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The impact of bank liquidity regulation Basel III On credit supply: Modeling with panel data

Leila ABDERRAZAK, *(PhD Student)*
Laboratory of Economics and Management of Organizations
National School of Business and Management (ENCG)
Ibn Tofail University, Kenitra, Morocco

Hamid AIT LEMQEDDEM, *(PhD, Professor)*
Laboratory of Economics and Management of Organizations
National School of Business and Management (ENCG)
Ibn Tofail University, Kenitra, Morocco

Correspondence address :	Faculty of Economics and Management of Kenitra, IbnTofail University, Morocco (Kenitra) B.P 242- Kenitra +212 5 37 32 92 18
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Abstract

The final version of Basel III published in 2010 for the implementation between 2015 and 2019 showed that regulators have learned the lessons of the financial crisis, which highlighted the liquidity risk of financial institutions. Thus, the Moroccan banking system is much stronger today than it was during the previous crisis. Indeed, Moroccan banks are largely covered and have, today, safety cushions in terms of equity and liquidity built up thanks to the tightening of prudential standards. However, the cumulative effects of the new liquidity standards could lead to a contraction in the supply of bank credit, which, given the importance of this source of financing for the economy, could prove harmful to businesses. This study examines the impact of the Liquidity Coverage Ratio (LCR) on the supply of credit to non-financial firms and households in Morocco using annual data from 2015 to 2021. The empirical analysis uses data from a panel of Moroccan credit institutions. The results suggest that the level of the liquidity ratio (LCR) has a positive impact on the growth rate of credit granted. The study reveals that Moroccan banks with a higher liquidity ratio granted more loans to Moroccan households and non-financial firms. The impact of the implementation of the short-term liquidity ratio is less problematic for Moroccan banks, especially the big banks, insofar as they are retail banks whose majority of resources are deposits. Therefore, the impact of the LCR ratio is perceived as moderate for retail banking activities. The quantitatively small impact of the constraints suggests that Basel III has been successful in setting liquidity requirements to minimize the impact on bank supply credit and the likelihood of an industry-wide liquidity crisis.

Keywords: Basel III, Credit supply, LCR, Panel model; Moroccan banking system
JEL Classification: C01; G21; L20
Paper type: Empirical research

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1. Introduction

Since the beginning of the financial crisis in 2008, ensuring adequate levels of liquidity has been a major concern for all banking institutions. Banks have realized that illiquidity or lack of liquidity can negatively affect their solvency and can even lead to their failure. Moreover, the reversal of market conditions illustrates that liquidity will quickly dry up and shortages will persist (Basel Committee on Banking Supervision, 2008). Liquidity thus plays a key role in ensuring the necessary stability of credit institutions and the banking system and is even considered "an important factor in the viability of any banking organization" (Basel Committee on Banking Supervision, 2006). After the last subprime crisis in 2008, the Basel Committee put in place several measures to enhance the soundness and stability of the international banking system by establishing capital and liquidity buffers to be used in times of crisis. Capital buffers are a major innovation of Basel III. Placing solvency requirements above minimum capital requirements, they aim to reduce the pro-cyclicality of solvency requirements by acting as a buffer, as they are built up in times of growth and then consumed in times of crisis (QUIGNON, 2021). For this, banks have secured themselves by providing more and more capital. Another key factor related to the crisis was the sudden drop in the supply of short-term credit in the capital markets, which worsened the situation of already distressed banks (Basel Committee on Banking Supervision, 2013). The 2008 financial crisis thus highlights the important role that liquidity must play in the optimal functioning of banking and financial markets. To address the weaknesses revealed by the crisis, the Basel Committee implemented in December 2010 the Basel III BCBS (2010) reforms, which represent the international framework for measuring, standards and monitoring liquidity risk. The regulation aims to control liquidity through two new liquidity ratios, the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR). The LCR addresses liquidity risk and requires banks to maintain adequate stocks of high-quality liquid assets (HQLA) relative to expected short-term flows. The NSFR addresses funding risk and promotes long-term bank stability by requiring banks to adopt more secure and stable funding sources.

The introduction of liquidity regulation has led to much debate about the potential impact of these new standards on banking activity and the supply of credit to the economy. At the end of 2011, the Banking Stakeholders Group set up by the European Banking Authority (EBA) warned about the potential impact of the LCR. The analysis conducted by the group estimates that the liquid asset gap (HQLA) of banks operating in the EU exceeds one trillion euros. Moreover, they would have to shift the funds generated into more liquid assets at the expense of lending to the economy and other less liquid assets to comply with the new legal requirements of the LCR. In other words, the group concluded that the LCR had a crowding out effect on productive investment by mobilizing more than 1 trillion euros of liquidity. However, in the context of the current health crisis and the economic recession in the Moroccan kingdom, the regulator decided to soften this regulatory regime temporarily to allow banks to finance the real economy. The severe economic shock caused by the Covid 19 pandemic and the extraordinary containment measures imposed have had a significant impact on the economy. Indeed, the pandemic has caused a slowdown in the economy and, in some cases, a complete halt in business activity, including a decline in household consumption and private and public investment. Consumers and businesses are now experiencing severe income losses. Combining the above regulatory developments, this study examines the relationship between the impact of the short-term liquidity ratio and bank credit supply in light of the above regulatory changes. The question that arises at this level is: **What is the impact of the short-term liquidity ratio on the supply of credit to Moroccan non-financial firms and households?**

Nevertheless, the most recent empirical studies have revealed that the impact of the implementation of the new liquidity standards on credit flows to the economy would be very

limited. In order to answer this question, we will, in the first part of the paper, focus on the explanation of bank liquidity and the presentation of the tools used to measure it, namely the short-term liquidity ratio (LCR). In the second part, through a review of the literature, we will highlight the scientific and empirical contributions of the economic literature on the effects of the Liquidity Coverage Ratio (LCR) on bank credit supply and develops the hypotheses. As for the third axis, it will be the subject of an analysis of the Moroccan banking regulation in the light of Basel III. The fourth and last axis reserved for the study of the impact of the Short-Term Liquidity Ratio on the supply of credit to non-financial firms and Moroccan households by an econometric model of panel data. For this we will work on the case of the 8 most important Moroccan banks, namely: Attijariwafabank (AWB), Banque Centrale Populaire (BCP), Bank of Africa (BAO), Crédit Agricole du Maroc (CAM), Crédit Immobilier et Hôtelier (CIH), Banque Marocaine pour le Commerce et l'Industrie (BMCI) and Société Générale du Maroc (SGMA). The period runs from 2015, the year of the LCR implementation, to 2021.

2. Literature review

2.1. Liquidity Regulations

For Freixas & Rochet (2008), the existence of the banking system can be justified when it constitutes a liquidity center providing agents with liquidity insurance against idiosyncratic shocks affecting their consumption needs or their income. One can distinguish three types of liquidity and therefore three corresponding risks: central bank liquidity, market liquidity and funding liquidity. Central bank liquidity is the ability of a central bank to provide the liquidity needed by the financial system. The liquidity risk inherent in this case is almost non-existent because the central bank can always provide central bank money, which it has a monopoly on issuing. For Goodhart & Schoenmaker (1995), the intervention of the central bank as a lender is necessary because of the imperfections characterizing the credit market. Indeed, because of these imperfections, on the one hand, the survival of an individual bank can be threatened in the event of a liquidity crisis and, on the other hand, the failure of a bank can have destabilizing effects on the entire banking system. However, market liquidity is the liquidity, or money, that a bank is able to obtain from the liquidation of the assets it holds. It therefore refers to the liquidity of assets that can be traded on a market, i.e., their ability to be instantly resold without loss of value. This is clearly a Keynesian conception of liquidity (Keynes, 1936).

Third and last, the liquidity of a credit institution, which is the subject of this paper (Funding liquidity and funding liquidity risk). Drehmann & Nikolaou (2009) define funding liquidity in banks as a cash position where they are able to meet their obligations on time. Therefore, a bank is illiquid if it suffers from a cash shortage, i.e., if the bank is no longer able to meet its immediate obligations (disbursements) with its receipts. Internally, the bank therefore has liquidity reserves in the form of receipts linked to its activity, which may correspond, for example, to an increase in the collection of deposits. Financing liquidity is therefore similar to a net demand for liquidity, which can also correspond, in certain cases, to a net supply of liquidity when the bank's net cash position is positive (the bank will then lend on the interbank money market). These authors therefore consider that “funding liquidity risk corresponds to the possibility that, over a given time horizon, the bank may become unable to settle its obligations immediately”. For the Basel Committee on Banking Supervision (2008), liquidity is the ability of a bank to finance increases in assets and to meet its liabilities as they fall due, without incurring unacceptable losses. Because of their fundamental role in maturity transformation, i.e. the conversion of short-term deposits into long-term loans, banks are, by definition, exposed to liquidity risk, whether it is specific to a particular institution or generalized to all markets. Taking all these definitions into account, we can say that the liquidity of a credit institution corresponds to the immediate availability of the necessary funds to enable it to honor its

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commitments. If it turns out that these funds are not sufficient, the banking company can proceed to the convertibility of some of its assets. This operation must be carried out quickly and without any loss of value. With regard to the measurement of bank liquidity, a distinction must be made between tools for assessing liquidity risk and those for determining the level of liquidity. However, funding liquidity risk, which is the risk that a bank will not be able to meet its present and future expected and unexpected cash flow and collateral requirements, without adversely affecting its day-to-day operations or financial condition, is different from market liquidity risk, which is the risk that a bank will not be able to easily offset or eliminate a position at market price due to insufficient market depth or market disruptions BCBS (2008).

2.2. The Treatment of Liquidity Risk in Basel III

The international financial crisis that began in 2007 led to a consensus on reforming the international banking and financial system to make it safer and more stable. For example, in 2009, Jacques de La Rossière, the former head of the International Monetary Fund, confirmed that the crisis was due to a lack of regulation and that the banking supervision system needed to be reformed. Stricter financial rules called Basel III to guarantee access to credit and avoid overheating and economic collapse are introduced. The crisis has shown that some capital is less hard than others in its capacity to absorb losses. It is therefore necessary to improve the quality of the "core" capital of banks, the (Core Tier 1). By allocating more and better-quality capital to the riskiest activities, the solvency of banks would thus be increased. The Basel Committee's reforms aim to strengthen capital and liquidity regulations. These reforms must therefore be accompanied by improvements in banking supervision, risk management and governance, as well as improvements in transparency and financial communication. Basel III aims to improve the quality of capital by strengthening the loss-absorbing capacity, the robustness of banks and their ability to manage periods of stress. Thus, the capital structure has been simplified through the application of strict eligibility criteria for the core Tier 1 and supplementary Tier 2 elements.
According to BCBS (2010), the main objective of Basel III is to make significant changes to several components of the Basel II ratio:

- The Core Tier 1 ratio, fixed at 2%, has been increased to 4.5% of the net weighted risks (this ratio only includes equity and earnings in the equity),
- The Tier 1 ratio, which was set at 4%, was increased to 6%, and the core capital must be The Tier 1 ratio, as core capital must consist essentially of common shares and retained earnings,
- The ratio on complementary Tier 2 capital can be a maximum of 2%, given that the total amount of required capital remains 8%.

On the face of it, this 8% minimum might lead one to believe that there is no capital increase. However, there is indeed an increase in the amount of capital required by the implementation of two complementary reserves, the conservation buffer and the counter-cyclical buffer. The conservation buffer is a new device designed to promote the conservation of capital and the constitution of adequate buffers, beyond the minimum, that can be mobilized in times of stress. A capital conservation buffer is made up of common shares and similar Tier 1 capital, which amounts to 7% (4.5% capital and 2.5% conservation buffer). One of the fundamental characteristics of the crisis was the accumulation of leverage in the banking system, both on and off the balance sheet. The Committee therefore decided to introduce a simple, transparent, non-risk-based ratio, defined as the ratio of equity to total assets. The minimum requirement is set at 3%. The troubles of mid-2007 were a reminder of the importance of liquidity to the functioning of financial markets and the banking sector. Prior to the turmoil, asset markets were trending upward and capital was readily available at low cost. The downturn showed that the

drying up can be rapid and sustained. The banking system came under severe stress, which led central banks to intervene to ensure the proper functioning of money markets and, at times, to support certain institutions. The Basel I (1988) and Basel II (2004) agreements did not harmonize internationally the regulation of liquidity risk. The Basel III accords took up this issue and integrated liquidity risk alongside credit, market and operational risks (BCBS, 2008). Thus, the improvement of liquidity risk management was achieved through the creation of two liquidity ratios, the Net Stable Funding Ratio (NSFR) and the Liquidity Coverage Ratio (LCR). The crisis highlighted the absence of appropriate measures in the existing regulations, and banks found it difficult to maintain their liquidity despite an adequate level of capital. Moreover, Basel II excludes two essential risks, namely liquidity risks and interest rate risks, for which no capital ratio is provided. This is why the Basel Committee has introduced two ratios: the first relating to short-term liquidity (LCR), and the second relating to long-term (NSFR).

- *The liquidity coverage ratio (LCR)* intend to ensure that any bank is able to cope with a "severe but not extreme" short-term liquidity crisis. Accordingly, it requires that net cash outflows over a month be covered by an equivalent amount of liquid assets;
- *The net stable funding ratio (NSFR)* intend to maintain a balance between the liquidity of assets and the payability of liabilities over a one-year horizon.

The minimum requirement for each of these ratios is 100%.

2.3. LCR objective and use of high-quality liquid assets

The objective of this standard is to ensure that a bank has sufficient unencumbered high-quality liquid assets (HQLA) outstanding, in the form of cash or other assets that can be converted to cash in private markets without losing value, to cover its liquidity needs in the event of a liquidity crisis lasting 30 calendar days. The unencumbered HQLA outstanding should at least allow the bank to survive until day 30 of the stress scenario, by which time the institution's management and prudential officials will have had to decide on appropriate remedial actions or the institution's problem will have been able to be resolved in an orderly fashion. It also gives the central bank more time to take appropriate action, if deemed necessary (BCBS, 2013).
The scenario associated with this ratio assumes both an idiosyncratic and widespread shock in which an institution would need to have sufficient liquidity to survive for up to 30 calendar days (BCBS, 2013). Thus, the crisis scenario would have the following consequences:

- Sharp decrease in the stock of assets that can be used to cover the liquidity shortfall, as well as haircuts on these assets;
- Withdrawal of part of the retail deposits;
- Partial loss of the possibility to carry out unsecured refinancing on the capital market;
- Partial drying up of short-term financing secured by certain collateral and with certain counterparties;
- Additional contractual outflows, including the obligation to provide additional collateral, following a downgrade of the institution's rating by up to three notches;
- Increased market volatility affecting the quality of collateral or the potential future exposure of derivative positions, resulting in additional liquidity requirements;
- Unscheduled drawdowns on granted, but unused, credit and liquidity commitments provided by the bank to its customers;
- Potential need for the bank to repurchase its debt securities or honor non-contractual obligations to mitigate reputational risk.

This stress test should be considered a minimum prudential requirement. Institutions should conduct their own tests to assess the level of liquidity they should build beyond this minimum, and should develop their own scenarios that may affect their various business lines. These internal stress tests should cover longer periods than those imposed by the LCR (BCBS, 2013).

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The LCR consists of two components:

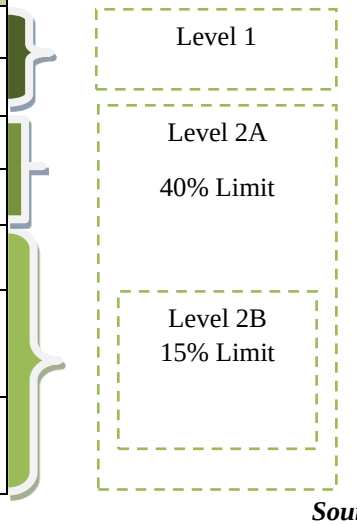
- The value of outstanding HQLA under stress;
- The total net cash outflow.

$$\boldsymbol{LCR} = \frac{\text{High quality liquid assets outstanding}}{\text{Total net cash outflow over the next 30 days}} \geq 100\%$$

The numerator of the LCR is the amount of HQLA "high quality liquid assets", these are assets that remain liquid in the markets in times of crisis and meet, the criteria for acceptance by the central bank (BCBS 2013). Assets are considered high quality liquid assets when they can be quickly and easily converted into currency at their market value. Assets are divided into Tier 1 assets and Tier 2A and 2B assets.

Figure 1: Composition of the liquid asset cushion

Asset class	Weighting
Available cash and central bank deposits	100%
Sovereign securities weighted at 100%	100%
Corporate securities and covered bonds≥ AA-	85%
Sovereign securities weighted at 20%	85%
Liquid RMBS with ratings ≥ AA	75%
Corporate securities with a rating between A+ and BBB-	50%
Non-financial corporate equities	50%



Source: Author

HQLA are subdivided into Tier 1 and Tier 2 assets. Tier 1 assets include, in principle, reserves with the central bank, as well as certain marketable securities guaranteed by sovereign issuers and central banks, among others. Generally, these assets are of the highest quality and most liquid, and there is no limit on how much a bank can use them to meet the short-term liquidity ratio requirements. Tier 2 assets are further divided into two tiers: 2A and 2B. Tier 2A assets include certain government securities, covered bonds and corporate debt. Level 2B assets consist of lower rated corporate bonds, residential mortgage-backed securities and equities meeting certain conditions. Tier 2 assets may not represent, in aggregate, more than 40% of a bank's outstanding HQLA and Tier 2B assets may not represent more than 15%.

The calculation of HQLA outstanding is as shown below:

Outstanding HQLA = level 1 + level 2A + level 2B – adjustment for 15% cap – adjustment for 40% cap

The denominator of the liquidity ratio, which is the total net cash outflow, is composed as shown below:

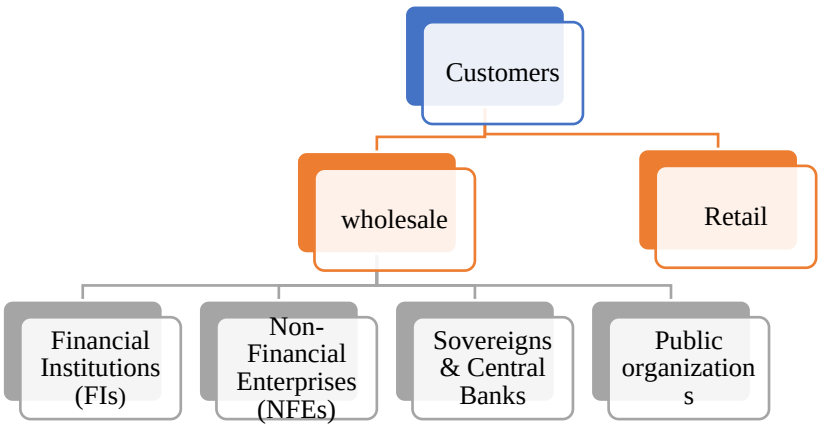
Total net cash outflow = Disbursement flows – Cash flow

Deposit flows
Credit lines

Depreciation of receivables

The calculation of disbursements flows by type of counterparty is a major specificity of the liquidity ratio. During the crisis, disbursement flows or run-offs differed according to the type of clients and deposits. Thus, Basel III segmented the latter and resulted in differentiating the applicable outflow according to the type of counterparty. Basel III distinguishes between "retail" natural persons and "wholesale" legal or public persons. The latter are then distinguished according to their outstanding balance sheet savings between financial institutions, non-financial companies, sovereigns and central banks, and public bodies. Thus, all natural persons (individuals and professionals) in the legal sense of the term are treated as retail customers, while legal entities and public bodies are treated as wholesale customers. As a result, the clientele of professional "legal entities" is considered in the Small and Medium Enterprise (SME) category and is therefore not included in the retail clientele. However, this has no impact on demand deposits, since small and medium-sized enterprises (SMEs) classified as wholesale are treated in the same way as retail customers in terms of the weighting of outstandings.

Figure 2: Third party classification



Source: Author

However, to ensure that banks do not rely solely on expected cash inflows to meet liquidity requirements, and to ensure a minimum amount of HQLA outstanding, the amount of inflows that can offset outflows is capped at 75% of total expected outflows. As a result, the bank will be required to have HQLA outstanding equal to at least 25% of total expected cash outflows.

Total net cash outflow over the next 30 calendar days = total expected outflows – minimum {total expected cash inflow; 75% of total expected cash outflow}

Thus, according to this standard, the outstanding amount of high-quality liquid assets must be at least equal to the net cash outflow during the 30 days following the date on which the ratio is calculated. By complying with this ratio, the institution should thus have sufficient liquidity despite refinancing difficulties on the markets (BCBS 2013).

Hypothesis 1 (H1): There is a significant relationship between The LCR and Banks' lending activity

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2.4. Influence of the LCR on banks' lending activity

The credit granted by banks seems to be essential to create the conditions for stable and sustainable growth. This particular relationship is a key issue for policymakers but also for regulators. Indeed, while one of the main objectives of regulation is to move toward a more resilient banking and financial system, it is equally necessary that regulation does not impede the supply of credit and that banks' business conditions remain appropriate. Academic work on the influence of regulatory standards on banks' lending activity dates back to the introduction of the Basel II capital standards. The studies were mainly based on the analysis of changes in the behavior of credit institutions (Van Hoose, 2007), as well as on the overall impact on credit extended (Gambacorta & Mistrulli, 2004). The Macroeconomic Assessment Group (2010) published a report that aggregated the impacts of the new capital and liquidity requirements at the aggregate level. The authors estimate that the introduction of the liquidity rules leads to a 14 basis point increase in credit spreads and a decline in loan volumes of about 3.2%. The Basel Committee also estimates that the new liquidity and capital requirements represent a cost for credit institutions but that these reforms are accompanied by several benefits. Indeed, the Basel III standards should lead to a more stable banking system and a lower probability of banking and financial crises.

On this same topic, numerous research studies on the consequences of short-term liquidity risk regulation on lending, have been published and have led to different conclusions. In the eyes of European banks and the French Banking Federation (FBF), the effects of the LCR ratio are underestimated and could be significant in the years to come. This ratio was subject to several adjustments by the Basel Committee in January 2013 and again in January 2014. The impact study of the LCR conducted by the European Banking Authority (EBA) revealed that the asset classes making up the numerator were too restrictive and the assumptions of cash outflow over one month in the denominator were harsher than those observed during the crisis. Thus, the January 2015 revision of the LCR broadens the assets eligible for the numerator, eases the constraint on the forecast cash inflow cap (75%) for institutions engaged in specific activities (factoring, leasing, auto financing), and allows certain intra-group flows (liquidity lines) to be exempt from the forecast cash inflow cap by benefiting from more favorable weightings.

There are many works that have studied the impact of the new short-term liquidity ratio, among them Blundell-Wignall & Atkinson (2010) who pointed out how the LCR, which is introduced by Basel III in 2015, is skewed towards government bonds with respect to private sector lending. In particular, they explain how even though it could be beneficial from an interest rate risk perspective, it will necessarily have a negative impact on corporate lending. However, according to Pollin (2012), the process of reducing banks' liquidity risk will naturally have different consequences depending on the country and the institution. But overall, it does not seem to pose insurmountable difficulties, judging by the speed with which it is proceeding, according to impact studies and bank communications. Nevertheless, at the European level, the situation is even more delicate, since calculations made by the European Banking Authority (EBA) on a sample of 156 institutions from 18 European countries show that only 37% of institutions complied with the required ratio in June 2011, and only 45% had an LCR greater than 85%. This only reflects the high exposure of European banks to liquidity risk that the crisis has highlighted.

Hypothesis 2 (H2): There is a negative relationship between The LCR and Banks' lending activity.

RN. Banerjee, H. Mio (2014) conduct an empirical study on the effect of liquidity regulation on bank balance sheets. They find that banks have adjusted their asset and liability structures to meet stricter liquidity requirements. Banks have increased the share of HQLA to total assets, while reducing the share of short-term intrafinancial loans and short-term wholesale funding,

on the liability side, banks have shifted to stable deposits from nonbank and nonfinancial firms and reduced their reliance on less stable short-term funding. However, they found no evidence that tighter liquidity regulations had an impact on the overall size of bank balance sheets or a negative impact on lending to the nonfinancial sector, either through a reduction in the supply of loans or through an increase in interest rates on loans.

Banerjee & Mio (2018) examine ex-post the response of banks in the United Kingdom to tighter liquidity standards. Their results suggest that the tightening was indeed an additional constraint on the composition of intra-bank assets and liabilities, but did not affect credit flows to the real economy. In order to comply with the rules, banks tend to adjust their asset composition toward HQLA assets (Duijm & Wierts 2016; Fender & Lewrick 2013), leading to increased competition for the categories of funding considered preferable under the regulations. The increased demand results in higher asset prices and, consequently, higher funding costs for banks. This increase in prices further impacts the performance of these HQLAs. Fuhrer and al. (2017) found that yield differentiation existed between Tier 1, Tier 2, and non-HQLA securities before the regulatory changes. Yet, the introduction of the LCR further widened this gap by introducing the HQLA-premium. Thus, the marginal cost of acquiring additional units of liquid assets begins to exceed the relative yield.

Chollet (2021) whose work demonstrates that the activity of banks is intimately linked to the LCR. More specifically, the presentation of the subtle and consubstantial links between banking products (credit, collection of deposit and refinancing) and the LCR sheds light on the practices, markets, structures and operations favored by this norm. The introduction of a rule is undoubtedly a cost for banks. It shows that the cost of the LCR comes from the holding of HQLA securities and the lengthening of the debt maturity schedule. This cost has a substantial impact on banks' Net Banking Income (NBI) and varies according to the structure of the institution and the type of customer. On the other hand, using a database of 26 German banks from January 2008 to December 2011, Bonner (2012) finds that the LCR has no significant influence on lending to the private sector. He shows that banks that are close to the regulatory liquidity requirements do not charge higher interest rates to non-financial customers. The author explains this effect by the fact that credit institutions do not have the ability to incorporate the higher costs of refinancing in the interbank market into loans to nonfinancial customers, which is a lack of pricing power. Thus, Covas & Driscoll (2014) show that liquidity rules make banks more resilient under stress but push them to hold low-risk liquid assets at the expense of lending to the economy, which, moreover, could be made at higher interest rates.

Veeramoothoo & Hammoudeh (2022) studied the impact of Basel III liquidity constraints, represented by the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR), on bank profitability, using the simultaneous quantile regression framework with time fixed effects. They found a positive and significant relationship between LCR and profitability across most quantiles. However, the small magnitude of the coefficients on LCR and NSFR across all quantiles of profitability suggests that LCR and NSFR have a minor quantitative impact on bank profitability. They find that Basel III liquidity constraints have a significantly different impact on banks with very low profits compared to banks with high profitability, underscoring the need for a quantile approach. Small banks are more vulnerable to short-term liquidity risks (LCR) and large banks are more sensitive to medium- and long-term liquidity risks (NSFR).

The above discussion shows that, while complying with the new liquidity ratios, banks are reducing risky investments and making better credit allocation decisions. This allows them to build stronger and more stable asset portfolios while reducing default risk. However, it is important to understand that each economic system has its own set of characteristics that determine its relationship with different banking regulations. The same is true for Moroccan banks. The higher liquidity levels of the new regime may encourage banks to turn to riskier business activities to maximize their profits, which will worsen the situation of non-performing

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assets. Therefore, it becomes crucial to study how the credit supply of Moroccan banks meets the new liquidity standards.

Hypothesis 3 (H3): LCR has a significant impact on the lending activity of Moroccan banks.

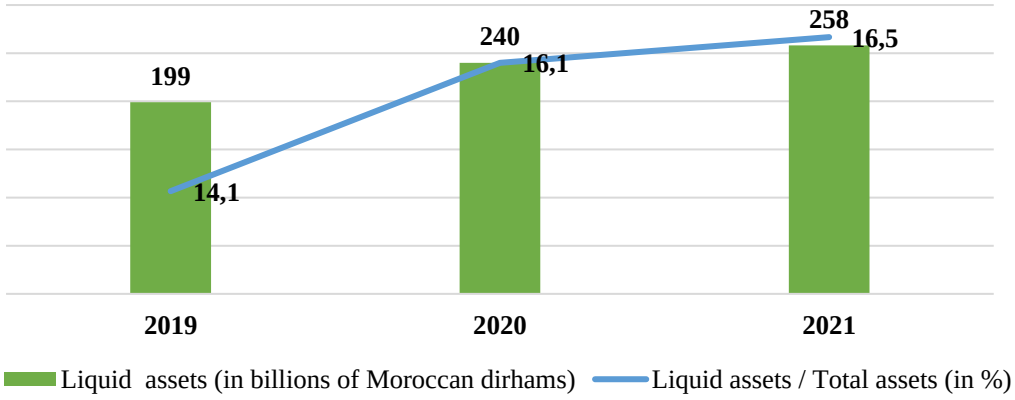
3. Analysis of the Moroccan banking regulation in the light of Basel III

In line with the directives of the Basel Committee, the central bank of morocco, Bank Al-Maghrib (BAM) follows the new reforms proposed by the committee and thus, is inspired by the international standards, in force to provide financial institutions of the Moroccan market a more robust regulatory framework. The adoption of the provisions relating to the Short-Term Liquidity Ratio of Banks transposes in Morocco the Liquidity Coverage Ratio (LCR) of the Basel Committee, by integrating the evolutions brought in January 2013 to this reform. The circular n°15/G/2013 relating to the liquidity ratio of banks. This circular set out the provisions on the liquidity ratio to be observed by banks. The LCR has been a minimum regulatory requirement since 2015 and has come into full effect (minimum requirement of 100%) since July 2019. As a transitional measure, banks were required to comply with a minimum liquidity ratio of 60% from July 1, 2015, 70% from July 1, 2016, 80% from July 1, 2017, 90% from July 1, 2018 and 100% from July 1, 2019.

The Liquidity Coverage Ratio (LCR) replaces the liquidity ratio, which is now obsolete. The LCR is a more elaborate ratio, resulting from the Basel III standards. Indeed, whereas the former ratio is based more on accounting data, the elaboration of the LCR requires detailed management data (classifications by nature of counterparty, criteria of stability of deposits, etc.) and integrates complex scenarios of cash outflows.

In 2021, the banking sector has thus achieved an average solvency ratio, on a parent company basis, of 15.8% and an average Tier I capital ratio of 12%, well above the regulatory minimums of 9% applied respectively. The average Core Tier 1 ratio, whose numerator includes only the capital used to absorb losses as a going concern, stood at 11.1% for a minimum of 8% (BAM, AMMC, 2021). So, according to the report of the banking supervision of BAM published in 2021, In the context of the 2nd year of the Covid-19 crisis, the Bank maintained the monetary policy measures it had put in place in 2020 having focused on the reduction of the policy rate to 1.5%, the expansion of collateral eligible for refinancing operations with the Central Bank and the full release of the reserve requirement. After reaching a level of 90.2 billion dirhams on average in 2020, the first year of the Covid-19 crisis, the need for liquidity of banks has been reduced to 70.8 billion in 2021, following the gradual easing of restrictions on economic activities. To this effect, Moroccan banks are largely covered and have, today, safety cushions in terms of equity and liquidity constituted thanks to the tightening of prudential and accounting standards over the past 10 years.

Figure 3: Evolution of liquid and realizable assets of conventional banks



Source: Author - based on the annual banking supervision report, BKAM 2021

The liquid and realizable assets of the banks, made up in particular of cash in hand, deposits in Bank Al-Maghrib, interbank operations, Treasury bills and certificates of deposit, totaled, at the end of 2021, an outstanding amount of 257.6 billion dirhams, up by 7.4%. The share of these assets in total assets stood at 16.5% against 16.1% a year earlier. (BKAM, 2021)

Figure 4: Average LCR rate in percentage

Source: Author

Also, the short-term liquidity ratio (LCR), which is the ratio of high-quality liquid assets (HQLA) to net cash outflows over a 30-day period for conventional banks on a social basis, stood at 170% at the end of 2021, compared to 185% a year earlier, i.e., a level well above the regulatory minimum requirement.

In order to approach the behavior of banks on a broader panel, the rest of this study uses the results of the annual financial reports of Moroccan banks, to measure the impact of the short-term liquidity ratio (LCR) on the supply of credit to Moroccan non-financial firms and individuals.

4. Methodology

4.1. Definition of variables

In our analysis, we used eight Moroccan banks, listed in the African Business report (2022), which indicates that seven Moroccan banks are among the top 20 financial institutions in North Africa, Attijariwafa Bank (AWB); Banque Populaire (BCP); Bank of Africa (BOA); Crédit Agricole du Maroc (CAM); Banque Marocaine pour le Commerce et l'Industrie (BMCI); Crédit Immobilier et Hôtelier

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(CIH); Crédit du Maroc (CDM) and Société Générale du Maroc (SGMB). The choice of those banks is for the availability of information and data, in a period starting from 2015 to 2021 (7 years). The data obtained from different sources; the number of publications per year comes from the annual reports of the banks and the database developed by the Moroccan Capital Market Authority (AMMC). For the macroeconomic variable, the World Bank indicator is used. The table below presents the definitions, acronyms and role of each variable:

Table 1: Definition of variables

Variables	Definition	Source	Acronym	Type	Individuals	Range
Receivables Non-financial corporations	These are claims of non-financial enterprises with private share capital in the legal form of companies or in the form of economic interest groupings. The different types of companies concerned are civil and commercial companies (companies with legal personality) and joint ventures and de facto companies (companies without legal personality)	Annual reports of the banks/AMMC	**RNFC**	Endogenous variable	8 banks	From 2015 to 2021
GDP growth rate	The annual average rate of change of the gross domestic product (GDP) at market prices based on constant local currency, for a given national economy, during a specified period.	World Development Indicators	**GDP r**	Exogenous variable	8 banks	From 2015 to 2021
Size Balance sheet	A common size balance sheet is a balance sheet that displays both the numeric value and relative percentage for total assets, total liabilities, and equity accounts.	Official website of AMMC/ Annual reports of the banks	**SB**	Exogenous variable	8 banks	From 2015 to 2021
Individuals receivables	Receivables from individuals, i.e. natural persons other than sole proprietors who enjoy autonomy of expenditure and whose main function is consumption (employees, civil servants, temporary customers, etc.)	Annual reports of the banks/AMMC	**IR**	Endogenous variable	8 banks	From 2015 to 2021
Liquidity Coverage Ratio	The liquidity coverage ratio (LCR) refers to the proportion of liquid assets held by financial institutions, to ensure their ongoing ability to meet short-term obligations. This ratio is essentially a generic stress test that aims to anticipate market-wide shocks and make sure that financial institutions possess suitable capital preservation, to ride out any short-term liquidity disruptions, which may plague the market.	Official website of AMMC/ Annual reports of the banks	**LCR**	Exogenous variable	8 banks	From 2015 to 2021

Source: Author

4.2. Model methodology

Our model is largely inspired by the panel study carried out by European Banking Authority report on liquidity Measures under article 509(1) of the CRR - 2018 which related several indicators. In this paper, the main model of the OLS (Ordinary Least Squares) panel approach is to obtain the relationship between GDP growth rate, Size Balance sheet, Liquidity Coverage Ratio on Receivables Non-financial corporations and Individuals receivables.
All variables will be transformed into "*ln*" to have homogeneity of the variables, eliminate the time effect and any other externality.

In our case, we have Random / None / Fixed (to estimate the panel model) presented below:

- Model – M1: **None**

It can be presented as:

$$y_{it} = a + a_i + \beta X_{it} + e_{it}$$

- Model – M2: **Fixed effect**

It can be presented as:

$$y_{it} = a + \beta X_{it} + e_{it}$$

- Model – M3: **Random effect**

It can be presented as:

$$y_{it} = a + \beta X_{it} + v_{it}$$

With a and β are the coefficient, x and y are the variables, e and v are the residus.
We must note that $v_{it} = a_{it} + e_{it}$

The estimated model has the following form:

$$L_{it} = \beta_1 LCR_{it} + \beta_2 IR_{it} + \beta_3 GDP\ r_{it} + \beta_4 \frac{SB_{it}}{L_{it}} + \beta_0 + \quad v_{it}$$

With: $L_{it} = RNFC_{it} + IR_{it}$

Modeling choice:

Hausman test

The Hausman test can be described as a test to choose the optimal model between the fixed and random. The null hypothesis in Hausman test is the preferred model is random effect. In otherwise: $Hausman\ test\ statistic\ < Chi - sq$

5. Results and discussion

5.1. Descriptive statistics

Before estimating the model, it would be appropriate to know the quality of our exogenous and endogenous variables. In our case, we have for all of them, a mean higher than the standard deviation thus a representative sample. Therefore, according to the Jarque-Bera probability, all the variables follow a normal distribution: *p-value of JB > 5%.*

Table 2: Descriptive statistics

	Receivables Non-financial corporations	Size Balance sheet	Liquidity Coverage Ratio	Individuals receivables	GDP growth rate
Mean	17,33477	1,071081	0,413111	17,14771	-2,531429
Median	17,3615	1,071697	0,385262	16,9422	-3,146555
Jarque-Bera	51,72453	1566,076	1,583688	5,717703	35,90365
Probability	0,58565	0,748787	0,453009	0,057335	0,64585
Sum Sq, Dev,	7,720145	0,074604	0,182976	10,85814	0,4711

Source: Author – Eviews

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5.2. Correlation

In our case, we have a high positive correlation between "Receivables non-financial corporations" and "Individuals receivables" with 71%. Regarding the correlation between "Liquidity coverage ratio and Receivables non-financial corporations" and "GDP growth rate and Receivables non-financial corporations" have a weak positive correlation of 4.65% and 4.27% respectively. Regarding the correlation between "Size balance sheet" and "Receivables non-financial corporations" have an average negative correlation of 40.41%.

Table 3: Matrix correlation

	Receivables Non-financial corporations	Size Balance sheet	Liquidity Coverage Ratio	Individuals receivables	GDP growth rate
Receivables Non-financial corporations	100,00%				
Size Balance sheet	-40,41%	100,00%			
Liquidity Coverage Ratio	4,65%	13,46%	100,00%		
Individuals receivables	71,56%	-8,92%	9,38%	100,00%	
GDP growth rate	4,27%	19,98%	27,75%	6,44%	100,00%

Source: Author – Eviews

5.3. Causality

The Granger test shows the causal link between two variables. As results, ***" L "*** is in bidirectional causality with all other exogenous variables namely SB_L, LCR, IR and GDPr. In other words, they have a probability higher than 5%.

Table 4: Causality test

Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
SB_L does not Granger Cause L	42	1.00565	0.3756
L does not Granger Cause SB_ L		3.16878	0.0537
LCR does not Granger Cause L	42	0.03913	0.9617
L does not Granger Cause LCR		3.81268	0.0612
IR does not Granger Cause L	42	6.37679	0.0542
L does not Granger Cause IR		6.72151	0.0532
GDP_R does not Granger Cause L	42	0.54719	0.5832
L does not Granger Cause GDP_R		0.58222	0.5637

Source: Author – Eviews

5.4. Econometric analysis

In order to answer our research problem, we have estimated the model in three parts: None, Fixed and Random.

- **The None model:** All variables are statistically significant by the student test (*0.0001 < 5%; 0.0089 < 5%; 0.0000 < 5%; 0.0005 < 5%; 0.0021 < 5%*). Hence, an F-statistic greater than F-tab, which means that the model is jointly significant at the 1% level (*0 < 1%*). Regarding the variability of the model, we have a R^2 de 0.633685, so we can say that 63% of the variation of ***" L "*** is explained by our exogenous variables.
- **The Fixed model:** All variables are statistically significant by the student test (*0.0000 < 5%; 0.0003 < 5%; 0.0065 < 5%; 0.0000 < 5%; 0.0000 < 5%*). The model is globally significant because Fisher's probability is zero (*0 < 1%*). Regarding the variability of the model, we have an R^2 of 0.942469, so we can say that 94% of the variation of ***" L "*** is explained by our exogenous variables
- **The Random model:** All variables are statistically significant by the student test (*0.0000 < 5%; 0.0007 < 5%; 0.0003 < 5%; 0.0009 < 5%; 0.0000 < 5%*). With respect to overall significance, the F-statistic is greater than F-tab, which means that the model

is jointly significant at the 1% level (*0 < 1%*). Regarding the variability of the model, we have an R^2 of 0.6818817, so we can say that 68% of the variation of ***"L"*** is explained by our exogenous variables.

To choose the optimal model we used the Hausman test presented in the methodology section.

Table 5: Model estimation

	None	Fixed	Random
SB_L	6,915***	7,992***	8,059***
σ	(1,683739)	(0,777568)	(0,774301)
Prob.	*0.0001*	*0.0000*	*0.0000*
LCR	1,176***	0,038**	0,0176**
σ	(0,228803)	(0,113131)	(0,112105)
Prob.	*0.0089*	*0.0003*	*0.0007*
IR	1,083***	0,2**	0,443**
σ	(0,136981)	(0,240991)	(0,207816)
Prob.	*0.0000*	*0.0065*	*0.0003*
GDP_R	0,077***	0,035**	0,033***
σ	(0,028296)	(0,012461)	(0,012417)
Prob.	*0.0005*	*0.0000*	*0.0009*
C	12,443**	22,383***	18,443***
σ	(3,119577)	(4,129918)	(3,599392)
Prob.	*0.0021*	*0.0000*	*0.0000*
R-squared	0,633685	0,942469	0,681817
Adjusted R-squared	0,604955	0,928087	0,656862
F-statistic	22,05616	65,52823	27,32129
Prob(F-statistic)	0	0	0

Hausman test: Model Choice

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	4.476050	4	0.3454

Source: Author – Eviews

The adequate model is the fixed model, because the Hausman probability is higher than 5%. So, we reject the null hypothesis (acceptance of the Random model).

The model is written in the form:

$$\widehat{L_{it}} = 0{,}038\, LCR_{it} + 0.2\, IR_{it} + 0.35\, GDP\, r_{it} + 7{,}992\frac{SB_{it}}{L_{it}} + 22.383$$

5.5. Validation of the model: post-estimation test

- **Autocorrelation test:**

In order to test the Autocorrelation of the residuals, we used three tests: *Breusch-Pagan LM, Pesaran scaled LM and Pesaran CD* which have the same results. The probability of the entire test is lower than 5%, as a conclusion, we can accept the null hypothesis that no cross-section dependence in residuals.

Table 6: Residual Cross-Section Dependence Test

Null hypothesis: No cross-section dependence (correlation) in residuals			
Test	**Statistic**	**d.f.**	**Prob.**
Breusch-Pagan LM	136.3659	21	0.0000
Pesaran scaled LM	17.80135		0.0000
Pesaran CD	11.63809		0.0000

Source: Author – Eviews

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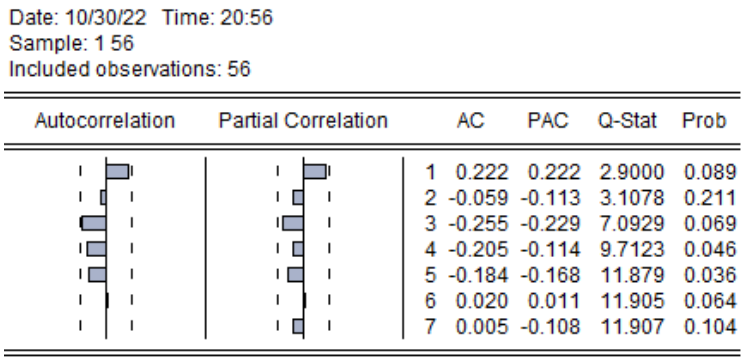
- **Stability of the model:**

We notice that the bars are inside the interval, which shows that the residues are stable in time. As a conclusion, the model is also stable in time.

Figure 5: Correlogram of the residuals

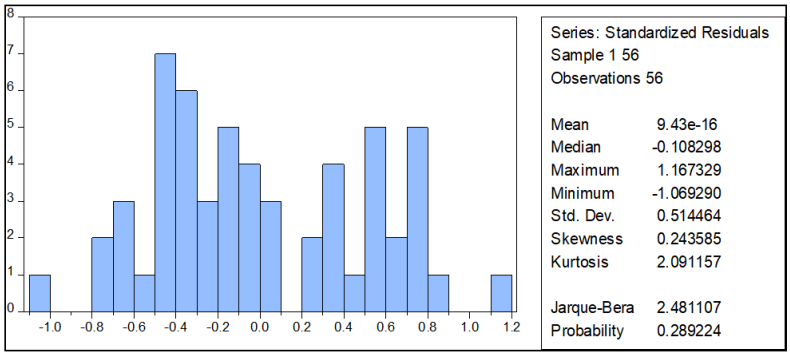


Source: Author – Eviews

- **Normality test:**

In order to test the normality of the residuals, we used a Jarque-Bera test. we conclude that the probability is greater than 5%. Therefore, the model follows a normal distribution.

Figure 6: Normality test



Source: Author – Eviews

5.6. Discussion:

In order to answer our problem, we used data from eight banks in a time interval from 2015 to 2021. We used panel data. As results, an increase of LCR of one unit leads to an increase of ***"L"*** of 0.038. For the IR, an increase of one-point leads to an augmentation of ***"L"*** of 0.2. For the GDP, it impacts positively on the ***"L"***, an appreciation of one point generates an increase of ***"L"*** of 0.35. On the other hand, the SB/L ratio also has a positive impact on the ***"L"*** with 7.992. All these variables seem to be statistically significant at the '1% level. In terms of overall significance, the model is statistically significant.

The LCR liquidity ratio shows a positive sign, therefore, increasing the LCR by one percentage point for a bank implies, all else equal, an increase in new lending of almost 0.038. Therefore, the hypothesis that there is a negative relationship between The LCR and Banks' lending activity is rejected and the hypothesis that states that LCR has a significant impact on the lending activity of Moroccan banks is accepted. This result is consistent with the results observed by (RN. Banerjee, H. Mio 2014; Bonner 2012) and refutes the findings of (Blundell-Wignall & Atkinson 2010; Covas & Driscoll 2014). The parameters of the variables show signs consistent with expectations. The coefficient on GDP is positive and statistically significant by specification. Thus, GDP growth contributes positively to credit growth. The parameter of the

SB/L ratio is also positive, meaning that the rate of coverage of credits by the banks' balance sheet would be a determining factor for the growth of credit flows to the economy.
Therefore, the result of our study is consistent with (Veeramoothoo & Hammoudeh, 2022) the liquidity constraints of Basel III have a significantly different impact on banks with very low profits compared to banks that enjoy high profitability. So small banks are more vulnerable to short-term liquidity risks (LCR) than large banks, based on the bank balance sheet, which is negatively correlated with credits granted to non-financial companies and individuals on our case. This suggests that consideration should be given to tailoring liquidity regulations to the size and relative profitability of banks. The research results support the hypothesis that there is a significant relationship between The LCR and Banks' lending activity. The quantitatively small impact of the regulations, implies that Basel III has succeeded in setting liquidity requirements to minimize the impact on the supply of bank credit to individuals and professionals, and the likelihood of an international liquidity crisis. Thus, banks with liquidity ratios close to the level required by the regulation did not pass on the additional cost in interest rates on loans granted. Therefore, it did not hinder the supply of bank credit.

6. Summary and conclusions:

The objective of this study was to quantify the impact of the implementation of the LCR by the Moroccan banking regulation on the supply of credits, by a sample of eight representative Moroccan banks to non-financial companies and individuals using an econometric model estimated on fixed panel data. The results obtained reveal a positive relationship between the level of the LCR and the flow of credit to the economy. It is thus dominated by the positive effects of the variables, which are the performance of the national economy (GDP growth) and the credit coverage ratio of bank balance sheets. In this context, it is useful to recall that the concerns raised by the (EBA) Banking Stakeholder Group are not materialized. The impact of the implementation of the short-term liquidity ratio is less problematic for Moroccan banks, especially the big banks, insofar as they are retail banks whose resources are mostly deposits, so the impact of the LCR ratio is perceived as moderate for retail banking activities.
As a result, liquidity regulations are designed to enhance the ability of banks to withstand severe financial stress from either the financial system or the economy. Therefore, the incubation and design of liquidity ratios are such that they should lead to a higher stock of liquid assets. Sufficient liquidity reduces the risk of insolvency and promotes robustness and resilience during periods of stress. As a reminder, the LCR ratio requires that a bank hold enough liquid, readily marketable assets to withstand a crisis that results, for example, in a massive withdrawal of funds by depositors or a halt to loan renewals by the bank's creditors. This ratio pushes banks to balance their loans and deposits. The results obtained by our model estimate that banks with liquidity ratios close to the level required by regulation did not pass on the additional cost in interest rates on loans to firms. Although the impact of bank liquidity regulations on credit supply has been examined in the literature, there are very few studies that have explored this relationship in the Moroccan context. As it is imperative to study the impact of these regulations in different countries/economies, this study examined the impact of the new liquidity standards namely the LCR on Moroccan banks.
We analyzed more than 8 banks over a 7-year period between 2015 and 2021. Three different models were created to analyze the correlations between significant attributes using various weighted combinations. The models developed were based on leading fixed panel data regression methodologies. The results of the study show that an increase in LCR and its components increases the supply of financing, which has a positive impact. Thus, increasing liquidity reduces the liquidity risk faced by banks, and it comes at the expense of profitability. Empirical evidence suggests that bank lending tends to increase in response to higher levels of

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liquidity, further adding to the stress on bank profitability. The limitation of the study is the unavailability of data on the long-term liquidity ratio (NSFR) of banks. However, our results can be completed by other comparative work with other emerging countries.

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