

Liquidity risk regulation and its practical implications for banks: the introduction and effects of the Liquidity Coverage Ratio

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Received 14 February 2020 | Accepted 29 August 2020 | Published 21 October 2020

Abstract

Following the financial crisis, quantitative liquidity risk regulation was introduced by means of the Liquidity Coverage Ratio (LCR). This literature study aims to investigate whether the introduction of the LCR leads to better liquidity risk management in banks. It elaborates on the drivers and definition of liquidity risk as well as the history, benefits and goals of this regulation. It also delves into the exact composition of the ratio and the assumptions used. The impact on bank lending as well as banks' business model and risk management is addressed, as well as the interaction with monetary policy operations and capital regulation. This paper then describes the operational differences that were observed after the implementation, and behavioral aspects. We also address the Net Stable Funding Ratio (NSFR) and the discussion on interaction between the two indicators and possible redundancy. We have found that the introduction of the LCR leads to better management of liquidity risk for most financial institutions, but more harmonious implementation throughout the sector could reduce liquidity risk even further.

Relevance to practice

One of the most important additions to bank regulations since the financial crisis of 2007–2008 was the introduction of quantitative requirements regarding liquidity risk. This paper will mainly go into the effects of the Liquidity Coverage Ratio (LCR) and will also discuss the Net Stable Funding Ratio (NSFR), to assess whether these regulatory additions actually lead to better management of liquidity risks in banks and which consequences their implementation might have brought about.

Key words

bank, bank regulation, risk management, financial risk management, liquidity risk, LCR, NSFR

1. Introduction

Following the financial crisis in 2007–2008, a significant amount of additional regulation was introduced. One of the most important additions was the introduction of new regulatory requirements regarding liquidity risk. Among others, the Liquidity Coverage Ratio (LCR) was introduced. This paper will address the rationale behind this ratio and its effects by means of a literature study. It will try to answer the following questions:

1. How is liquidity risk defined and what are drivers for liquidity risk?

2. Why was the LCR introduced eventually?
3. How is the LCR defined?
4. What are the effects of the LCR on banks, also combined with the NSFR requirement?

This will lead us to answering the main question:

Does the introduction of the LCR lead to better management of liquidity risk for banks?

The paper is structured as follows: In section 2, the definition and drivers of liquidity risk will be addressed. Section 3 gives an overview of the history of liquidity risk

regulation. Section 4 addresses the introduction and perceived benefits of the LCR ratio and NSFR. Section 5 gives details on the composition of the LCR ratio. Section 6 is the main part of this paper and will address the effects and consequences of the LCR ratio. Section 7 addresses the Net Stable Funding Ratio, its effects as well as possible interaction between the two liquidity indicators and possible redundancy. The paper ends with a conclusion in section 8.

2. Definition and drivers of liquidity risk

The fundamental role of banks in the maturity transformation of short-term deposits into long-term loans makes banks inherently vulnerable to liquidity risk. Liquidity is defined by the Basel committee as the ability of a bank to fund increases in assets and meet obligations as they come due, without incurring unacceptable losses. Every transaction or commitment of a bank has an impact on its liquidity. Cash flow obligations are often uncertain, because they are affected by external events such as clients withdrawing their money (Basel Committee 2008).

As identified by Drehmann and Nikolaou (2013) and Bonner et al. (2015), academics use different definitions for liquidity. We identify two main definitions; funding liquidity and market liquidity.

Funding liquidity is defined as the bank's ability to pay its financial obligations upon request. "Funding liquidity risk is the risk that the firm will not be able to meet efficiently both expected and unexpected current and future cash flow and collateral needs without affecting either daily operations or the financial condition of the firm" (Basel Committee 2008). The classic example of a bank being illiquid due to a bank-run is expressed in terms of funding liquidity; when customers (en masse) choose to withdraw their deposits the financial obligations of the bank rise and the bank may, at some point, not be able to cash out anymore.

"Market liquidity risk is the risk that a firm cannot easily offset or eliminate a position at the market price because of inadequate market depth or market disruption" (Basel Committee 2008). Such was the case during the financial crisis, when many large institutions held mortgage-backed securities which were marketable at first, but demand vanished and the market dried up, creating illiquidity for those institutions who held on to these securities.

By definition of market liquidity, determinants of liquidity risk are embedded in the market conditions of the bank, the operating countries and the marketability of the assets. This is exemplified in crisis, when assets may be sold in a 'fire sale' to provide short-term funding while generating large losses on the expected value of the assets. Academics have found several drivers of liquidity risk (Bonner et al. 2015; Chen et al. 2018). They find that both national and institution-specific characteristics drive the level of liquidity buffers. Examples are regulatory re-

quirements on a national level and sector concentration, profitability, business models and size at institution level.

3. The history of liquidity regulation

(Bonner and Hilbers 2015) give an interesting overview of the history of liquidity regulation. The initial plan of the Basel Committee on Banking Supervision (BCBS) in 1975 was to harmonize both capital and liquidity regulation, but the main focus quickly became capital and credit risk. Until the mid-1980's, liquidity was considered too complex and bank specific, leading to the opinion that general guidelines instead of a harmonized minimum standard were most appropriate. Liquidity issues were perceived as a matter for national authorities. A working group worked on the feasibility of a survival period, leading to a report in 1987, but the liquidity proposal was never discussed in detail and later, the subgroup working on liquidity took a stance against harmonizing liquidity regulation. The expectation was that capital adequacy in itself would also raise liquidity standards by inducing banks to hold low-weighted assets. In 2000, a BCBS paper was published containing sound practices for managing liquidity risk, containing qualitative but no quantitative requirements (Basel Committee on Banking Supervision 2000).

In the Netherlands, specific liquidity regulation was already introduced in 2003. Banks were at all times required to have a 'Liquidity Balance' greater than or equal to zero. The Liquidity Balance was defined as:

$$\frac{\text{Available liquidity} - \text{Required liquidity}}{\text{Required liquidity}}$$

Where Available liquidity is defined as the weighted stock of liquid assets plus the weighted cash inflow scheduled within the coming month (De Haan and Van den End 2013).

In 2004, further study into liquidity risk management was initiated by a Joint Forum consisting of BCBS, the International Organization of Securities Commissions (IOSCO) and the International Association of Insurance Supervisors (IAIS). Their report in 2006 concluded that a centralization was ongoing in liquidity risk management and that firms seemed to have improved their ability to provide quantitative indicators of liquidity risk. The most common measures used at that time were liquid asset ratios, cash flow projections and stress tests. Since most indicators only referred to idiosyncratic stress, the Joint Forum suggested that supervisors should explore the reasons why firms did not consider market-wide shocks (Basel Committee on Banking Supervision 2006). The Institute of International Finance (IIF) also worked on liquidity risk. They published recommendations regarding the governance and organizational structure for managing liquidity risks, the monitoring and stress testing. Harmonization was considered positively, but based on qualitative approaches, not by setting prescriptive, quantitative measu-

rements. In 2008, an updated version of the 2000 BCBS paper containing sound practices was published (Bonner and Hilbers 2015) which still did not contain quantitative elements. These academics mention three obstacles that hampered the harmonization of liquidity regulation:

1. the lack of supervisory momentum;
2. the view that capital also addresses liquidity risks, and
3. the interaction of liquidity regulation and monetary policy implementation.

These will be addressed in more detail in section 4 and 6.

4. The introduction of the LCR and NSFR and perceived benefits

4.1. The financial crisis led to the introduction of the LCR and the NSFR

The financial crisis has shed a new light on the perceived obstacles mentioned above. As described in the preamble of the Delegated Regulation (European Commission 2015): *“During the early ‘liquidity phase’ of the financial crisis that began in 2007, many credit institutions, despite maintaining adequate capital levels, experienced significant difficulties because they had failed to manage their liquidity risk prudently. Some credit institutions became overly dependent on short term financing which rapidly dried up at the onset of the crisis. Such credit institutions then became vulnerable to liquidity demands because they were not holding a sufficient volume of liquid assets to meet demands to withdraw funds (outflows) during the stressed period. Credit institutions were then forced to liquidate assets in a fire-sale which created a self-reinforcing downward price spiral and lack of market confidence triggering a solvency crisis. Ultimately many credit institutions became excessively dependent on liquidity provision by the central banks and had to be bailed out by the injection of massive amount of funds from the public purse. Thus it became apparent that it was necessary to develop a detailed liquidity coverage requirement whose aim should be to avoid this risk by making credit institutions less dependent on short-term financing and central bank liquidity provision and more resilient to sudden liquidity shocks.”* As Bonner and Hilbers (2015) state, *“The 2007-08 financial crisis showed how quickly liquidity can evaporate and how rapidly even well capitalized banks can lose their access to funding markets.”* Liquidity risk and lapses in liquidity risk management were key factors leading to the outbreak of this crisis and especially its rapid expansion. The financial crisis also showed that capital regulation does not (fully) mitigate liquidity risks, capital and liquidity requirements are not substitutes but complements.

In 2009, the BCBS started working on the Basel III regulation. By lack of an existing global standard, as was present for capital, a more theoretical approach was chosen for liquidity regulation compared to capital regula-

tion. In 2010, the international framework for liquidity risk management was introduced, including proposals to introduce the LCR and the Net Stable Funding Ratio (NSFR). Being the first quantitative regulations for liquidity risk management, these regulations were expected to have a large impact on banking activity and financial markets. In January 2013, the Committee published a final document with the new Basel III Liquidity Coverage Ratio (Basel Committee on Banking Supervision 2013). The final NSFR standard was published in October 2014. The NSFR was introduced because of similar reasons to the LCR but implementation has lagged throughout several countries. The formal implementation in the European Union laws will take place as part of the revised Capital Requirements Regulation (CRR2), which was published in June 2019 and is expected to come into force as of June 2021. Section 7 will further address the NSFR.

4.2. Benefits of quantitative liquidity measures

In their report on liquidity measures, the European Banking Authority (EBA 2013) mentions a number of benefits of quantitative liquidity regulation, that are depicted in Figure 1.

Figure 1. Benefits of quantitative liquidity regulation.



The externality of individual banks' liquidity problems, e.g. the risk that this is shifted to the public balance sheet is, according to EBA (2013), internalized and reduced, leading to an increase in economic welfare. Also, the quantified regulation makes the risk of banks underestimating their liquidity risks smaller.

According to EBA (2013) liquidity regulation was (together with capital regulation) also expected to improve the soundness of the banking sector. It was perceived to protect against bank runs and potential losses from fire sales of assets because of the liquidity buffer and also support bank solvency. Defining what the buffer could consist of, the High Quality Liquid assets (HQLA), is also perceived as beneficial by EBA because it bolsters confidence within the sector by reducing uncertainty about what buffers a bank has. This was expected to lead to reduced funding costs. As a final benefit, EBA mentions reduced interconnectivity between banks in the banking system, which is beneficial in case of resolution or restructuring (EBA 2013).

The floor for liquidity risk contributes to avoiding excessive loan growth and therefore helps to reduce the underlying growth factors for another possible bubble or financial crisis (EBA 2013). These perceived benefits

need further investigation now that the LCR has been implemented, to determine whether they actually materialized.

5. Definition of the LCR

5.1. The LCR in more detail

The LCR is a short-term buffer providing liquidity to banks in distress while maintaining independent from central bank or government assistance. The LCR was created with the emphasis on short term liquidity and the ability to withhold from a fire sale. The LCR formula is fairly simple;

$$\frac{\text{Liquidity Buffer}}{\text{Net outflows in next 30 days}} \geq 100\%$$

The LCR is designed to indicate liquidity by requiring the Liquidity Buffer, defined as HQLA, to be larger than the short term net outflows of the bank. The 30-day time period allows additional measures to be taken by supervisory authorities, if the stress scenario holds.

The main assumptions for determining the LCR are:

- **Deposit flights;** The run-off by depositors in fear of a collapse or closure might lead to the actual collapse of the bank, an example of the classic bank-run.
- **Non-renewal of market and unsecured inter-bank refunding;** Markets and other banks will not renew loans towards the institution in fear of a collapse.
- **Increase in drawdown of committed funding in favor of clients;** clients with committed credit lines draw to the maximum amount of the line.
- **Continuation of credit production;** Credit production is not stopped but continued in the same way as in a non-stress situation.
- **Non resort to Central Bank (as last resort) except for liquidity lines;** For as long as the bank is independent and out of trouble, it will try not to resort to the Central Bank for liquidity support.

As is shown in Figure 2, the LCR formula consists of different factors that contribute to liquidity of the bank. The formula in Figure 2 is not the most detailed depiction of the LCR formula, as the complete formula includes

haircuts and caps for certain types of assets and outflows (European Commission 2015). Due to the volatility of both determinants in the formula and the short time-span of the ratio, the LCR can be rather volatile compared to other prudential ratios.

Therefore, it is worthy to note that the LCR should not be considered too strictly by investors or depositors as a reflection on the value or potential security of (assets in) a bank. The LCR is considered to reduce the impact of liquidity risk as banks are encouraged to hold HQLA and academics have argued this leads to a higher investor confidence (Bonner and Hilbers 2015).

5.2. High Quality Liquid Assets

The Liquidity Buffer is comprised of HQLA. HQLA should be liquid even in stress scenarios as the value of HQLA depends on the price in private markets during these stress scenarios. The HQLA is categorized into three main groups (including types and haircut percentages):

- Level 1 High quality assets (covered bonds 7%, sovereign bonds 0%, cash 0%)
- Level 2A Good quality assets (other assets 15%)
- Level 2B Good quality assets (RMBS 25%, ABS 25%, SME ABS 35%, and Corporate Debt Securities 50%)

The haircuts associated with the types of assets are instrumental to the application of the LCR and the banks' portfolio of HQLA. An example of this is the work of Tawfik (2015), which shows an optimization for the LCR based on the haircuts presented for the various assets. As perhaps intended by the regulators, the optimal formula desires all Level 1 assets first, then Level 2A. Level 2B is not desirable at all, in terms of LCR, as the haircut on the perceived value is too costly. Where even further requirements are provided, such as relative thresholds of Level 1 assets and Level 2 assets, assets are subjected to a haircut and cap (European Commission 2015).

5.3. Outflows and inflows

The Net Outflow is further formulized:

$$\text{Total expect cash outflow} - \text{Min}\{\text{Total expected cash inflow}; 75\% \text{ of Total expected cash outflow}\}$$

Figure 2. Breakdown of LCR formula.

$$\text{LCR} = \frac{\sum \left(\begin{array}{c} \text{High Quality Liquid Assets} \\ \text{Market Value} \\ \text{Asset Factor Haircut} \end{array} \right)}{\sum \left(\begin{array}{c} \text{Net Cash Outflow (30 days)} \\ \text{Cash Outflow} \\ \text{Cash Inflow} \end{array} \right) \cdot \text{Min} \left(\begin{array}{c} 75\% \text{ of Total Expected Cash Outflow} \\ \text{Total Expected Cash Inflow} \end{array} \right)}$$

The denominator represents the net amount that the institution would have to disburse if it would face a normalized liquidity stress, which are called the net outflows. As a buffer, inflows taken into account are limited to 75% of outflows.

Liquidity outflows are calculated by multiplying the outstanding balances of various categories or types of liabilities and off-balance sheet commitments by the rates at which they are expected to run off or be drawn down. They include e.g. the current outstanding amount for stable retail deposits and other retail deposits, the current outstanding amounts of other liabilities that become due, the maximum amount that can be drawn down during the next 30 calendar days from undrawn committed credit and liquidity facilities (European Commission 2015).

The inflow should be assessed over a period of 30 calendar days. They shall comprise only contractual inflows from exposures that are not past due and for which the credit institution has no reason to expect non-performance within 30 calendar days. This comprises of e.g. monies due from central banks and financial customers, securities maturing within 30 calendar days and also monies due from positions in major indexes of equity instruments. All of these to an inflow rate of 100%.

50% inflow rate to be applied to e.g. monies due from non-financial customers.

6. Effects of the LCR

In this section, we address the effects of the LCR on banks.

6.1. Bank lending

The effect of liquidity regulation on bank lending is a topic of debate among scholars and regulators. It is argued that banks' demand in liquid assets and maturities of wholesale liabilities increase, which leads to a larger lending spread. Banks' demand for long-term funding increases, which is expected to increase the yield curve of the overnight rate, deeming it less applicable for monetary policy (Bonner and Hilbers 2015). Li et al. (2017) argue that the LCR could have a multiplier effect on liquidity in the banking sector, especially during extremer scenarios of liquidity or illiquidity. This is argued as the (re-)payment of loans has an effect on the banks' LCR in which (re-)payment reinforces the motions of liquidity for single banks and the system in general. These results are supported by the findings of Kim and Sohn (2017), who argue that a banks' capital only increases lending after sufficient liquidity has been achieved. De Haan and Van den End 2013) argue that when a liquidity shock occurs, banks first reaction is the decrease of lending, especially regarding wholesale lending.

On the contrary, it is argued that a higher LCR leads to a more stable financial system, thereby less disruptive credit flows to the real economy, ultimately leading to a positive effect on the real economy (Bonner and Hilbers

2015). It is stated by the EBA that *“the liquidity requirement is not likely to have a material detrimental impact on the stability and orderly functioning of financial markets, ..., with a particular focus on lending to SMEs and trade financing”* (EBA 2013). Part of the explanation may be found in the inability of banks to transfer the increased funding costs towards clients as argued by Bonner (2012).

Based on these academic results, we argue that the first implication of LCR on lending results in a higher lending spread due to higher demand for long-term funding, which reduces over time as argued by Bonner (2012). However, we do find support for the argument that a heterogeneous ratio, as the LCR is, could spur a multiplier effect in the financial system, as all institutions could increase demand (decrease supply) for certain assets (liabilities) when experiencing a liquidity shock.

6.2. Bank operations, business model and profitability

The effect of liquidity regulation on banks' operations and business model diversification is one of the focal points of the LCR, as the regulation implies the diversification of the asset portfolio for banks and a reduced dependency on short-term wholesale funding. The LCR is specifically designed to encourage an increase in deposits versus (short-term) wholesale funding and HQLAs versus less stable assets (EBA 2015). The impact of the LCR varies per institution but is expected to have the most impact on banks who struggle to meet the requirements as institutions who have a high LCR will not be required or motivated unnecessarily to alter their business model. This is increasingly true for banks with a large short-term liquidity gap and focused on specialized lending such as automotive banks, consumer credit banks and (to a lesser extent) private banks (EBA 2013; Cucinelli 2013). Private banks and boutique banks may be especially restrained in their business model as retail assets are not considered HQLAs, subsequently forcing them to reach other terms of funding (EBA 2015).

It is expected by regulators that the LCR will have a negative effect on the financial performance of banks, specifically through the reduction of earnings (EBA 2015). This is partly evidenced by Grundke and Kühn (2019) who argue that while *“the reduction of maturity transformation can effectively close liquidity gaps within one year, while this comes at a cost of a higher frequency of negative net cash flows above one year”*. The argument here being that the reduction of maturity transformation increases liquidity within the one-year horizon at the cost of more frequent losses on assets with a maturity of more than one year, ultimately negatively impacting the financial performance. This may be an intended consequence of the regulation. However, the specific transformation of the result near the 1-year maturity is not further acknowledged by regulators. Specific non-EU domestic results show that the negative relation with LCR implementation and profitability is not fully robust (Muriithi and Wa-

weru 2017). Additionally, European Commission (2015) found that banks holding a large excess reserve regarding repurchase agreements might have to pay a larger price when the market is stressed to, relatively, maintain their LCR as opposed to institutions with smaller excess reserves. However, it could be argued that, as higher LCR and liquidity levels within banks provide more financial stability, the LCR implementation increase the societal benefits and long-term value creation of banks.

Based on these findings, we conclude that the LCR implementation has a slightly negative effect on financial performance in the short term but may prove beneficial for the economy as a whole when banks face distress and require aid on a less-frequent basis.

6.3. Bank risk appetite and risk taking

Legislators have expected that the LCR implementation within banks results in a discouragement of risk taking with regards to the risk appetite, loan-to-deposit ratio and a reduction of Return on Equity (EBA 2015). Khan et al. (2017) have found that banks with a relatively lower liquidity risk (through funding), take higher risks in general with the inverse being found during the Global Financial Crisis (GFC). These results suggest that banks with higher deposits are willing to take more risk but are limited by bank size and capital levels. Additionally, legislators expect a larger demand for low-yield HQLAs and argue that, therefore, the risk appetite will decline (EBA 2015). While an increase in demand may be seen as a lower risk-appetite, it might also be just the result of regulation, thus forcing banks to look for high(er)-yield assets to increase the return on equity. Additionally, if banks are not able or allowed to increase their risk appetite, the demand for credit in the market might spur an increase in shadow banking.

Risk appetite (and attitude) could also change when the financial system is under duress, as argued by Grandia et al. (2019) when institutions experience a flight-to-quality in regards to HQLA. In some sense, the LCR preemptively moves banks' appetite towards HQLA before a flight-to-quality is applicable.

6.4. Interaction with capital regulation

As mentioned in Section 3, some interaction was expected between capital and liquidity regulation. In this section we will further investigate this interaction and the different views on capital versus liquidity regulation that can be observed. EBA Banking Stakeholder Group (2012) states in an opinion paper that to some extent, capital can be viewed as a substitute for liquidity requirements. They state that higher capital ratios could reassure depositors and make a bank run less likely and that therefore, the economic costs of capital and liquidity buffers should be assessed jointly. Admati and Hellwig (2013) argue that if institutions are solvent, meaning that the value of the bank's equity remains positive during stress,

the central bank can provide liquidity to help the bank overcoming liquidity problems and therefore regulating liquidity might not be necessary. De Haan and Van den End (2013) also show an interaction between capital and liquidity buffers, especially during non-crisis times. They found that more capitalized banks hold less liquid assets against their stocks of liquid liabilities. However, this effect of bank capitalization is smaller during the crisis period. Distinguin et al. (2013) find that US and European banks do not strengthen their solvency standards when they face higher illiquidity, or when they create more liquidity (i.e., when they fund larger portions of illiquid assets with liquid liabilities) but decrease their regulatory capital ratios. When focusing on core deposits in the US, it is shown that small banks do strengthen their solvency standards when faced with higher illiquidity. So adding liquidity ratios to capital ratios might be more relevant for large banking institutions than for small banks. These authors try to explain this difference by referring to a possible underestimation of liquidity risk by large banks, due to their too-big-to-fail position or to the fact that large banks might also be managing liquidity differently, with more sophisticated off-balance sheet instruments (Distinguin et al. 2013).

Bonner and Hilbers (2015) mention several views on the interaction. Capital regulation can be viewed as substituting liquidity regulation by encouraging banks to hold more assets with low risk-weights. These assets with low risk-weights are usually liquid, so it would be "two birds with one stone" to impose capital regulation only. "Related to this is the view that well capitalized banks are better able to attract funding and that high capital levels reduce the risk of bank runs. Again, regulating capital would reduce liquidity risks". On the other hand, they also argue that by requiring higher levels of capital, given the assumed decline in their profitability, banks might be inclined to adopt riskier strategies and to reduce the holding of costly liquid assets. It was shown that regulating capital was associated with declining liquidity buffers. Reasons for this were the costs of capital and liquidity, or less attention for liquidity risks given the focus on capital (Bonner and Hilbers 2015).

Another interesting study by Adrian and Boyarchenko (2018) investigates welfare implications of the LCR, as well as the interaction between liquidity and capital regulation. They conclude that "*liquidity requirements are preferable to capital requirements, as tightening liquidity requirements lowers the likelihood of systemic distress without impairing consumption growth. In contrast, capital requirements trade off consumption growth and distress probabilities.*"

In our view, the potential interaction between capital and liquidity regulation does not provide sufficient grounds to the view that liquidity regulation would be redundant given the current capital regulation, also based on what was observed in the financial crisis. We strongly argue for specific measures to mitigate liquidity risk while realizing a consistent and sufficiently clear regulatory

framework. Section 7.2 will address interaction between the two liquidity indicators LCR and NSFR.

6.5. The effects of monetary policy on the LCR

Bech and Keister (2017) state that the introduction of the LCR is expected to affect market and interbank interest rates and thus also have implications for monetary policy. Trading incentives for interbank lending could change because central bank reserves are liquid assets and banks lend or borrow these reserves from each other. Also, central bank monetary policy operations can have an effect on compliance with the LCR. This introduces the possibility that the new liquidity regulations could interfere with a central bank's ability to implement monetary policy by steering interest rates to a desired target level. Their analysis shows that when banks face the possibility of an LCR shortfall, the overnight interest rate tends to decrease, while a regulatory premium arises in longer-term rates. This is a result of these banks seeking for funding with a favorable regulatory treatment or to borrow from the central bank's standing facility. These actions lower the need for overnight market funding, reducing the overnight interest rates in equilibrium. An LCR premium is said to arise, reflecting for each type of loan their value in terms of complying with the regulation. So liquidity regulation can generate premia in interbank interest rates. *"When the LCR requirement binds, banks' funding cost at any maturity of longer than 30 days is determined, at least in part, by the quantity of high-quality liquid assets in the banking system rather than the quantity of central bank reserves."* (Bech and Keister 2017).

In addition, their analysis shows that the LCR requirement can substantially alter the effect of a central banks' open market operations (OMO) on equilibrium interest rates. *"When there is no LCR requirement, the overnight interest rate is determined by the total quantity of reserves supplied by the central bank. In such an environment, only the size of an OMO matters for interest rates; the details of the operation (assets used, counterparties, etc.) are irrelevant."*

"Once an LCR requirement is introduced, this result no longer holds. The structure of an OMO determines its effects on bank balance sheets and, hence, on the likelihood of a bank facing an LCR shortfall. This likelihood, in turn, affects banks' incentives to trade in interbank markets. For some types of operations the overnight interest rate becomes more responsive to changes in the supply of reserves than in the standard model, while for others it becomes unresponsive. Similarly, the equilibrium LCR premium increases when the central bank adds reserves with some types of operations, but decreases for others. The magnitude of these effects depends on a variety of factors, some of which may be unknown to the central bank when the operation takes place." (Bech and Keister 2017).

As Bonner and Hilbers (2015) summarize: *"Increasing banks' demand for long-term funding, the LCR might lead*

to a steepening of the yield curve, potentially making the overnight rate a less useful target rate for monetary policy implementation. To account for this, central banks should use long-term interest rates as additional target when implementing monetary policy."

Further study into the interaction between liquidity regulation and monetary policy implementation was done by Bindseil and Lamoot (2011). Their paper states that separated treatment of liquidity risk regulation and central bank operations framework can lead to certain interactions that are not necessarily positive when viewed from a monetary policy or financial stability perspective. The level playing field is disturbed while harmonized liquidity regulations exist alongside different central bank operational and collateral frameworks. 'Arbitrage' opportunities of the liquidity risk regulation through central bank operations can undermine the effectiveness of liquidity risk regulation.

In monetary policy operations, central banks should be aware of the effects that the LCR regulation has on the effectiveness of the operations, it becomes more difficult as more factors play a role. The LCR may hamper their ability to perform such operations in the way it was done before the introduction of the LCR due to the effect that LCR requirements may have on both short- and long-term interest rates, e.g. by means of an 'LCR premium' that fluctuates. It could prove a fruitful path for researchers to fully investigate the relationship between monetary policy and banks' decisions at different LCR levels.

6.6. Unintended effects and operational differences after implementation of LCR

The EBA has observed differences in the application of the LCR Delegated Regulation (EBA 2019). Predominantly, the differences in interpretation of article 27 are identified in regards to the treatment of wholesale deposits that have a relationship with the outflow in operational deposits. There is a significant difference in the LCR depending on whether wholesale deposits received are treated as operational or non-operational, since the outflow rates are materially lower for those treated as operational deposits. Wholesale deposits treated as operational deposits are assumed to be less vulnerable to significant deposit withdrawals during a period of combined idiosyncratic and market-wide stress than those treated as non-operational deposits. Banks could benefit from the outflow preferential treatment of operational deposits and in doing so, effectively improve their LCR. The treatment of operational deposits has been debated, as it was not clearly clarified at the time of LCR implementation. EBA (2019) provided additional guidance, including two methods for identifying operational deposits. Article 25(4) of the LCR was also differently interpreted. It allows credit institutions to exclude restrained retail deposits with a maturity of larger than 30 days from the calculation of outflows. 'Restrained' in this context means that the depositor is not legally allo-

wed to withdraw the deposit before the end of the 30 day timeframe or after a penalty has been paid. The restraint of these deposits is up to discussion on whether a penalty is significant or not, ultimately making the definition of restraint arbitrary. The bank can only exclude the deposit from outflows if the bank can reason that the deposit will not be withdrawn based on historic data. In EBA (2019), the regulator has provided further guidance on the definition of ‘material penalty’ to aid in a coherent approach regarding this topic.

Article 23 of the Delegated Act (European Commission 2015) addresses a “leftover category” for outflows of products not covered by earlier articles. For this category, no specific outflow percentages are prescribed: institutions can use their own methodology for assigning an appropriate outflow. As part of this assessment, institutions need to assume combined idiosyncratic and market-wide stress and they need to take into account material reputational damage that could result from not providing liquidity support to the products and services. This is a somewhat subjective assessment, which could offer incentive to downplay potential outflow (De Nederlandsche Bank 2018). EBA (2019) has provided additional guidance regarding this article as well.

The LCR is implemented in the EU and like other EU regulation, the implementation has been carried out by national supervisors with a material number of discretions. As stated by the Basel Committee on Banking Supervision, national authorities have discretions regarding deposit run-off rates, derivative recognition and funding (BCBS 2019). Overall, all relevant authorities strive towards a harmonized application of regulation but the consistency of the LCR needs to improve further to increase comparability between banks and to really achieve its perceived benefits. It appears necessary to scrutinize and maybe decrease the leeway that was given to banks to assess material items in the LCR.

Next to the operational differences, there may also be some unintended consequences connected to the LCR implementation. Before implementation, there were fears of a negative effect on GDP growth through lending to the real economy, a higher encumbrance of assets and increasing possible losses for bond holders. Reports from Schmitz and Hesse (2014) argue that all these fears are unsubstantiated and the expected negative effects were minimal. Additionally, Banerjee and Mio (2018) find no evidence of a reduction of lending to the real economy or a decrease of the balance sheet size of financial institutions. Regarding the numerator of the LCR formula, there has been a subjective practice regarding the operational requirements for HQLA. Banks reclassify HQLA assets as (non-HQLA) inflows during the last 30 days of maturity due to perceived changed operational qualities. This allows banks to circumvent the haircuts applied to inflows from HQLA, which in term decreases the Net Outflows. Additionally, banks are not allowed to hold their own securities as HQLA but there have been market observations in which was attempted to circumvent this through

interbank swaps of retained covered bonds. This has been clarified further by EBA as, if the interbank swap is not a real marketable instrument, there would be a large systematic risk through this system.

There may also be a time dimension towards the calculation of the LCR as some end-of-month/quarter/year payments may be made, influencing the LCR. This could lead to a much better reported LCR as compared to the actual LCR over time, which undermines the effectiveness of the regulation altogether. EBA requires additional analysis to be done by supervisors regarding intramonth versus end of month LCR figures and express that they expect banks to apply a prudent approach in case of differences. Also, in times of distress banks may occur an inability to match their liabilities with respects to different currencies, as banks during times of distress may not be able to swap or hedge currency risks perfectly, creating significant currency mismatches. Only a reporting requirement for material currencies (>5%) is in place at the moment, requiring banks to report LCR levels for material currencies. But no formal requirement of an LCR >100% is in place for these currencies. This could be a risk in times of stress and requires banks to manage this in a prudent way. EBA is working on the LCR by significant currency (EBA 2019).

Where regulation is applied, it is always interesting to also look at the behavioral view. Even though the LCR does not specifically aim to alter behavior in the financial sector, there might be caveats in the application of supervision. Banks with an LCR close to or under 100% threshold might be inclined to alter their LCR at the time of reporting through the structure of payments (inflow or outflow). Currently, it is not proven that banks are actively managing this regarding LCR but an institution under duress might be inclined to do so. It reminds the authors of Lehman’s application of ‘Repo 105’ (Goldstein 2010), which was only discovered after the bank had already filed for bankruptcy. Additionally and as referred to in paragraph 6.3, the LCR and a stringent enforcement on risk appetite might lead to an increase in shadow banking. The link between shadow banking and risk appetite is confirmed by academics, such as Zhou and Tewari (2019). They argue that a decrease in interest rates and an increase in risk appetite in the banking sector increases the volume of assets in shadow banking. While it remains to be seen whether or not the LCR has a direct impact on shadow banking, it is interesting to observe the impact of regulation with the current levels of interest rates and banks’ risk appetite.

7. The NSFR, its effects and interaction with the LCR

In this section, we review the definition and effects of the NSFR and its interaction with the LCR in the application by banks.

7.1. Definition and effects of the NSFR

In addition to the LCR, the NSFR was introduced under the Basel III accords. The NSFR aims to promote stable funding over a medium horizon of 1 year, as opposed to the short-term goal of the LCR. The NSFR is focused on stable funding to reduce the effect of funding shocks on the financial stability of individual banks and the sector as a whole. In combination with the LCR, the NSFR (and liquidity regulation as a whole) is aimed at the prevention of the liquidity stresses that were experienced during the Financial Crisis.

The NSFR is constructed as follows:

$$\frac{\text{Total Available Stable Funding}}{\text{Total Required Stable Funding}} \geq 100\%$$

The Available Stable Funding (ASF) is comprised of funding sources such as debt and equity with appropriate factors to reflect the long-term and prudent nature of the funding. The Required Stable Funding (RSF) is comprised of all assets for which funding is required and applied with factors based on liquidity and nature of the assets. It follows instinctively that an institutions equity is calculated with a high ASF factor and that cash money is calculated with a very low RSF factor.

The NSFR is calculated based on a 1-year horizon, as opposed to the 1-month horizon of the LCR, to ensure banks are capable of withstanding prolonged liquidity stress (De Haan and Van den End 2013). The intentions behind the NSFR time period are so that banks do not finance long-term assets with short-term funding, which would create stress on the liquidity position of the individual bank and the system collectively (Behn et al. 2019). Additionally, the NSFR maintains a high degree of similarity with the LCR in terms of definitions and requirements, as regulators did not intend to add to the regulatory burden by introducing the NSFR (BCBS 2014).

7.2. Discussion on interaction and possible redundancy between LCR and NSFR

Discussion has been taking place regarding the impact of liquidity regulations ever since the publication of quantitative measures in 2013 (LCR) and 2014 (NSFR) by the Basel Committee. In a keynote speech from the head of the European Banking Federation in 2017 (Gasos 2018), it was mentioned that the impact of liquidity regulation has not been researched as much as was done for capital regulations, and that even less research is available about the interaction between liquidity indicators and other prudential instruments. There could be unintended consequences of the NSFR ratio in the financial markets, he stated. He also pointed to the combined negative effect of funding, leverage and capital requirements on the competitive profile of European banks. He compared the NSFR to a pacemaker prescribed to every bank, even healthy banks and points out that high liquidity and long term funding are costly for banks, where capital is perceived a cost-neutral choice.

In a simplified framework using stylized balance sheets of banks by Cecchetti and Kashyap (2018), the interactions of the risk-weighted capital ratio, the leverage ratio, the LCR and the NSFR were studied. The goal of studying these interactions was to determine which requirements were likely to bind and how these requirements would affect banks' business models. Their analysis concluded that the two liquidity requirements (LCR and NSFR) "almost surely will never bind at the same time" and "that it is impossible to construct a balance sheet were all four requirements bind simultaneously". They therefore also criticize the statement that the LCR and NSFR are complementary (Cecchetti and Kashyap 2018). The NSFR according to them "may not be doing what was envisaged" (Cecchetti and Kashyap 2018). They mention it to be likely that the tightness of different regulations is expected to vary according to banks' business models and that the combination of NSFR, LCR and the Leverage Ratio can push banks' business models in a homogeneous direction (Cecchetti and Kashyap 2018). The consequence of this may be that, as homogeneity increases, the systemic risk in banks increases. However, the counterargument is that the homogeneity is increased in relatively stable and safe products (e.g. HQLA). We argue that the increase of the systemic risks of these *safe assets* undermine the effectiveness of the (liquidity) regulation in certain scenarios.

Behn et al. (2019) analyse the interaction between the LCR and NSFR liquidity requirements, based on granular supervisory data for banks in the Euro area. Their findings suggest that the LCR and NSFR are complementary and enforce effectiveness in their own right. They mention that "*while the two liquidity ratios are positively related, there is no evidence of a mechanical interaction between them since movement in one ratio does not necessarily imply movement in the other*". The relative tightness depends on the composition of banks' balance sheets and differs between business models. However, it is important to note that the implementation of the complete Basel III regulation needs to be done consistently among all relevant parties, as unintegrated regulation implies major regulatory differences which severely decrease the effectiveness of regulation and increase the regulatory burden on institutions.

In our view, these interactions should be a topic for continuous study going forward but at this moment, both of the liquidity requirements serve a specific purpose and neither of them is perceived as redundant.

8. Conclusion

The LCR was introduced in the Basel III accord to aid regulators in curtailing liquidity risk in the financial system. The LCR requirement encourages banks to hold assets such as cash, bonds and high quality securities relative to the expected outflow in the next 30 days. At the time of introduction, The Netherlands was already familiar with liquidity regulation through application of the Liquidity

Balance. However, because of the change in momentum in the regulatory landscape due to the financial crisis, quantitative, harmonized liquidity requirements were introduced, reducing national differences. Among the perceived benefits of quantified liquidity regulation such as the LCR are an increase in economic welfare, improving the soundness of the banking sector and preventing excessive loan growth.

The requirement for banks to increase their assets (HQLA) is expected to decrease their ability and willingness to lend. The impact of these requirements should decrease over time. Initial results confirm these expectations. In line with a reduction in lending, the LCR is expected to have a negative effect on the short-term financial performance of banks, especially when banks hold an LCR close to or below the 100% threshold. This could result in an increase in risk appetite of banks, searching to compensate for the lesser financial performance. However, through initial findings of Khan et al. (2017) we find that banks with strong financial performance and larger deposit portfolios are willing to increase their risk appetite but are held back by bank size and capital levels. In general, the LCR increases the demand for low-yield assets (HQLA), which could be interpreted as a precautionary flight-to-quality, as the flight-to-quality used to be experienced during the period of distress. In addition, the implementation of the NSFR (together with LCR and Leverage Ratio) was intended to be complementary and aid the overall liquidity position of banks. However, we argue that the homogeneity in assets (through both the LCR and NSFR) leads to an increase in systemic risks and bank's business model due to this precautionary flight-to-quality. We recommend further analysis on the systemic risks in HQLA during stressed periods, as liquidity regulation is aimed at exactly these periods, in addition to a consistent implementation across all markets.

Although some interaction seems to exist between capital and liquidity regulation, this interaction does not provide sufficient grounds to the view that liquidity regulation would be redundant given the current set of capital regulation and including what was observed in the financial crisis. In monetary policy operations, central banks should be aware of the effects that the LCR regulation has on the effectiveness of the operations, it becomes more difficult as more factors play a role. The LCR may hamper their ability to perform such operations due to the effect LCR requirements may have on both short- and long-term interest rates, e.g. by means of an 'LCR premium' that fluctuates. One of the goals with the LCR is to

harmonize liquidity regulation. To a certain degree, this has been achieved. However, we also find that there are a number of unintended effects and operational differences observed. The behavioral aspect of LCR reporting could be one of the serious attention points, as institutions may find it optimal to structure their balance sheet to increase LCR and deter regulators' suspicions. Finally, the LCR may have had a positive effect on the attractiveness of shadow banking, especially for institutions with a higher risk appetite.

We therefore argue that the introduction of the LCR leads to a better management of liquidity risk for most financial institutions. We do want to note that liquidity risk in the financial sector as a whole might be reduced even more when the consistency of the LCR is further improved by clarifying the regulations. Doing so is expected to increase comparability between banks and to aid in really achieving its perceived benefits. Apart from monitoring this single ratio, it will remain important to consider the wider area of liquidity risk management in an integral way.

The increase in risk appetite, systemic risk, and shadow banking is a concern not limited to liquidity risk but should definitely be in scope for regulators regarding improvements on the stability and resiliency of the financial system. The Basel committee and an EBA working group are working on the monitoring of the LCR and on the assessment about whether the intended effects have been achieved and whether perceived benefits materialized. Results of these exercises could be relevant input for further study. A specific point of interest could be whether the funding costs of banks actually decreased, as was expected in 2013. Going forward, it is expected that more clarity will be provided by regulators regarding topics in the regulation that can be interpreted in multiple ways.

Since this paper was a literature study, no research in banks was performed. This could be an interesting addition to the study of liquidity regulation in banking. Once the NSFR has been implemented, this might be grounds for further research into (unintended) consequences as well. Additionally, this paper focused on the implementation in the EU and it could be interesting to analyze the implementation in other jurisdictions such as the USA.

There is a lot to be researched in terms of the effectiveness of quantitative liquidity risk regulation. Hopefully this will be achieved before the next crisis hits, and will show whether the new regulation is indeed able to limit the depth and consequences of the new crisis.

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