding liquidity. Yet the example above highlights the difficulty of obtaining a measure that adequately accounts for the dynamic nature of market liquidity. To circumvent this problem, we focus only on those assets in banks' portfolios which - virtually by their definition - are permanently market-liquid: cash and due from banks.[11] We expect that this narrow definition of liquidity captures banks' qualitative choices about liquid buffers.

2.2. Liquidity Risk

Liquidity risk refers to the risk that a financial agent will (at some point) be unable to meet obligations at a reasonable cost as they come due. In other words, it reflects the probability that the agent will become funding illiquid during a given time period. Since banks' core business is to "borrow short and lend long" they are especially prone to liquidity risk. Banks manage the liquidity risk inherent in their balance sheets by maintaining a buffer of (permanently) market-liquid assets - such as cash or government securities - which anticipates their depositors' liquidity demands within the relevant timeframe. As pointed out by Diamond and Dybvig (1983), banks thus benefit from the ability to pool liquidity risk over a large group of depositors. It would be undesirable for banks to invest only in perfectly market-liquid assets at all times as this would effectively eliminate the pooling advantage banks have compared to the liquidity risk management that could be undertaken by their individual customers. Yet, it would be equally undesirable for banks not to invest in market-liquid assets at all, as this would burden depositors with excessive liquidity risks. In other words, the determination of a bank's optimal liquid buffer involves a trade off between self-insurance against liquidity risk and the returns from illiquid, higher-yielding assets. Baltensperger (1980) as well as Santomero (1984) for instance argue that the size of banks' liquidity buffers is determined by the opportunity costs to hold liquid assets. Similar arguments can be found in Agénor et al. (2004) who show, using ag-

[11] Cash in this regard refers to cash at hand (not deposited, i.e. at the central bank) while due from banks only includes non-interest bearing deposit accounts.

gregate data for Thailand, that banks' liquidity holdings are positively related to the volatility of the money market rate, which proxies the need for self-insurance.

Unfortunately, we cannot observe liquidity risk exposure and banks' investment opportunities directly. We can, however, observe banks' structure and operating environment as well as their realized liquid buffers (i.e., revealed preference). Based on the trade off described above, we can therefore hypothesize as to the manner in which different firm-specific and environmental aspects of a bank's business should affect its liquid buffer. In particular, any observed factor that would be expected to lower (raise) liquidity risk should reduce (increase) observed liquidity buffers.

2.3. Liquidity Regulation

The aim of quantitative liquidity requirements is to ensure that banks hold enough market-liquid assets to remain funding liquid over a pre-defined stress period. The LCR for instance is defined as follows:

$$LCR = \frac{High\ Quality\ Liquid\ Assets}{Net\ cash\ outflows\ within\ 30\ days} \geq 100\% \tag{1}$$

High Quality Liquid Assets (HQLA) are composed of Level 1 and Level 2 assets. Level 1 assets are considered to be highly market liquid and consist of cash, central bank reserves and debt securities issued or guaranteed by highly rated public authorities. Level 2 assets are of lower (but still high) market liquidity and therefore receive haircuts between 15% and 50%. Level 2 assets include highly rated non-financial corporate and covered bonds as well as certain types of securitizations.

Net cash outflows are aimed to capture institutions' liquidity needs over a 30-day stress period and are calculated as the difference between assumed drawdowns of liabilities (including off-balance sheet commitments) and contractual inflows. Maturing unsecured interbank loans for instance are assumed to run off with a factor of 100% while retail deposits are assumed to run off only with a factor between 5% and 10%.

In classifying certain assets as liquid and quantifying the liquidity risk of banks' liabilities, a liquidity requirement is likely to take away banks' decision on how to solve the trade-off between self-insurance against liquidity risk and the opportunity costs from holding liquid, lower-yielding assets.[12] As this solution might be different from the solution of the individual institution, liquidity

[12]Please note that in the time dimension, a non-binding liquidity requirement is likely to have similar effects as a binding requirement. A formal requirement expects banks to stay above a certain threshold at all times and hence, while a (at the time) non-binding requirement is unlikely to have a major impact, over a period of 10 years it is still likely to change banks' liquidity risk management.

regulation can either substitute or complement banks' internal incentives to hold liquid assets.

2.4. Key Variables - Contextual Determinants

With the the previous section's considerations in mind, we discuss below the likely impact of our four key contextual factors on banks' liquid assets holdings and how the role of these factors might change due to liquidity regulation.

2.4.1. Concentration

A higher degree of bank concentration implies greater systemic importance for each bank within the economy. This, in turn, increases the probability that any bank will receive public support, should it become distressed. In other words, it reduces the effective liquidity risk faced by each individual institution thanks to a larger (implicit) public guarantee. Consequently, we would expect a more concentrated banking sector to be associated with lower liquidity buffers. Repullo (2003) for instance shows that the strength of the financial safety net lowers the incentives for banks to hold liquid assets. Using a panel of 57 UK resident banks, Aspachs et al. (2005) confirm this result when arguing that the likelihood of receiving support by the Lender of Last Resort reduces banks' liquidity holdings.

Liquidity regulation might change the role of concentration in determining banks' liquidity buffers. Without liquidity regulation, institutions might hold too low liquidity buffers as the risk of becoming illiquid is compensated by the expectation of government support. Liquidity regulation forces institutions to hold prudent liquidity buffers which are likely to be higher than the buffers held by institutions that are considered to be too big to fail.

Hence, while concentration is, generally speaking, expected to have a negative impact on liquidity buffers, liquidity regulation is likely to substitute this effect, thus making it insignificant.

2.4.2. Disclosure

The banking literature frequently associates disclosure practices with market discipline. Greater transparency allows market participants to price institutional strategies more accurately and, thereby, deter socially excessive risk taking by financial institutions.[13] In a market environment characterized by low transparency, financial institutions may find it profitable to adopt riskier strategies off the back of uninformed customers or investors. By similar reasoning, we expect a bank, which is subject to low disclosure requirements to manage liquidity risk less prudently, thus reducing the size of its liquidity buffer.

With a liquidity requirement in place, the role of disclosure becomes more important. A quantitative liquidity requirement gives investors a clear indication

[13] See for instance Jordan et al. (2000) or Nier and Baumann (2006).

whether a bank's liquidity holdings are sufficient or not which is likely to make disclosure requirements a complement to liquidity regulation.

2.4.3. Business Models

The impact of liquidity regulation on different business models is widely discussed. CRDIV (2012) mandates the European Banking Authority (EBA) to monitor and evaluate the impact of the LCR on different business models and to draw conclusions regarding the treatment of business models when implementing the LCR.

Different banks hold different levels of liquid assets. These differences can be caused by actual differences of institutions' liquidity risk exposures but also by differences of banks' assessments thereof.[14] In light of this, we analyze whether the role of banks' business models for determining liquidity holdings changes due to liquidity regulation. Especially banks with business models that traditionally require lower holdings of liquidity and systemically more important institutions are expected to increase their liquidity holdings when liquidity regulation is in place.

2.4.4. Deposit Insurance

Using the framework outlined above, we would expect the reliability and coverage of the deposit insurance system to lower banks' liquidity risk exposure and, hence, their liquidity buffers. Ceteris paribus, increasing deposit insurance coverage should reduce the likelihood of bank runs, an extreme form of liquidity shock. On the other hand, deposit insurance schemes in most jurisdictions are (at least partially) funded by the banking sector. Such a funding structure is likely to exert market discipline as the individual institutions have more incentives to conduct peer monitoring. Hence, independent of liquidity regulation, the net effect of deposit insurance is an empirical question: It either lowers liquidity buffers as it reduces liquidity risks or it increases liquidity buffers due to increased market discipline. The presence of liquidity regulation is likely to substitute the role of deposit insurance coverage, thus reducing its significance.

2.4.5. Additional bank-specific, macroeconomic and financial development variables

Along with our "contextual" factors, we consider several bank-specific, macroeconomic and financial development variables important determinants for banks' liquidity buffers, mainly as control variables.

Using a large panel of US banks, Kashyap et al. (2002) find a significant effect of bank size on liquid asset holdings. While Delechat et al. (2012) obtain

[14] See for instance Holmström and Tirole (1998), Kiyotaki and Moore (2008), Almeida et al. (2004), Kashyap et al. (2002) or Rochet and Vives (2004).

similar results, Aspachs et al. (2005) do not find a significant effect of size on banks' holdings of liquid assets. A bank's size can have a negative effect on liquidity holdings given that large banks can be expected to have less volatile cash flows (due to offsetting flows) and better access to different funding sources. On the other hand, given their special role in the economy, large banks might be particularly prone to peer and supervisory monitoring. Delechat et al. (2012) find a positive impact of profitability on banks' liquid asset holdings while Aspachs et al. (2005) do not find any significant impact of banks' profits. Delechat et al. (2012) argue that it is easier for more profitable banks to fund themselves if needed which makes them less liquidity constrained, thus reducing the incentives to hold liquid assets. A similar result is likely to hold for capital, as more solvent banks can be expected to have market access (at least to a point) even during stress.

Banks face a trade-off between self-insurance against liquidity risks and opportunity costs of holding liquid assets. The macroeconomic situation can help explaining how this trade-off is solved. Delechat et al. (2012) for instance discuss the cyclical behavior of liquidity demand. The authors argue that liquidity buffers should be negatively related to real GDP growth, credit cycle and policy interest rates. Such counter-cyclicality would limit the effectiveness of monetary policy: if central banks inject liquidity to stimulate the economy, liquidity buffers would increase but credit would not necessarily pick up. This discussion is in line with Aspachs et al. (2005) who find that liquidity buffers are negatively related to GDP growth and the policy rate. Similarly, Agénor et al. (2004) find that excess reserves are negatively related to the output gap. The stronger the presence of capital market frictions, the stronger the counter-cyclicality of liquidity buffers. Thus, Delechat et al. (2012) find that financial development and the quality of institutions have a significant effect on banks' holdings of liquidity. A further argument for the importance of financial development for liquidity buffers can be found in Almeida et al. (2004) who show that financially constrained firms have a higher propensity to save cash. Hence, one could argue that lower levels of financial development imposes financial constraints on banks, which presumably increases banks' liquidity holdings.

2.5. Institutional Liquidity Risk versus Systemic Risk

It should be noted that there is no direct mapping between our findings concerning banks' individual liquidity management and economy-wide financial risk. In particular, the observation that "variable x reduces banks' liquidity buffers" should not be taken as synonymous with "variable x increases aggregate liquidity risk". Indeed, a bank's choice to reduce the size of its liquidity holdings may be an *individually* optimal response to a *reduction* in economy-wide liquidity risk, proxied by a variable such as the coverage of deposit insurance. The net

effect of both on the aggregate risk in the domestic financial system may be positive or negative. This individually rational behavior, in turn, may not be socially optimal. An empirical characterization of the deviation of banks' liquidity management from the social optimum, however, is beyond the scope of this paper. We focus exclusively on documenting the ways in which banks respond to features of their business and policy environment. Our study nevertheless serves an important purpose: it highlights the variety of factors that influence banks' liquidity risk management and emphasizes the need to account properly for banks' institutional environment when attempting to determine the adequacy of liquidity buffers and when implementing liquidity regulation in national law.

3. The Data

3.1. Data Sources and Variable Construction

We use bank-specific, annual balance sheet data for all reporting banks from Bureau van Dijk's *BankScope* database in current local-currency units for the period from 1998 until 2007 for 30 OECD countries. We choose the start and end date of the sample so as to capture the period between the implementation of the Basel agreement in 1998 and the global financial crisis which started in mid-2007. By considering this period, we reduce the risk of unobserved underlying heterogeneity in domestic banking regulation across OECD countries, which was harmonized by Basel I, while being able to analyze banks' liquidity management in "normal" times.[15]

We checked the data for errors, inconsistencies and changes in definitions and converted values into constant (2005) US dollars, using the appropriate exchange rates and the US GDP Deflator. We only retain banks for which we can obtain at least 5 bank-year observations, guaranteeing sufficient intra-institutional variation. Wherever possible, we use data recorded under the IFRS accounting standard.[16] Figure 1 (a) shows the geographic location of our observations. The majority of banks are located in the US, followed by Germany and France. To limit the dependence of our results on any particular country, however, we only consider the 600 largest institutions of each country.

Our dependent variable, capturing banks' liquidity holdings, is the share of cash and due from banks relative to total assets. Cash is defined as cash at hand while due from banks only includes non-interest bearing deposit accounts. An

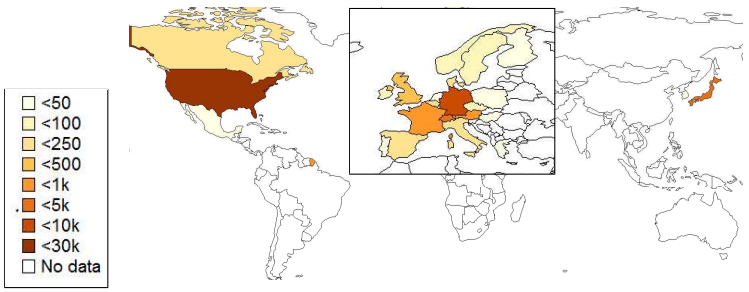
[15] While there are certainly arguments in favour of incorporating the recent crisis period, we specifically decided against it. We are particularly interested in banks' incentives to hold liquid assets during normal times as insurance against crises. Additionally taking into account a crisis period would weaken the explanatory power of our results as the "clean" incentive effect would be distorted by crisis related factors (eg actual government interventions).

[16] Please note that all findings reported below are robust to using the alternative Local GAAP accounting standard where possible.

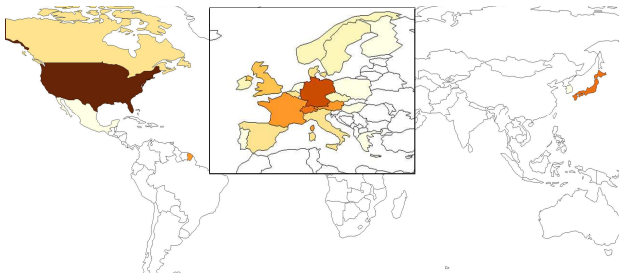
alternative measure of liquidity employed in the literature is the ratio of liquid assets to total deposits.[17] We use the second ratio as robustness check and show that our findings do not depend on the liquidity metric chosen. Figure 1 (b) shows that countries have distinctly different levels of liquidity. We will analyse these levels in more detail in Figure 2 below.

Figure 1: Various descriptives

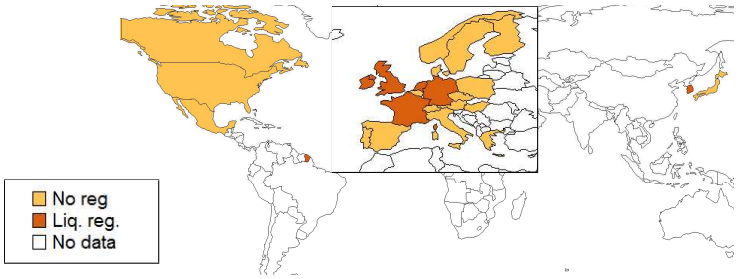
(a) Number of observations



(b) Average liquidity



(c) Liquidity regulation



Panel (a) shows the simple sum of all bank-year observations used in the first regression in Table 1. Panel (b) shows the simple average of liquidity. Panel (c) shows the countries with (without) regulation in dark (light) orange.

Our contextual factors are collected by the World Bank and the International Monetary Fund (IMF) – combining quantitative and (survey-based) qualitative data. Deposit insurance coverage is measured as the ratio of state-underwritten deposits to average savings.[18] Bank concentration is measured as the share of the three largest banks' assets in economy-wide bank assets for each country, based on Beck et al. (2006). An index of bank disclosure requirements is provided by the World Bank, and discussed in Huang (2006).

[17] See Aspachs et al. (2005) or Delechat et al. (2012).

[18] The variable's source is the World Bank's *World Development Indicators* (WDI). See also Demirgüç-Kunt et al. (2005).

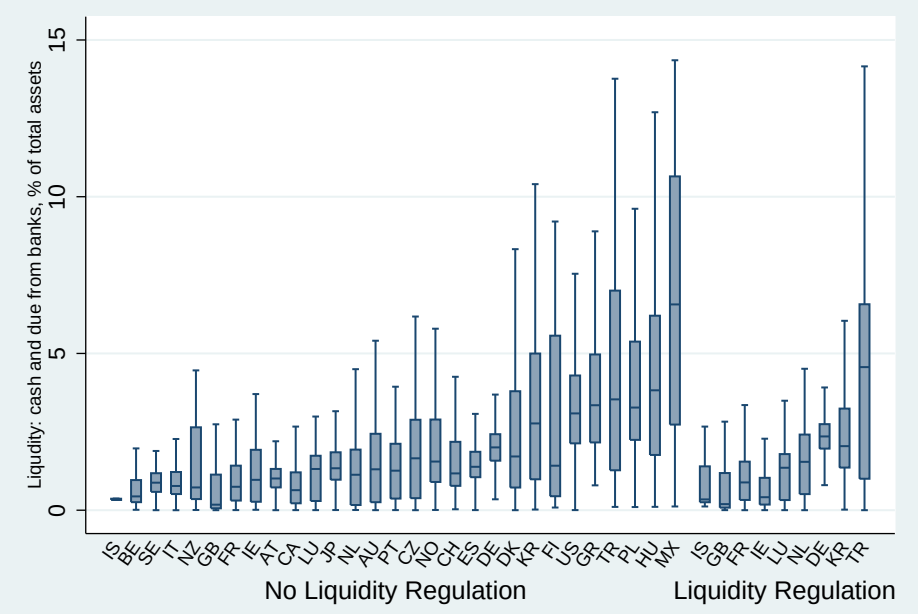
Information on country-specific regulatory liquidity requirements is taken from the World Bank's *Bank Regulation and Supervision* database, described in depth in Barth et al. (2008). Based on this survey, we calculate a dummy variable which is 1 in case a quantitative regulatory liquidity requirement is in place and 0 otherwise. Qualitative liquidity requirements or average reserve requirements do not qualify as liquidity regulation.[19] Figure 1 (c) shows which countries do and do not have liquidity regulation.

Additional control variables, capturing macroeconomic conditions as well as domestic financial development, are obtained from the WDI and the IMF's *International Financial Statistics*.[20]

3.2. A First Look at the Data

Figure 2 illustrates the difference between the distribution of liquidity holdings (pooled over time) in different OECD countries through a cross-country comparison of Box-Whisker diagrams, of our baseline liquidity measure. The average liquidity buffer in our sample is 1.98% of total assets.

Figure 2: Cross-Country Distribution of Liquidity, 1998-2007



As the figure shows, country means and distributions vary substantially. Notably, a liquidity requirement does not automatically imply higher liquidity buffers while it does seem to be associated with a more condensed distribution of

[19] Given that some of the classifications might be arbitrary, we also use an alternative measure of liquidity regulation, based on the answers to a survey circulated in the BCBS Working Group on Liquidity (WGL). The results are qualitatively similar.

[20] These variables include GDP growth, inflation, short- and long-term interest rates, stock market capitalization, government debt and financial openness.

liquidity and higher median holdings. Banks in countries with liquidity regulation have average (median) liquidity holdings of 2.11% (2.05%) while the average (median) liquidity buffer for banks in jurisdictions without a liquidity requirement amounts to 2.39% (1.82%).

On top of that, banks operating in countries with smaller financial sectors or less used currencies, like for instance Denmark or Mexico, seem to have larger liquidity buffers and larger variations across banks. This observation is consistent with the discussion in Section 2. Banks in smaller financial markets face higher individual liquidity risks because there are fewer options for cross-institutional risk sharing through interbank markets, and smaller stockmarkets imply more financial volatility. Moreover, if financial frictions are pervasive, this lowers returns from alternative, less liquid investments in the domestic economy. In this case, the opportunity costs of holding liquidity buffers are lower.

4. Results

4.1. The Model

Our baseline regression takes the form:

$$Liquidity_{bct} = \alpha + \beta_1 Bank_{bct} + \beta_2 Context_{ct} + \beta_3 Macro_{ct} + \beta_4 FinDep_{ct} + \varepsilon_{bt} \qquad (2)$$

where $Liquidity_{bct}$ measures the liquidity buffer of bank b in country c and year t. $Bank_{bct}$ is a set of b(ank)-, c(ountry)- and t(ime)-varying controls which include dummies for different business models, the bank's (relative) size, capital and profitability as well as the share of its total deposits in total assets. $Context_{ct}$, $Macro_{ct}$ and $FinDep_{ct}$ control for c(ountry)- and t(ime)-varying aspects of the policy environment, current macroeconomic conditions as well as the level of financial development respectively. Finally, ε_{bt} is a b(ank)-clustered error term which allows us, in combination with the included year and country dummies, to estimate our model with pooled OLS without being exposed to the usual shortcomings. While we are mainly interested in the time-dimension, we need to capture some cross-bank and -country variation to fully account for the impact of our *Context* variables.

4.2. Findings

Table 1 shows that all bank-specific and contextual variables have an economically and statistically significant impact on banks' liquidity holdings. Most of these factors, however, are substituted by liquidity regulation. Only *Disclosure* acts as complement to a liquidity requirement, thus remaining significant in presence of regulation.

Column 3 shows that on average *Cooperative* (-0.24%), *Mortgage* (-1.95%) and *Savings* (-0.91%) banks hold lower liquidity buffers than their peers. Given

Table 1: Banks' Liquidity Holdings under different regulatory Regimes

	All			No Regulation			Regulation		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Cooperative Bank	-0.22***	-0.22***	-0.24***	-0.45***	-0.45***	-0.49***	0.14	0.15	0.21*
	(0.08)	(0.08)	(0.08)	(0.15)	(0.15)	(0.15)	(0.12)	(0.12)	(0.12)
Cooperative*Size		0.14	0.39		0.56	1.99		-0.03	-1.88*
		(0.38)	(0.93)		(1.30)	(2.50)		(0.28)	(1.03)
Cooperative*Size^2			-0.11			-0.96			0.71*
			(0.36)			(2.21)			(0.36)
Investment Bank	-0.42	-0.51	-0.32	-0.74**	-0.37	-0.23	0.83	0.80	1.16
	(0.35)	(0.39)	(0.45)	(0.37)	(0.50)	(0.62)	(0.79)	(0.91)	(1.03)
Investment*Size		1.03	-2.62		-7.31*	-14.30		0.18	-5.27
		(0.85)	(2.70)		(3.84)	(10.68)		(0.92)	(3.46)
Investment*Size^2			2.71*			35.65			3.37**
			(1.49)			(33.04)			(1.71)
Mortgage Bank	-1.77***	-1.79***	-1.95***	-0.88***	-0.64	-0.48	-1.36***	-1.38***	-1.46***
	(0.15)	(0.16)	(0.18)	(0.31)	(0.44)	(0.57)	(0.22)	(0.22)	(0.24)
Mortgage*Size		0.80	10.16***		-13.32	-38.73		0.70	4.63
		(1.26)	(3.09)		(13.01)	(38.24)		(0.56)	(3.17)
Mortgage*Size^2			-12.79***			427.18			-5.87
			(3.88)			(475.52)			(4.12)
Savings Bank	-0.88***	-0.89***	-0.91***	-1.07***	-1.11***	-1.18***	-0.16	-0.15	-0.02
	(0.08)	(0.08)	(0.09)	(0.11)	(0.11)	(0.12)	(0.12)	(0.13)	(0.14)
Savings*Size		0.68	0.26		4.87**	14.27***		-0.40	-9.09**
		(0.59)	(1.60)		(2.08)	(2.83)		(0.88)	(4.48)
Savings*Size^2			1.22			-27.10***			7.70**
			(1.30)			(6.29)			(3.49)
Size	0.04	-0.01	-1.18***	-0.06	-0.10	-1.30*	-0.17	-0.17	-0.03
	(0.28)	(0.33)	(0.40)	(0.45)	(0.47)	(0.71)	(0.16)	(0.19)	(0.66)
Size^2			0.50**			0.56			-0.06
			(0.21)			(0.42)			(0.22)
Profit	0.26***	0.26***	0.25***	0.31***	0.30***	0.30***	0.09	0.09	0.09
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)	(0.08)	(0.08)	(0.08)
Capital ratio (%)	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.01	-0.01	-0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Deposits	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Disclosure	0.06***	0.06***	0.06***	-0.01	-0.01	-0.00	0.08***	0.08***	0.08***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.03)	(0.03)
Concentration	-0.01***	-0.01***	-0.01***	-0.01***	-0.01***	-0.01***	-0.00	-0.00	-0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
DGS	-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)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Year, Macro and Fin. Dep. dummies as well as the lagged dependent included for all regressions									
Constant	-5.15***	-5.21***	-4.99***	1.60	1.49	1.45	-7.17***	-7.16***	-7.22***
	(0.60)	(0.60)	(0.60)	(1.06)	(1.08)	(1.09)	(1.67)	(1.68)	(1.68)
Observations	20160	20160	20160	10360	10360	10360	6486	6486	6486
R^2	0.256	0.257	0.260	0.286	0.288	0.291	0.263	0.263	0.270

Note: The table shows pooled OLS estimations with robust standard errors. The dependent variable is reflected by banks' cash and due from banks as percentage of total assets (TA). The regression includes business model dummies while Size and Size2 are reflected by TA and TA squared over GDP. Profit is profits over TA while Capitalratio is reflected by equity as percentage of TA. Deposits is defined as total retail deposits over TA. Disclosure is an index describing countries' disclosure requirements while Concentration is measured as the share of the three largest banks' assets in economy-wide bank assets. DGS is measured as the ratio of state-underwritten deposits to average savings.

the relatively low mean (1.98%) and standard deviation (1.48) of our liquidity variable, all these effects are economically significant. The rationale behind these results is straightforward. The higher a bank's liquidity risk exposure, the larger is the incentive to hold liquid assets. Given the relatively high income volatility and uncertainty about future cashflows, *InvestmentBanks* can be expected to hold more liquid assets than for instance *MortgageBanks* with relatively stable and predictable cashflows.[21] In the absence of liquidity regulation, size only plays a role for *MortgageBanks* while suggesting a non-linear relationship between the interaction of a bank's business model and size with its liquidity holdings.

An increase of *Profit* and *Deposits* from the 25th to the 75th percentile (henceforth "increase") increases liquidity holdings by 0.18% and 0.25%, respectively. Thus, while an institution's *Capitalratio* has no effect on the size of its liquidity buffer, its *Deposits* from clients have a large impact. The positive effect of *Deposits* is also found by de Haan and van den End (2013) and is likely attributable to a lack of funding diversification. Banks with large amounts of *Deposits* are very concentrated in a single funding source and therefore specifically prone to liquidity risks.[22]

Our results with respect to *Size* and $Size^2$ point towards a non-linear relationship between size and banks' liquidity buffers, suggesting that intermediate institutions hold less liquid assets while the largest institutions have larger liquidity buffers. A likely explanation for this result is that systemically important banks are subject to more peer and supervisory monitoring. In line with theory, *Disclosure* increases liquidity holdings while *Concentration* reduces banks' incentives to hold liquid assets. An increase of *Disclosure* increases liquidity holdings by 0.25% while an increase of *Concentration* is associated with a reduction of liquidity holdings by 0.40%.

The presence of liquidity regulation reduces the economic and statistical significance of several factors. Splitting our sample with respect to the presence of liquidity regulation (columns 4 to 9) shows that regulatory requirements fundamentally change or substitute the determinants of banks' liquid asset holdings. While most factors are substituted by a liquidity regulation, our results suggest that *Disclosure* and a bank's size remain important in the presence of liquidity regulation.[23]

Our results suggest that the presence of liquidity regulation changes the liquidity holdings of several business models. Most of these changes are driven

[21] Note, once again, that a bank's business model is only a proxy for its liquidity risk exposure.

[22] Please note that this argument holds despite the fact that retail deposits are considered to be the most stable source of funding.

[23] Please note that although *Size* and $Size^2$ turn insignificant, size remains an important determinant in interaction with banks' business models.

by a non-linear impact of liquidity regulation on large institutions. While the interaction with *Size* suggests a negative relationship between *Cooperative* and *SavingsBanks* with liquidity holdings, the interaction with $Size^2$ points to a positive relationship. This non-linear impact suggests that regulators pay particular attention to the liquidity holdings of the largest institutions. Although this approach seems rational in itself, care needs to be taken not to lose track of other risky and interconnected institutions. *Profit*, *Deposits* and *Concentration* have a significant impact on liquidity holdings in the absence of liquidity regulation but not in presence thereof. *Disclosure*, on the other hand, becomes more important under a liquidity requirement. The intuition behind this result is that in the absence of liquidity regulation it is difficult for market participants, especially retail clients, to observe an institutions' liquidity risk. However, with liquidity regulation and strict disclosure requirements in place, market participants have a very clear view on institutions' risks, which presumably increases their buffers. Intuitively, *Disclosure* can be viewed as a complement to liquidity regulation while the role of most other factors is substituted by a liquidity requirement.

Summarizing, our results show that without liquidity regulation, a combination of bank-specific (business model, profitability, deposit holdings, size) and country-specific (disclosure requirements and concentration of the banking sector) variables determine the size of banks' liquidity buffers. The presence of liquidity regulation, however, substitutes most of these bank- and country-specific factors. An institution's size and disclosure requirements, on the other hand, remain significant. While the former is likely caused by increased supervisory attention, *Disclosure* can be seen as a complement to a quantitative liquidity requirement.

4.3. Robustness Checks

In this section we provide a number of robustness checks for our baseline regression results (Tables A.2 through A.4). In particular, we 1) use a different measure for liquidity regulation; 2) exploit the panel structure of our dataset; 3) assess the robustness of our coefficients to the use of appropriate instruments for potential endogenous variables, and 4) use another measure for banks' risk bearing capacity.

First, given that our liquidity regulation variable is based on a survey, some of the answers might be noisy due to different interpretations of the questions. In order to check the robustness of our results in this respect, we use the results of another survey as basis for our assessment of liquidity regulation. This survey was circulated in the BCBS' Working Group on Liquidity (WGL) in 2007 and asked banking supervisors to describe their current liquidity supervision while specifically distinguishing between qualitative and quantitative requirements. The results in Table A.2 show that our baseline results are robust to using another

measure for liquidity regulation. While there are some differences with respect to economic and statistical significance, the pattern of the impact of liquidity regulation is consistent across all specifications.

Second, we exploit the panel structure of our data to control for unobserved country heterogeneity using random effects estimators.[24] The random effects model results in coefficients which are not materially different from our baseline regression.

While it is unlikely that our business model and contextual variables include an endogeneity bias, one could argue that a bank jointly determines its liquidity holdings with *Profit*, *Capital* and *Deposits*. To address these concerns, we instead included the lags of these variables in our regressions. While the lagged values show somewhat different results, with *Profit* being less important and *Capital* gaining a bit significance, our overall results are robust to replace all bank-specific variables with their lags.

Finally, we use a different measure for banks' liquidity holdings, namely cash and due from banks over total deposits instead of total assets. Our results are robust to this change of our dependent variable.

4.4. Shortcomings

Although we conducted several robustness checks, some caveats are in order. First, our liquidity variable only includes cash and due from other banks and is therefore very narrowly defined. One could think of additionally including government bonds which are considered to be very liquid and would strengthen the link to the LCR. However, government bonds in different countries are not equally liquid. To avoid that our analysis is driven by products which are highly liquid in one market while being less liquid in another market, we are focussing on cash and due from banks, which are, by definition, permanently liquid in all markets.

Second, we are mainly interested in the relationship between a bank's liquidity risk exposure and its liquidity risk bearing capacity. While we are able to obtain data for the second, our measures of business model, profitability, deposit holdings and regulatory environment are only proxies for banks' actual liquidity risk exposure and thus subject to measurement error. However, the purpose of this study is to analyze the impact of banks' policy environment on their liquidity holdings and therefore, by definition, we need to use these proxies.

Third, when measuring the impact of liquidity regulation, we cannot distinguish between binding and non-binding liquidity requirements. However, over time, a non-binding liquidity requirement is likely to have similar effects as a

[24] Please note that we do not run a fixed effects panel estimation given that all our regressions include robust bank-clustered standard errors.

strictly binding requirement. A formal requirement expects banks to stay above a certain threshold at all times. Hence, while a (at the time) non-binding requirement is unlikely to have a major impact (at the time), over a period of 10 years it will change the behavior of some banks at some point in time. Having said this, our analysis is likely to capture the impact of all liquidity requirements at some point while potentially overestimating the impact of non-binding requirements while understating the impact of binding ones.

Finally, we cannot distinguish between purely local and more globally active banks.[25] Given that we are mainly interested in the impact of the institutional environment of an institution such a distinction would enrich our analysis. At the same time, however, even global banks are likely to be mainly influenced by the regulation in their home country and again, given this drawback, our results rather understate the impact of our contextual variables.

5. Conclusions

In this paper, we undertake a global analysis of the determinants of banks' liquid asset holdings and the role of liquidity regulation. In doing so, we highlight the role of several bank-specific and institutional variables, so-called "contextual factors", in shaping banks' liquidity risk management. Our main purpose is to analyze whether the presence of liquidity regulation substitutes or complements banks' incentives to hold liquid assets.

Our results reveal that without liquidity regulation, banks' liquidity buffers are determined by a combination of bank-specific (business model, profitability, deposit holdings, size) and country-specific (disclosure requirements, concentration of the banking sector) factors. As most factors turn insignificant with a liquidity requirement in place, we conclude that regulation substitutes most incentives to hold liquid assets. A bank's disclosure requirement, however, is likely to complement liquidity regulation, thus remaining significant in the presence thereof. Our results further suggest that liquidity regulation leads to a non-linear relationship between size and banks' liquidity holdings, with the very largest institutions holding more liquidity.

A key takeaway from our analysis is that the complementary features of disclosure and liquidity requirements provide strong incentives for regulators to jointly harmonize disclosure and Basel III liquidity requirements across countries. Our results with respect to size point towards the general tendency of overstating the impact of institution's size on their contribution to systemic risk. While size needs to play a role in these considerations, care needs to be taken to

[25] See de Haas and van Lelyveld (2010, 2013) and the literature cited therein for an analysis of how local and global shocks affect internationally active banks.

not understate the systemic importance of certain intermediate institutions when defining global systemically important banks (G-SIBs).

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Table A.1: Summary statistics

Variable		N	Mean	Median	sd	Min	Max
Liquidity	All	21867	2.26	1.96	1.76	0.00	14.80
	No Regulation	11471	2.39	1.82	1.94	0.00	14.79
	Liquidity Regulation	10396	2.11	2.05	1.52	0.00	14.80
Cooperative Bank	All	21867	0.40	0.00	0.49	0.00	1.00
	No Regulation	11471	0.27	0.00	0.44	0.00	1.00
	Liquidity Regulation	10396	0.54	1.00	0.50	0.00	1.00
Investment Bank	All	21867	0.01	0.00	0.10	0.00	1.00
	No Regulation	11471	0.01	0.00	0.12	0.00	1.00
	Liquidity Regulation	10396	0.01	0.00	0.08	0.00	1.00
Mortgage Bank	All	21867	0.02	0.00	0.14	0.00	1.00
	No Regulation	11471	0.01	0.00	0.08	0.00	1.00
	Liquidity Regulation	10396	0.03	0.00	0.18	0.00	1.00
Savings Bank	All	21867	0.15	0.00	0.36	0.00	1.00
	No Regulation	11471	0.17	0.00	0.37	0.00	1.00
	Liquidity Regulation	10396	0.14	0.00	0.35	0.00	1.00
Size	All	21867	0.03	0.00	0.16	0.00	5.15
	No Regulation	11471	0.02	0.00	0.13	0.00	4.52
	Liquidity Regulation	10396	0.03	0.00	0.19	0.00	5.15
Profit	All	21867	0.56	0.37	0.66	-2.33	3.92
	No Regulation	11471	0.68	0.56	0.74	-2.33	3.92
	Liquidity Regulation	10396	0.43	0.29	0.54	-2.31	3.79
Deposits	All	21867	83.12	86.95	12.28	15.12	96.11
	No Regulation	11471	81.84	85.25	12.50	15.12	96.11
	Liquidity Regulation	10396	84.53	88.46	11.86	15.18	96.08
Disclosure	All	21867	76.15	76.00	4.78	61.00	90.00
	No Regulation	11471	78.54	78.00	3.86	65.00	90.00
	Liquidity Regulation	10396	73.52	74.00	4.29	61.00	90.00
Concentration	All	21867	52.15	55.76	21.24	21.16	100.00
	No Regulation	11471	46.68	37.10	23.38	21.16	100.00
	Liquidity Regulation	10396	58.19	66.49	16.63	21.38	100.00
DGS	All	21867	190.71	110.98	951.55	36.83	39782.31
	No Regulation	11471	243.82	239.12	1308.65	45.39	39782.31
	Liquidity Regulation	10396	132.12	79.82	91.64	36.83	777.54

Table A.2: Banks' Liquidity Holdings under different regulatory Regimes: WGL measure

	All			No Regulation			Regulation		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Cooperative Bank	-0.22***	-0.22***	-0.24***	-0.29**	-0.27*	-0.28**	-0.12	-0.11	-0.09
	(0.08)	(0.08)	(0.08)	(0.14)	(0.14)	(0.14)	(0.11)	(0.11)	(0.12)
Cooperative*Size		0.14	0.39		-0.62	-1.48		-0.32	-0.87
		(0.38)	(0.93)		(0.82)	(1.06)		(0.38)	(1.14)
Cooperative*Size^2			-0.11			1.75**			0.19
			(0.36)			(0.76)			(0.50)
Investment Bank	-0.42	-0.51	-0.32	-0.65*	-0.28	-0.05	0.60	0.58	0.91
	(0.35)	(0.39)	(0.45)	(0.38)	(0.53)	(0.70)	(0.63)	(0.73)	(0.83)
Investment*Size		1.03	-2.62		-5.90	-14.31		0.11	-4.92*
		(0.85)	(2.70)		(3.92)	(10.77)		(0.97)	(2.92)
Investment*Size^2			2.71*			37.47			3.31**
			(1.49)			(31.67)			(1.47)
Mortgage Bank	-1.77***	-1.79***	-1.95***	-0.04	0.89	1.82***	-1.23***	-1.24***	-1.33***
	(0.15)	(0.16)	(0.18)	(0.60)	(0.62)	(0.54)	(0.22)	(0.23)	(0.23)
Mortgage*Size		0.80	10.16***		-56.17***	-203.55***		0.73	6.35**
		(1.26)	(3.09)		(18.57)	(39.87)		(0.76)	(3.18)
Mortgage*Size^2			-12.79***			2,978.41***			-7.77*
			(3.88)			(683.11)			(3.99)
Savings Bank	-0.88***	-0.89***	-0.91***	-1.10***	-1.11***	-1.16***	-0.53***	-0.53***	-0.49***
	(0.08)	(0.08)	(0.09)	(0.10)	(0.10)	(0.11)	(0.12)	(0.12)	(0.13)
Savings*Size		0.68	0.26		1.88	6.91***		-0.08	-3.87
		(0.59)	(1.60)		(1.15)	(1.95)		(0.65)	(3.22)
Savings*Size^2			1.22			-7.55***			3.72
			(1.30)			(2.27)			(2.47)
Size	0.04	-0.01	-1.18***	0.05	0.06	-0.88*	0.29	0.36	-0.19
	(0.28)	(0.33)	(0.40)	(0.35)	(0.37)	(0.51)	(0.27)	(0.35)	(0.78)
Size^2			0.50**			0.37*			0.23
			(0.21)			(0.20)			(0.40)
Profit	0.26***	0.26***	0.25***	0.22***	0.22***	0.22***	0.17**	0.17**	0.17**
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.09)	(0.09)	(0.09)
Capital ratio (%)	0.00	0.00	-0.00	-0.00	-0.00	-0.00	0.01	0.01	0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
Deposits	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***	0.01***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Disclosure	0.06***	0.06***	0.06***	-0.03***	-0.03***	-0.03***	0.06**	0.06**	0.06**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.03)	(0.03)
Concentration	-0.01***	-0.01***	-0.01***	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
DGS	-0.00	-0.00	-0.00	0.01***	0.01***	0.01***	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Year, Macro and Fin. Dep. dummies as well as the lagged dependent included for all regressions									
Constant	-5.15***	-5.21***	-4.99***	1.93*	1.73*	1.63	-3.60**	-3.54**	-3.62**
	(0.60)	(0.60)	(0.60)	(1.00)	(1.02)	(1.04)	(1.74)	(1.74)	(1.77)
Observations	20160	20160	20160	10399	10399	10399	7970	7970	7970
R^2	0.256	0.257	0.260	0.327	0.328	0.330	0.253	0.253	0.257

Note: The table shows pooled OLS estimations with robust standard errors. The dependent variable is reflected by banks' by cash and due from banks as percentage of total assets (TA). The regression includes business model dummies while Size and Size2 are reflected by TA and TA squared over GDP. Profit is profits over TA while Capitalratio is reflected by equity as percentage of TA. Deposits is defined as total retail deposits over TA. Disclosure is an index describing countries' disclosure requirements while Concentration is measured as the share of the three largest banks' assets in economy-wide bank assets. DGS is measured as the ratio of state-underwritten deposits to average savings.

Table A.3: Random effects including clustered bank effects

	All			No Regulation			Regulation		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Cooperative Bank	-0.17	-0.16	-0.11	-0.16	-0.13	-0.10	0.27*	0.50***	0.61***
	(0.11)	(0.11)	(0.12)	(0.22)	(0.22)	(0.22)	(0.17)	(0.18)	(0.20)
Cooperative*Size		-2.13	-13.76***		1.49	-5.18		-21.46**	-38.45*
		(2.29)	(4.93)		(2.40)	(6.75)		(8.31)	(23.30)
Cooperative*Size^2			63.67***			54.23**			202.38
			(21.93)			(27.03)			(361.78)
Investment Bank	-0.32	-0.53*	-0.34	-0.74***	-1.06***	-1.36***	-0.23	-2.52*	7.70
	(0.36)	(0.31)	(0.65)	(0.24)	(0.23)	(0.33)	(0.47)	(1.53)	(18.28)
Investment*Size		1.63	-13.80		20.15**	58.74			
		(1.73)	(28.76)		(7.94)	(36.09)			
Investment*Size^2			31.38			-899.81			
			(54.92)			(732.65)			
Mortgage Bank	-1.84***	-1.84***	-1.95***	-1.61	-2.88*	0.73	-1.40***	-1.31***	-1.37***
	(0.28)	(0.29)	(0.34)	(1.00)	(1.59)	(4.62)	(0.44)	(0.42)	(0.41)
Mortgage*Size		-0.57	7.17		409.64*	-2,109.36		-4.37	-5.15
		(1.66)	(16.12)		(218.11)	(3,984.30)		(3.11)	(17.65)
Mortgage*Size^2			-4.71			363k.94			48.34
			(20.12)			(604k.65)			(106.80)
Savings Bank	-0.95***	-0.93***	-0.87***	-1.13***	-1.18***	-1.21***	0.07	0.42**	0.64***
	(0.11)	(0.12)	(0.12)	(0.14)	(0.14)	(0.15)	(0.18)	(0.19)	(0.21)
Savings*Size		-1.88	-17.16**		18.52***	33.55***		-27.60***	-70.42***
		(5.04)	(7.10)		(2.52)	(12.78)		(6.64)	(18.08)
Savings*Size^2			97.59***			-89.53			462.77***
			(29.50)			(59.18)			(120.23)
Size	-0.91	-0.38	3.76	-1.77*	-2.46***	-4.18	-0.72	4.30	13.01
	(0.93)	(1.61)	(4.22)	(0.95)	(0.82)	(5.88)	(0.74)	(3.13)	(18.73)
Size^2			-9.43			3.52			-57.77
			(8.49)			(10.30)			(109.49)
Profit	0.24***	0.24***	0.24***	0.25***	0.25***	0.24***	0.24	0.22	0.22
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.18)	(0.18)	(0.17)
Capital ratio (%)	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	0.01	0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.02)	(0.01)
Deposits	0.03***	0.03***	0.03***	0.02***	0.02***	0.02***	0.01*	0.01***	0.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Disclosure	0.07***	0.07***	0.07***	0.03	0.03	0.03*	0.03	0.04	0.03
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.04)	(0.04)	(0.04)
Concentration	-0.02***	-0.02***	-0.02***	-0.02***	-0.02***	-0.02***	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
DGS	-0.00	-0.00	-0.00	0.00	0.00	0.00	-0.01***	-0.00**	-0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Year, Macro and Fin. Dep. dummies as well as the lagged dependent included for all regressions									
Constant	-7.02***	-6.94***	-6.87***	-2.42	-2.62*	-2.59*	-5.04*	-5.65**	-5.55*
	(0.90)	(0.92)	(0.96)	(1.53)	(1.53)	(1.53)	(2.81)	(2.79)	(2.99)
Observations	12478	12478	12478	7933	7933	7933	2454	2454	2454
R^2	0.324	0.324	0.325	0.341	0.342	0.343	0.255	0.270	0.276

Note: The table shows pooled OLS estimations with robust standard errors. The dependent variable is reflected by banks' by cash and due from banks as percentage of total assets (TA). The regression includes business model dummies while Size and Size2 are reflected by TA and TA squared over GDP. Profit is profits over TA while Capitalratio is reflected by equity as percentage of TA. Deposits is defined as total retail deposits over TA. Disclosure is an index describing countries' disclosure requirements while Concentration is measured as the share of the three largest banks' assets in economy-wide bank assets. DGS is measured as the ratio of state-underwritten deposits to average savings.

Table A.4: Endogeneity

	All			No Regulation			Regulation		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Cooperative Bank	-0.09	-0.07	-0.10	-0.48***	-0.49***	-0.59***	0.30**	0.31***	0.39***
	(0.08)	(0.09)	(0.09)	(0.15)	(0.15)	(0.15)	(0.12)	(0.12)	(0.12)
Cooperative*Size		-0.40	-0.45		-0.38	3.21		-0.19	-2.04**
		(0.44)	(0.85)		(1.56)	(2.88)		(0.30)	(1.04)
Cooperative*Size^2			0.04			-2.58			0.73**
			(0.33)			(2.59)			(0.36)
Investment Bank	0.34	0.56	0.72*	0.54	0.94*	1.11*	0.03	0.01	-0.05
	(0.34)	(0.39)	(0.43)	(0.47)	(0.55)	(0.64)	(0.42)	(0.52)	(0.56)
Investment*Size		-1.32**	-3.24**		-5.08***	-8.70		0.01	0.55
		(0.57)	(1.38)		(1.91)	(5.31)		(0.45)	(1.56)
Investment*Size^2			1.56**			9.39			-0.37
			(0.73)			(6.56)			(0.73)
Mortgage Bank	-1.40***	-1.35***	-1.41***	-0.45	-0.28	-0.47	-1.31***	-1.32***	-1.36***
	(0.16)	(0.17)	(0.18)	(0.43)	(0.40)	(0.47)	(0.20)	(0.20)	(0.21)
Mortgage*Size		-1.18*	0.55		-6.79	4.77		0.34	2.71
		(0.67)	(2.00)		(10.43)	(29.45)		(0.36)	(1.88)
Mortgage*Size^2			-1.41			-74.18			-3.50
			(2.85)			(170.00)			(2.29)
Savings Bank	-0.67***	-0.66***	-0.68***	-1.08***	-1.11***	-1.23***	0.04	0.06	0.25*
	(0.09)	(0.09)	(0.10)	(0.14)	(0.15)	(0.15)	(0.13)	(0.14)	(0.14)
Savings*Size		-0.02	-0.23		4.13**	15.06***		-0.90	-15.11***
		(0.53)	(1.48)		(1.92)	(3.45)		(1.12)	(3.52)
Savings*Size^2			0.96			-29.70***			12.20***
			(1.19)			(8.65)			(2.78)
Size	-0.07	0.09	-1.10***	-0.03	0.04	-2.92***	-0.12	-0.06	0.05
	(0.27)	(0.34)	(0.36)	(0.52)	(0.55)	(0.62)	(0.14)	(0.18)	(0.62)
Size^2			0.52***			1.56***			-0.05
			(0.18)			(0.34)			(0.21)
Profit_lag1	-0.01	-0.01	-0.01	-0.00	-0.00	-0.00	0.03	0.03	0.02
	(0.03)	(0.03)	(0.03)	(0.06)	(0.06)	(0.06)	(0.04)	(0.04)	(0.04)
basiccapitalratio_lag1	0.01**	0.01**	0.01**	0.01	0.01	0.01	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Deposits_lag1	0.01***	0.01***	0.01***	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)	(0.00)	(0.00)
Disclosure	0.05***	0.05***	0.05***	0.01	0.01	0.01	0.08***	0.08***	0.09***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.03)	(0.03)
Concentration	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)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
DGS	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)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Year, Macro and Fin. Dep. dummies as well as the lagged dependent included for all regressions									
Constant	-3.20***	-3.18***	-3.09***	0.80	0.87	1.09	-7.41***	-7.37***	-7.60***
	(0.48)	(0.49)	(0.49)	(1.13)	(1.14)	(1.14)	(1.77)	(1.77)	(1.76)
Observations	14369	14369	14369	5300	5300	5300	6410	6410	6410
R^2	0.108	0.110	0.115	0.101	0.106	0.119	0.232	0.232	0.241

Note: The table shows pooled OLS estimations with robust standard errors. The dependent variable is reflected by banks' by cash and due from banks as percentage of total assets (TA). The regression includes business model dummies while Size and Size2 are reflected by TA and TA squared over GDP. Profit is profits over TA while Capitalratio is reflected by equity as percentage of TA. Deposits is defined as total retail deposits over TA. Disclosure is an index describing countries' disclosure requirements while Concentration is measured as the share of the three largest banks' assets in economy-wide bank assets. DGS is measured as the ratio of state-underwritten deposits to average savings.

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