EFFECTS OF THE BASEL III LIQUIDITY COVERAGE RATIO ON BANKS' LENDING IN THE UNITED STATES

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ABSTRACT

The objective of this paper is to explore how the Basel III Liquidity Coverage Ratio influences banks' lending behaviour. Using a panel data which belongs to 24 commercial banks of different sizes from the United States allows us to compare the effects based on bank size. Moreover, this paper compares the banks whose lending is subject to regulations and the banks which are not obligated to meet the requirements. Results reveal a significant decrease in real estate lending while there is not any significant negative effect on consumer lending. Also, loan growth is limited by the regulations for the banks that are obligated to meet the requirements.

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1. INTRODUCTION

The 2008 Great Financial Crisis damaged the financial system substantially in the United States. Moreover, along with the U.S, it was a severe global crisis. Many U.S. banks, such as Bear Stearns, Lehman Brothers, defaulted during the crisis. One of reasons for the defaults was the maturity mismatch in the banking sector (Farhi and Tirole, 2012). Traditionally, banks profit from the maturity transformation; they borrow in short-term from the lenders in the form of demand deposits and invest in long-term lending, such as mortgages which might take 30 years to be repaid. However, investing in long-term illiquid assets can be dangerous. If there is confidence in the economy, there will be casual withdrawals from banks; however, if panic strikes depositors, that will lead to a bank-run and every depositor goes to the bank before the bank gives out all of its assets. In this case, banks might not have enough funds to meet its obligations (Diamond and Dybvig, 1983). Therefore, the bank must liquidate all of the assets and execute these illiquid assets which make the banking system more vulnerable to shocks.

During the financial crisis, both commercial and investment banks were exposed to the liquidity risk as they invested in long-term assets and borrowed from short-term papers. They had started to rely on overnight funding more and more and eventually they were exposed to maturity mismatch (Brunnermeier, 2009).

Therefore, Bank for International Settlements (BIS) Basel Committee proposed the Liquidity Coverage Ratio to the internationally active banks with assets of more than $50 billion in their balance sheet in 2013. Under the Basel III Liquidity Coverage Ratio banks are obligated to hold enough liquidity for a case of 30 days stress scenario. Banks can provide that liquidity by adjusting their assets or by decreasing their net cash outflows in a stress period. In addition to the Liquidity Coverage Ratio, they have also proposed the Net Stable Funding Ratio. Both regulations have the same purpose, and they are complementary; the difference is their implementation duration. Liquidity Coverage Ratio focuses on 30 days, short-term activities of banks while the Net Stable Funding Ratio is a long-term activity regulation which creates incentives for banks to rely on more stable funding sources. Net Stable Funding Ratio which is not covered by this paper plays a supplementary role to Liquidity Coverage Ratio in the long-term.

Basel norms compromised capital requirements rather than liquidity requirements, until now, and this has been the first time banks are subjected to liquidity regulations. However, on a country basis, there are other liquidity regulations similar to the Liquidity Coverage Ratio, such as Individual Liquidity Guidance in the United Kingdom and Dutch Liquidity Coverage Ratio in the Netherlands. Therefore, other papers related to country basis liquidity regulations will be used to interpret the effects of the current Basel III liquidity rules.

Regulations aim to create a globally resilient banking system against economic shocks by steering the banks to hold liquid assets. On the other hand, by creating a more resilient financial system, regulations might affect banks' maturity transformation actions, and thereby their lending behaviour to the real economy. Regulations were proposed in 2013 while the

Basel started to implement it in 2015. During the two year period, banks had started to hold liquid assets in preparation to comply with the regulations by 2015. Rather than the overall lending, regulations might substantially affect the sectorial lending behaviour. European Bank Authority (EBA) report[1] (2017) shows that there is a decrease in automotive and consumer loans after the liquidity regulations in Europe. A regulation on banks' liquidity management is essential, but a significant effect on real economy[2] lending might be dangerous.

This paper focuses on banks' lending because it is one of the main resources for banks' profitability and growth. Meanwhile, banks' lending plays a significant role for the economies and it is positively correlated with the economic growth and productivity of the nations. Economic growth and increasing productivity lead to higher average incomes, lower unemployment, lower government borrowing, improved public services …etc.

Dataset covers the United States commercial banks and seeks finding the results that depend on banks' size and also expects to find the changes in two different types of loans; consumer loans and real estate loans which have a substantial effect on the real economy growth. By using a panel data, fixed effects regression measures the effects of Liquidity Coverage Ratio on banks' lending between the 2013 and 2015.

The results reveal that there is a decrease in real estate lending for medium-size banks while it is not significant for large banks. Also, overall, banks which are subject to regulations have a smaller long-term lending growth compared to banks that are not subject to regulations.

In the remainder of the paper, the second section provides a brief background about the Liquidity Coverage Ratio. The third section reveals the literature related to banks behaviour in the absence of liquidity regulations and their potential responses to it. Moreover, according to literature, central bank and monetary policy have an essential role in steering the possible effects of the liquidity regulation so the third section will also be discussing it. The fourth section explains the methodology and other variables that are used to explain the changes in banks' consumer and real estate lending. If the banks' lending is crucial, it is essential to know what else affects bank lending. Briefly, factors can be divided into two categories as bank-specific and central bank dependent factors, and they are used as a variable. So, the fourth section also gives short information about these variables. The fifth section presents the results, and, finally, the last section concludes the paper.

2. LIQUIDITY COVERAGE RATIO BACKGROUND

Specifically, the Liquidity Coverage Ratio went into operation on the 1st of January 2015, but the minimum requirement was set at 60% to be raised in equal annual steps to reach 100% by the 1st of January 2019. This graduated approach is designed to ensure that the Liquidity

[1] The European Banking Authority report (2017) on liquidity measures under article 509(1) and the review of the phase-in of the liquidity coverage requirement under article 461(1) of the CRR

[2] Real economy produces goods and services unlike the financial markets part of the economy.

Coverage Ratio can be introduced without material disruption to the orderly strengthening of banking systems or the ongoing financing of economic activity[3].

	1 January 2015	1 January 2016	1 January 2017	1 January 2018	1 January 2019
Minimum LCR	60%	70%	80%	90%	100%

Privately, in the United States, banks that hold more than $50 billion had to comply with the regulations by 100% by 2017, according to the U.S. Department of the Treasury. However, many banks already achieved the 100% goal in 2015.

Banks for International Settlements define the primary objective of the liquidity regulations as "*this standard aims to ensure that a bank has an adequate stock of unencumbered high quality liquid assets that consists of cash or assets that can be converted into cash at little or no loss of value in private markets".* As it is mentioned above, the liquidity coverage ratio aims to increase the resilience of banks against liquidity shocks. Therefore, according to regulations, banks are required to hold enough amounts of high quality liquid assets against a 30-day stress scenario.

Under the regulations, banks are exposed to following stress test;

$$\frac{TOTAL\ STOCK\ OF\ HIGH\ QUALITY\ LIQUID\ ASSETS}{TOTAL\ NET\ CASH\ OUTFLOWS\ OVER\ THE\ NEXT\ 30\ CALENDAR\ DAYS} \geq 100\%$$

Initially, high quality liquid assets are the the assets that can easily be converted to cash with a little or no loss. However, an asset's liquidity depends on the type of stress scenario, but there are some certain assets with safe characteristics. These assets are divided into 3 categories, but they all have to carry some fundamental and market-related characteristics.

2.1. High Quality Liquid Assets' Fundamental Characteristics

- Low risk: assets that carry low risk have higher liquidity than others. Low duration, low legal risk, low inflation risk and denomination in a convertible currency with low foreign exchange risk all enhance an asset's liquidity

- Ease and certainty of valuation: if market participants agree on the valuation of an asset, this increases its liquidity. If the asset has homogenous expectations about its price and risk, it tends to be more fungible and promotes liquidity. Also, the market participant must have access to information about the asset, and therefore the price calculation will be easier.

- Low correlation with risky assets: liquid assets must not be in correlation with risky assets that can be affected by a stress scenario since it can influence the liquid asset.

- Listed on a developed and recognised exchange: it refers to the transparency of an asset.

[3] Bank for International Settlements, 2013, *Basel III:Liquidity Coverage Ratio and liquidity risk monitoring tools*

2.2. High Quality Liquid Assets' Market-Related Characteristics

- Active and sizeable market: that means there has to be a large number of market participants and high trading volumes. Also, diversified participants decrease the market concentration and raise the reliability of liquidity in the market.

- Low volatility: this refers to stable prices and smaller price declines over time. There has to be historical evidence from the previous stress scenarios that shows the changes in the prices.

- Flight to quality: historically, the market has to move into that type of assets during a crisis period since they are safe.

Three groups that are defined by the Bank for International Settlements as high-quality liquid assets are Level 1, Level 2A and Level 2B assets. Banks can hold an unlimited share of Level 1 assets as the stock of high-quality liquid assets. These assets are not subject to haircuts; examples of these assets are cash, deposits at the central bank, government or government-guaranteed bonds, and covered bonds that meet certain specific conditions. Level 2 assets (comprising Level 2A assets and any Level 2B assets permitted by the supervisor) can be included in the stock of high-quality liquid assets, subject to the requirement that they comprise no more than 40% of the overall stock after haircuts have been applied. A 15% haircut is applied to the current market value of each Level 2A asset held in the stock of high-quality liquid assets. They include third country government bonds and bonds issued by public entities with a 20% risk weight. Certain additional assets (Level 2B assets) may be included in Level 2 at the discretion of national authorities. A larger haircut is applied to the current market value of each Level 2B asset held in the stock of high-quality liquid assets.

The expected outflows are generally calculated as a percentage outflow on balance sheet items, such as funding (e.g., deposits and wholesale funding) received by banks and off-balance sheet commitments (e.g., credit and liquidity lines) made by banks. This outflow varies typically by the counterparty. For example, the outflow expected on retail deposits made by physical persons and small and medium entities is lower than the outflow expected on deposits provided by corporates and especially financial institutions. Expected liquidity outflows on maturing "repurchase agreements" are also taken into account.

The expected inflows are also generally calculated as a percentage inflow on balance sheet items and they include inflows, e.g. on retail, corporate and financial loans that will be repaid within 30 days, as well as cash arising from funding returning to the bank on maturing repo contracts.

Furthermore, according to BIS, the stress scenario is as follows;

"(a) with a run off retail deposits;

(b) if banks loses the wholesale funding capacity;

(c) a partial loss of secured, short-term financing with certain collateral and counterparties;

(d) additional contractual outflows that would arise from a downgrade in the bank's public credit rating by up to and including three notches, including collateral posting requirements;

(e) increases in market volatilities that impact the quality of collateral or potential future exposure of derivative positions and thus require larger collateral haircuts or additional collateral, or lead to other liquidity needs;

(f) unscheduled draws on committed but unused credit and liquidity facilities that the bank has provided to its clients; and

(g) the potential need for the bank to buy back debt or honour non-contractual obligations in the interest of mitigating reputational risk. "

The following part covers the related literature on the banks liquid asset holdings and the liquidity regulations.

3. LITERATURE REVIEW

To understand the effects of regulations, it is essential to know why banks prefer to hold liquid or illiquid assets, how it affects their lending and how it is related to their size. Therefore, the first part of the literature review looks for the banks' natural behaviour in the absence of liquidity regulation. The second part reviews the papers which are directly about the effects of liquidity regulations on banks' lending. Furthermore, as it mentioned in the introduction, monetary policy is quite essential when banks determine their preferences about the liquid asset holdings, borrowing and lending. This is what this paper argues for in the third part.

3.1. Banks' Liquidity Preferences

Broadly, banks have two main activities; they obtain funds through deposits and grant loans. If a bank chooses not to invest any funds in loans, it can hold these funds as cash or invest these funds in marketable securities, such as Treasury Bills and bonds. The main difference between these actions is liquidity and yield of the assets they invest in. If an asset has high convertibility to cash, it has lower liquidity vice versa. The answer to the question of determinants for the bank's liquidity holdings can be divided into three parts. First, Alger (1999) implies that banks have a trade-off between liquid assets and profitability. Basically, a bank can invest in riskless lower-yield assets like Treasury Bills, or it can hold cash. In contrast, it can invest in higher-yield risky assets which are illiquid loans in this case. That creates a portfolio management side which depends on banks' risk aversion. Secondly, Stiglitz and Weiss (1981) refer to the demand and supply side of loans. They describe a moral hazard situation when considering borrowers' default risk. Given the level of deposits, banks should increase their liquid assets if the borrowers in the economy are believed to have become riskier, as it can be during a recession period. Lastly, banks use liquid assets as a buffer against shocks. In a case of cash withdrawals, they must meet the excessive cash calls by the depositors. There is extensive literature that discusses the optimal portfolio for banks liquidity holdings and bank runs (see, e.g., Alger (1999), Edgeworth (1888), and Porter (1961))**.** Eventually, banks' liquid asset holdings depend on their risk aversion and the state of the economy. However, literature shows that banks behaviour about liquidity holdings depends substantially on their size.

Nguyen et al.'s (2017) work aims to find the relation between the banks' market power and liquidity. They carry out their analysis of more than 4,000 banks in 101 countries and show that bank liquidity increases when the market power goes up until a point; after this point (they call it empirical-constructed threshold) the scenario changes. When banks have more substantial market power than this threshold, they hold less liquidity. Also, they find that dominant banks hold less liquid assets and earn greater profits from high-yielding risky assets. They explain the reason as following; banks with more market power experience less financial friction in accessing funding markets, and since they can afford to hold less liquid assets, they invest in high-yielding illiquid loans.

Berger and Bouwman (2009) look for the correlation between banks value and liquidity creation. Their findings show that banks with total assets of more than $50 billion create 81% of the liquidity while they comprise only 2% of all banks, and they also say higher bank value is positively correlated with liquidity creation. Similar to their results, Allen and Santomera (1998) and Allen and Gale (2014) say that higher bank value means higher liquidity creation. Additionally, they say that banks which create liquidity are exposed to risk and a larger probability and severity of losses related to having to dispose of illiquid assets to be able to pay customers' liquidity demands. That means banks with higher value are exposed to the risk more and decrease their liquid asset holdings.

Consequently, large banks which are highly interconnected with the financial system hold less liquid assets compared with medium and small size banks. Since the regulations cover a stress scenario, as Alger (1999) points out, banks behaviour under a stress scenario depends also on their size; during a stress period, small banks start to hold less liquidity in comparison with medium and large banks which increase their liquid asset holdings substantially.

As the financial system had experienced during the 2008 Great Financial Crisis, a disruption of highly interconnected banking system caused severe damage. That means if a bank has high value and strong market power, it must hold more liquid assets. Nevertheless, according to the papers above, large banks only try to increase their liquid holdings if there is a stress scenario. However, in a severe liquidity crunch, it is not easy to find funding sources even for the banks with higher value as economies experienced during the most recent crisis. At this point, the liquidity regulations can be useful and create more resilient banking system since they assume it will be prepared for a stress scenario that lasts one month. However, obliging banks to be prepared for such a scenario may decrease lending to the real economic sectors which constitute the largest share for granted loans. Therefore, banks' reaction to the new norms is crucial for the economy.

3.2. Banks' Response to Liquidity Coverage Ratio

The second part of the literature review explains how banks would react under the Liquidity Coverage Ratio. Banerjee and Mio (2017) explain the expected changes in banks' balance sheet when banks try to be in compliance with the Individual Liquidity Guidance (ILG) which carries almost the same characteristics as Liquidity Coverage Ratio.

They say that banks response to the regulations might be in the following ways:

1) Shrinking the size of the balance sheet by cutting the loans to the non-financial sector which would increase the ratio of high-quality liquid assets to stressed liability outflows.

2) Increasing the size of the balance sheet by issuing equity to acquire high-quality liquid assets to meet liquidity requirements without affecting lending to the real economy.

3) Not changing the size of the balance sheet but changing the composition of assets or liabilities.

They find that banks adjusted both their assets and liabilities while they could not find any evidence related to overall bank balance sheet size. However, banks with ILG had an increase in high-quality assets by 12%. 75% of this increase was cash and central bank reserves while 25% was the UK Treasury Bills and longer maturity gilts. The increased share of high-quality assets was matched by an almost equal reduction in the share of short-term intra-financial loans[4]. This means banks increased the amount of high-quality liquid assets by holding more cash and central bank reserves instead of short-term lending to financial institutions. Roberts and Sarkar (2018), who have similar findings, say that the effects of liquidity regulations on liquidity creation depend on the banks' individual response to the regulation. For the banks that do not meet the requirements, the direct effect may be a decrease in the liquidity mismatch, and that means reducing liquidity creation.

Nevertheless, since the liquidity preferences differ from one bank to another, banks can undo the direct effect. For instance, banks are able to manage their non-high quality liquid assets, so they can change the composition. They can increase the portfolio weight of low-liquid assets. Even within a certain high-quality liquidity level, banks can substitute relatively lower liquid or larger maturity assets for liquid, short-term assets. Eventually, whether the liquidity creation changes or not, it is an empirical matter. Roberts and Sarkar (2018) examine liquidity creation per unit of assets by banks subject to the Liquidity Coverage Ratio. They have found that since 2013, there has been reduced liquidity creation by banks which occurred mostly through greater holdings of liquid assets or less illiquid assets. They have found sharper declines of commercial and residential real estate loans. Also, Ihrig et al. (2017) look for the optimal high-quality liquid assets portfolio that depends on each banks' risk tolerance. Their work was based on the three different assets which compose the most considerable proportion of high-quality liquid assets; excess reserves, treasury securities, and mortgage-backed securities of the U.S government-sponsored enterprises. Their findings show that a high-risk averse bank prefers relatively large shares of reserves. Naceur and Roulet (2017) look for the effects of liquidity regulations on bank lending in the United States and Europe. They have found that the United States banks reinforced their risk absorption capacities when expanding their risky activities. As a result, even if liquidity indicators have positive effects on bank lending growth, indicators increase banks' risky lending which supports the need for heterogeneous banks characteristics and behaviours when implementing new regulatory policies. Also, Bonner et al. (2013) point out the issue of

[4] Intra-financial loans mean secured and unsecured lending to other financial and monetary institutions.

the interest rates on loans, and they say in order to maintain profitability, the bank will look for other ways to counter the decrease in their profitability by raising the interest rates charged on loans and decrease the rates paid on deposits.

The EBA (2017) paper shows that, in December 2015, all banks had an average of 134% Liquidity Coverage Ratio and it says that 90% of the banks complied with the 100% minimum requirement. The analysis reveals that the majority of liquid assets are the Level 1 assets which contain cash, central bank reserves, and securities. Their data shows that banks doubled their liquidity buffers after the Liquidity Coverage Ratio was proposed. In contrast, net cash outflows remained stable until 2015. Also, the report implies that since the number of total assets has remained stable as well, it can be concluded that the asset side of the balance sheet is the primary source for improving their liquidity profiles. Moreover, Level 1 assets have the largest positive effect on the Liquidity Coverage Ratio, which is not surprising since they are not subject to haircuts. The EBA (2017) report was unique in reporting the finding that an increase in the share of Level 1 assets by 1% provides a rise in the Liquidity Coverage ratio by 1.18%. On the other hand, non-operational deposits have the most negative impact on cash outflows; an increase of 1% causes a decrease in the Liquidity Coverage Ratio by 0.75%.

Nicolo et al. (2014) say liquidity requirements decrease the lending, efficiency, and welfare. In detail, an additional liquidity requirement to a capital requirement alters optimal bank policies significantly. Their results show that banks' lending and debt shrink for every realized systematic shock. Thus the liquidity requirements turn out to be more restrictive than capital requirements, forcing banks to invest in low yield, liquid assets rather than high profitable, illiquid assets. Moreover, the correlation between the systematic shock and lending is reduced for the banks subject to capital regulation only. Liquidity ratios are dramatically larger than the prescribed level (about 120%) since the cost related to the liquidity constraint pushes banks to hold precautionary high-quality liquid assets to avoid hitting that constraint. Additional liquidity requirements to capital requirements undo the positive effects of mild capital requirements since they cause significant declines in lending, banks' efficiency and welfare. Lastly, they say liquidity requirements limit banks maturity transformation function by forcing them to hold unproductive liquidity buffers.

Summarising this part show that banks changed the composition of their balance sheet, and they started to hold more liquid assets. Results show that this decreased lending for some specific sectors. Moreover, realising a shock, push banks to hold more precautionary stocks of liquid assets and it might decrease lending further. As Naceur and Roulet (2017) and Roberts and Sarkar (2018) say, response might depend on banks characteristics, especially on their size. It is also important to state that sectoral lending would be affected rather than overall lending. Nguyen et al. (2017) emphasize that bank liquidity can be affected by the country's financial regulations, bank supervision, and industry infrastructure. Implications of their results are that liquidity requirements under Basel III may prove effective only for banks whose market power is beneath the empirical-constructed threshold. Therefore, Basel III standards on bank liquidity may benefit from having greater sensitivity to bank dominance in deposit and loan market. Thinking about Treasury Bills, banks can hold Treasury Bills to

meet the ratio, but they are still lending to the government. Banks can still give loans that are included in the 2B asset category and increase their liquidity ratio. This means that measuring the effects by using central bank dependent variables is critical as much as bank-specific characteristics. Hence, the following part explains the relationship between the monetary policy and liquidity regulations.

3.3. Monetary Policy and Liquidity Regulations

The third part expresses the idea about the relation between the regulations and monetary policy since the central bank can conduct money supply by performing open market operations and it can control market interest rates by steering discount rate. Therefore, the central bank can steer banks investments and lending through the monetary policy vehicles. So the central bank must be in co-operation with the Basel liquidity regulations. Kording and Scheubel (2018) explain how the co-operation must be in a case of interaction between the central bank policies and regulation on financial markets. They say regulations will affect the equilibrium of money markets which also alters the central bank actions to affect this market. However, the central bank must be able to adjust its operational framework to the changes in equilibrium that exist when regulation is in place. They say that interaction can be complementary or conflicting which depends on each authorities' behaviour. It becomes complementary if the action of one policy-maker brings the other one closer to its optimum level. On the other hand, it can be conflicting if the action of one force the other one to take more action since it gets away from the optimum level. In the Liquidity Coverage Ratio scenario, since it is a global norm, each central bank must adjust its operational framework that depends on average ratio levels.

Central bank's behaviour can influence the commercial banks in different ways. Initially, a spread between loans and deposits[5] pushes banks to perform in maturity transformation, but it also exposes them to liquidity risk. Banks hold reserves as a precautionary buffer, but the banks that face high amounts of withdrawals have to use these reserves to meet these withdrawals. After banks have to appeal to costly interbank market or *discount window* [6] borrowing, here the central bank has the authority and the power to change the liquidity premium between the interbank and discount rates, and by doing that they can affect the economic activity (Bianchi and Bigio, 2014). Furthermore, Alper et al. (2012) empirically analyse whether monetary policies are able to manipulate liquidity positions of banks that can affect bank lending as well as they look for the effects of liquidity holdings on lending behaviour. Their results say that bank-specific liquidity is important in credit supply. Moreover, in determining their lending, banks do not only consider their individual liquidity position but also the systemic liquidity. They relate it to the monetary policy and indicate that any monetary policy which can alter the liquidity in the market is potentially effective on credit supply.

[5] Interest rate difference between the loans and deposits.

[6] The Federal Reserve and other central banks maintain discount windows, referring to the loans they make at an administered discount rate to commercial banks and other deposit-taking firms. Discount window borrowing tends to be short-term – usually overnight – and collateralized.

Some works specifically explain the interaction between the Liquidity Coverage Ratio and central bank's monetary policy; Bech and Keister (2017), for instance, show that when there is a Liquidity Coverage Ratio shortfall, the relationship between the amount of central bank reserves and market interest rates changes. A bank which is concerned about its inability to meet the ratio can seek funding in the market and is more presumably to borrow from the central bank. Both of these contribute to the bank's reserves and decrease the need to look for funds in the overnight market. That also means decreasing demand for overnight funds which causes a decline in overnight rates. Their results suggest that the central bank can adjust the operational framework as the new regulation is implemented. Duffie and Krishnamurty (2016) say that when Liquidity Coverage Ratio decreases, this can be mitigated by the central banks or treasury actions to increase the supply of short-term, high-quality liquid assets, such as additional supplies of Treasury Bills or some variant of them. That means when the ratio decreases for many banks, the central bank can supply additional liquid assets, decreasing these assets' prices and playing a supplementary role to banks. Moreover, they say if there is a scarcity of high-quality assets, the Liquidity Coverage Ratio will cause the rate spread between Level 1 and Level 2 assets to raise. They say the central bank must purchase riskier or longer-term assets in exchange for safe, short-term assets. The central bank can do it directly by buying Agency Mortgage-Backed Securities and paying with reserves. Also, it can increase the supply of safe short-term assets by issuing reverse repos against Agency Mortgage-Backed Securities. While Bech and Keister (2017) talk about the dilemma which banks can be in due to regulations, Duffie and Krishnamurty (2016) explain how the central bank can prevent the losses of commercial banks that rise from requirements.

A more detailed paper by the Bonner and Eijffinger (2012) look for the impact of liquidity regulations on interbank money markets and monetary policy implementation. They show that liquidity requirements cause an increase in long-term borrowing and lending rates as well as the demand for long-term interbank loans. Lower levels of aggregate liquidity in the economy increases the estimated effects. Short-term borrowing and lending rates only increase during periods of lower market-wide liquidity. They show that the banks which are around the liquidity coverage ratio requirements pay and charge larger interest rates than other banks in the unsecured interbank money market. They say "*during a crisis, being just above or below the prudential liquidity requirement induce a negative impact on lending, even when controlling for relationship lending and the riskiness of the borrowing counterparts".* Bonner and Eijffinger (2012) empirically analyse banks which resort either to central bank's discount window or interbank market, and they find an increase in the demand for long-term interbank loans which have maturities longer than one month. Therefore, they think that the current design of the Liquidity Coverage Ratio decreases the efficiency of the central bank.

Li et al. (2017) link the reserve requirements, liquidity regulations and banks' liquidity creation. They look for the effects of liquidity requirements on banks' money creation by adopting the new requirements to the money multiplier. They emphasise that banks' loan supply is restricted because of the central banks' reserve requirements and Liquidity Coverage Ratio. When the reserve requirement is tighter than the Liquidity Coverage Ratio,

the money multiplier has the same statement of that in the prevailing fractional reserve regime. When the situation departs from this regime, the determinants of the money multiplier are found to be associated with the parameters that characterise the behaviour of banks subject to the regulation rather than those monetary structural factors. It is remarkable that there may be a credit contraction and even a significant reduction in money multiplier when the Liquidity Coverage Ratio regulates the bank. This novel perspective on credit creation of the banking system also offers us an insightful understanding of the impacts of banking regulations on the stability of the banking system and suggests a new guide tool for designing them.

The literature review implies that banks with higher value are exposed to more risks. Nevertheless, they hold less liquid assets compared to smaller banks. Liquidity regulations would have a larger effect on large banks, but their lending behaviour might change based on their characteristics. Moreover, monetary policy plays an important role in steering banks behaviour through the reserve requirements and discount window rate. That means the central bank's behaviour is also crucial for the liquidity creation since the money multiplier is dependent on required reserves. As well as the central bank has an effect on the liquidity regulations and banks' lending behaviour, Liquidity Coverage Ratio can influence the efficiency of central bank's interest channel, according to Bonner et al. (2015)**.** As it is mentioned in the first part of literature review, banks might look for other ways to counter the decrease in their profitability by raising the interest rates charged on loans and decreasing the rates paid on deposits. Finally, the related literature shows that in addition to the bank's preferences, central bank monetary policy vehicles and liquidity regulations will be connected and affecting each other.

4. METHODOLOGY

According to the literature, the model will contain bank-specific and central bank dependent variables. Roberts and Sarkar (2018) use two different bank sizes; first category (large banks) has more than 250 billion dollar assets while the second category (small banks) banks hold assets between 3 and 50 billion dollars. They discard the banks with less than $3 billion assets. Nevertheless, this paper divides the large banks into 2 categories by their size; the largest four United States commercial banks and banks that hold fewer assets than largest banks but hold more than $50 billion total assets. The second category is called medium-size banks. Small size banks with less than $50 billion assets in their balance sheet are not subject to regulations. Therefore, testing the loan growth difference between the small banks and the other two categories can also reveal whether the Liquidity Coverage Ratio has an adverse effect on loan growth or not. Moreover, to see the precise effect, a fixed effect regression will be run for medium and large banks.

The paper aims to see the change in the amount of loans. Similar to Robert and Sarkar (2018), a dummy variable is added which is 1 if the time period is between the first quarter of 2013 and the last quarter of 2015. Analysing the effect between these 2 periods is the critical point because the Liquidity Coverage Ratio was announced in 2013; however, the authorities began to implement it at the end of 2015. The two-year gap was an adaptation process for the banks,

so the changes in loans were larger than the following periods since the other papers' observations reveal that banks have already started to hold enough amounts of liquidity ratios by 2015 (EBA Report, 2017; Robert, and Sarkar, 2018). Several independent variables will be used which can affect banks' lending behaviours. As it has been used in previous studies, bank-specific and central bank dependent variables will be considered. Bank-specific variables are the capital to risk-weighted asset ratio, non-performing loans to total loans ratio, return on average equity, liquidity ratio and cost of funds while the monetary policy variables are the required reserve balances and effective federal funds rate. The following part also explains the reasons to pick up these variables.

4.1. Data and Regression Model

The Panel data from S&P 500 Market Intelligence database covers the four large, nine medium-size, and eleven small-size commercial banks of the United States determined by the ranking of the Federal Reserve. Each bank's balance sheet and financial regulatory highlights contain the data about the consumer and real estate loans and bank-specific variables respectively. The dataset covers quarterly data for each banks' balance sheet with 840 observations from the second quarter of 2009 to the first quarter of 2018.

In detail, panel data allows us to control for variables which are not observable or measurable, such as business strategy across banks, customer portfolio, and individual decisions by executives which may be correlated with banks' lending variables or with supply-side effects. Fixed effects model reveals the relationship between independent and dependent variables within an entity (a bank in this case). Each bank has its own individual characteristics that may or may not affect the independent variable. When using this model, it is assumed that something within the individual may affect or bias the dependent or independent variables and we need to control for this. This is the rationale behind the assumption of the correlation between a bank's error term and independent variables. Fixed effects model removes the effect of those time-invariant characteristics, so it is possible to assess the net effect of the predictor variables on the outcome variable.

Moreover, to understand if the model is suitable for fixed effects, a Hausman test must be run where the null hypothesis is that the preferred model is random effects vs. the alternative, the fixed effects (see Greene, 2000). Therefore, after the results, running a Hausman test would illustrate whether the model is accurate for that panel data or not[7]. Results of the Hausman test (table 4 and 5) show that the preferred model is the fixed effects model and it is as follows:

$$log(Y_{it}) = B_0 + B_1 lcrann_{it} + B_2 roae_{it} + B_3 npl_{it} + B_4 cap_{it} + B_5 liq_{it} + B_6 cof_{it} + B_7 res_{it} + B_8 fed_{it} + u_{it}$$

Where: $log(Y_{it})$ is either the logarithm of the amount of consumer loans or real estate loans of bank i at time t; β is the coefficient for each variable; β_0 is the constant; u_{it} is the error term; and *lcrann* is the Liquidity Coverage Ratio announcement which is a dummy variable with a value of 1 between the first quarter of 2013 and the last quarter of 2015.

[7] If the chi square is lower than 0.05, the model is suitable for the fixed effects. Otherwise the random effects model is the appropriate one.

4.1.1. Bank specific variables

These are:

Roae: Return on average equity which is calculated by net income divided by total equity.

Npl: Rate of non-performing loans to total loans;

Capratio*:* Capital to risk-weighted asset ratio;

Liq: Liquidity ratio; and

Cof: Cost of funding.

4.1.2. Central bank-dependent variables

These are:

Res: Required reserve balances percentage change; and

Fed: Effective federal funds rate

4.2. Variable Descriptions

This part gives a brief definition for each variable and explains why these variables are crucial to analysing banks' lending behaviour.

4.2.1. Return on Average Equity Ratio

Return on average equity ratio is also important for banks' lending decision. It is the rate of net income to the average total equity and, as Aisen and Fraken (2010) state, with more profitability banks will have greater incentives to lend.

4.2.2. Non-performing Loans

Non-performing loans to total loans ratio is another important variable to express banks' lending behaviour. Credit risk increases when the borrower cannot pay back to the bank and the increase puts pressure on bank's capital which leads to a decrease in the banks willing to lend (Naceur and Roulet, 2017). Also, there are other papers which show that high credit risk decreases the banks' lending growth (Stiglitz and Weis 1981; Berrospide and Edge 2010). Additionally, other than individual bank level, increasing rate of non-performing loans can be a negative signal for the economy as the financial system experienced in the 2008 financial crisis.

4.2.3. Capital to asset ratio

Capital to asset ratio has been discussed by Berger and Bouwman (2009), and they say higher capital levels and liquidity creation have a negative relationship for smaller banks while it is the opposite for large banks. Allen and Santomera (1998) and Allen and Gale (2014) indicate that higher capital levels mean more liquidity creation and higher risk absorption. However, this paper will be using the capital to risk-weighted asset ratio, following Ihrig et al. (2017), which refers to the amount of capital that banks hold against risky assets. Banks' regulatory financials summary provides the ratio for each bank on S&P 500 database.

4.2.4. Liquidity Ratio

Banks' current liquidity is essential to create more loans. Even if the regulations restrict them, liquidity ratio is a crucial variable since it is the leading source for granting loans. According to Kim (2017), who looks for the efficiency of capital and liquidity level for lending behaviour, higher liquidity means higher levels of loan growth.

4.2.5. Cost of Funding

Cost of funding is the cost of liabilities that banks use to grant loans. The literature says that there is a negative relationship between the cost of funding and loan growth. Raknerud and Vatne (2013) empirically investigate how the difference in funding cost influence loan volumes and rates. Their findings reveal that higher levels of cost of funding increase the lending rates and that decreases the households' demand for loans.

4.2.6. Effective Federal Funds Rate

Central banks intervene in the economy through money supply or interest rates. However, the central bank can only change the overnight lending rate which is the federal funds rate in the U.S case. The idea is that by changing the federal funds rate at which banks lend to each other overnight, other market interest rates may be affected. On the banks' lending side, Olusanya et al. (2012) empirically examine the determinants of commercial banks' lending behaviour, and they have found that interest rate has a significant negative effect on banks' lending behaviour. Also, Karim et al. (2006**)** support these finding and they show there is a negative relationship between interest rates and banks' lending behaviour.

4.2.7. Percentage Change in Reserve Balances Required

The required amount of reserve balances shows whether banks hold more reserves than they are supposed to or not. Using that variable can explain how banks steer their reserve balances under requirements and it can indicate how the central bank conducts commercial banks reserve behaviour. Any trend of change in reserve balances, whether negative or positive, might provide information about banks required reserve amounts. Increasing the amount of required reserves might affect banks' lending as Li et al (2017) suggest.

5. RESULTS

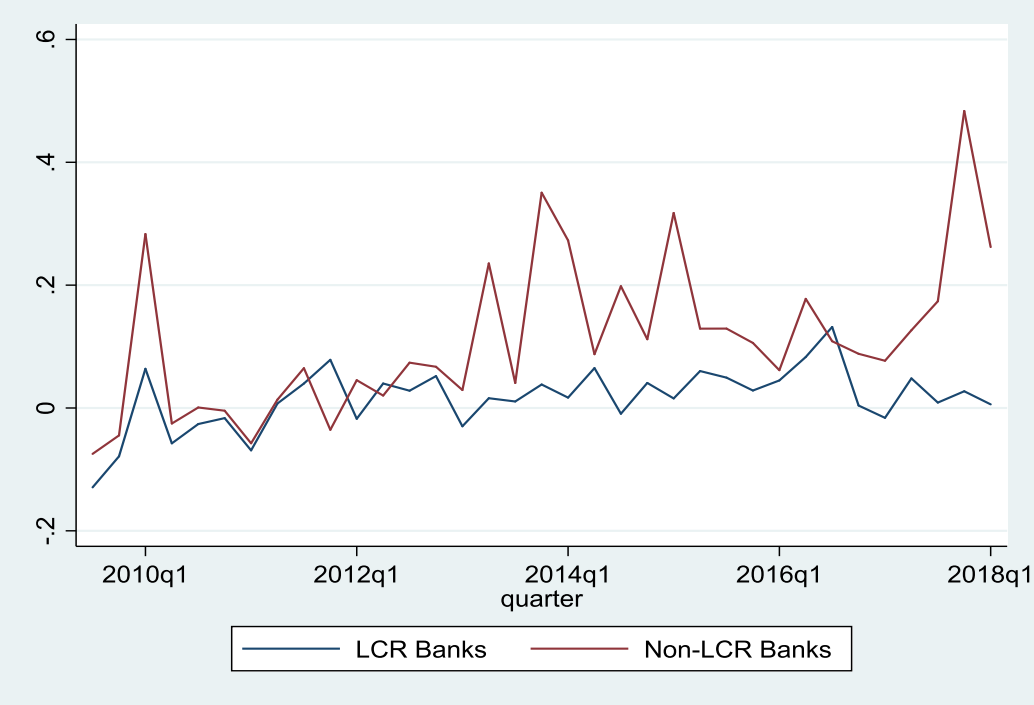
The findings show that there is decrease in real estate lending in overall for the banks subject to Liquidity Coverage Ratio while the effects are not significant for the consumer lending (see Table 1). This work and results have expected a decline in illiquid assets shows that the real estate lending drove the decrease. Since the real estate loans usually have a longer maturity than consumer loans, banks preferred not to decrease consumer lending. However, real estate loan yields are higher compared to consumer loans. It reveals that banks trade-off between the yield and liquidity holdings resulted with decreasing levels of profitability.

Moreover, for the largest four banks, any significant effect is not observed while the there is a significant decrease in real estate lending for the medium size banks (see Table 2 and 3). Thus, it is possible to see the effects of accessibility to the financial markets. Since large banks have a better opportunity to achieve funds from the interbank market as Nguyen al. (2017) mention, they do not have any incentive to decrease their lending behaviour. They can

meet their liquidity requirements in overnight markets, perhaps with lower interest rates compared to medium size banks. On the other hand, medium banks might face funding problems; hence they decrease their real estate lending. In detail, while the liquidity requirement did not change the large banks' real estate lending, there has been a decrease of 4% for the medium size banks during the adaptation period because of regulations.

A comparison between the loan growth for non-Liquidity Coverage Ratio banks which have assets smaller than $50 billion in their balance sheet and banks that are subject to Liquidity Coverage Ratio reveals that Liquidity Coverage Ratio decreased the loan growth.

Figure 1: Loan Growth Difference



The figure above shows that the gap for loan growth between the non-Liquidity Coverage Ratio banks and regulated banks widened after the first quarter of 2013, and it almost remained stable until 2018. Therefore, overall, Liquidity Coverage Ratio banks act more careful about their lending behaviour because of the regulations. Combining the regression results and the loan growth difference shows that the gap is driven by medium size banks. Moreover, the gap still exists after the adaptation process, which means there is a sustained effect for the banks that are subject to the Liquidity Coverage Ratio.

To conclude this part, the regulations significantly affected the medium-size banks in the economy. Furthermore, the loan growth for medium and large size banks has decreased.

6. CONCLUSION

Initially, my results show that the Liquidity Coverage Ratio has a significant effect on banks' lending in the United States. As it is expected, there is a significant decrease in real estate lending while the consumer lending surprisingly did not change. That shows banks' maturity transformation behaviour has been affected by the regulations. I believe that the effects of liquidity regulations must be well-studied and they must be more specific for the banks in the medium size category. For instance, different liquidity ratios for asset-level categories could be developed to decrease the significant effects on loan growth. It does not mean that regulations are not effective since we consider the most recent financial crisis.

On the other hand, macroeconomic conditions depend on every country so the effect might differ on a country level. The regression model is a simple one, and it can be improved further for a more detailed work. Adding external supply factor variables, such as exchange rate, trade openness and capital flow for bank level can improve the model. Also, it is possible to increase the number of observations. Besides, adding different variables for real estate and consumer lending can give more significant results. However, the results are satisfying, and they comply with the expectations of the literature. The results show that the changes in the amount of loans must be discussed on a sectoral level. However, the overall implications of the regulations are observable as well. Finally, the future effects must be considered carefully because the comparison between Non-Liquidity Coverage Ratio banks and regulated banks show that there is continuous significant gap for the loan growth which means effects are continuous after the adaptation process.

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APPENDICES

Table 1 Large Commercial Banks	Real Estate Loans	Consumer Loans
Announcement Effect	0.0336 (1.40)	-0.00750 (-0.30)
Return on Average Equity	-0.0241 (-0.16)	0.198 (1.24)
Non-Performing Loans/Loans	-4.251*** (-3.80)	-4.260*** (-3.65)
Risk Weighted Capital Ratio	2.014* (2.22)	0.733 (0.77)
Liquidity Ratio	0.273 (1.41)	1.031*** (5.08)
Cost of Funding	0.594*** (9.31)	0.420*** (6.30)
Reserve Balances	-0.210 (-1.42)	-0.296 (-1.92)
Effective Federal Funds Rate	-0.202*** (-4.79)	-0.186*** (-4.22)
Constant	12.04*** (79.18)	11.30*** (71.13)
Number of Observations	140	140
t statistics in parentheses: * p<0.05 , ** p<0.01 , *** p<0.001 Banks:JP Morgan Chase, Bank of America, Wells Fargo, Citigroup		

Table 2
Medium Commercial Banks

	Real Estate Loans	Consumer Loans
Announcement Effect	-0.0457** (-3.17)	0.0375 (1.48)
Return on Average Equity	-0.0000675 (-0.82)	-0.000407** (-2.82)
Non-Performing Loans/Loans	-0.000110 (-1.21)	-0.000734*** (-4.59)
Risk Weighted Capital Ratio	0.0206 (0.16)	-0.0702 (-0.31)
Liquidity Ratio	0.877*** (5.77)	-0.749** (-2.80)
Cost of Funding	0.167*** (7.65)	-0.167*** (-4.36)
Reserve Balances	-0.160 (-1.64)	-0.0623 (-0.36)
Effective Federal Funds Rate	-0.00247 (-0.14)	0.204*** (6.37)
Constant	10.000*** (100.01)	9.655*** (54.93)
Number of Observations	315	315

t statistics in parentheses: * p<0.05 , ** p<0.01 , *** p<0.001
Banks:Suntrust, BB&T, Zion, Comerica, Fifth Third, U.SBancorp, Regions, Key Bank, Citizen Bank NA

Table 3
Banks Subject to Liquidity Coverage Ratio

	Real Estate Loans	Consumer Loans
Announcement Effect	-0.0327*	-0.0135
	(-2.22)	(-0.60)
Return on Average Equity	-0.243*	0.284
	(-2.54)	(1.94)
Non-Performing Loans/Loans	-2.596***	-2.740**
	(4.06)	(-2.80)
Risk Weighted Capital Ratio	-1.081*	-0.744
	(-2.31)	(-1.04)
Liquidity Ratio	0.496***	-0.287
	(3.81)	(-1.44)
Cost of Funding	0.125***	-0.0255
	(4.58)	(-0.61)
Reserve Balances	-0.141	-0.0836
	(-1.54)	(-0.60)
Effective Federal Funds Rate	0.0292	0.0822**
	(1.42)	(2.61)
Constant	11.17***	10.09***
	(146.01)	(86.24)
Number of Observations	455	455

t statistics in parentheses, * p<0.05 , ** p<0.01 , *** p<0.001
Banks: TCF, Bancorp South, Home Bancshares, Trustmark, Old National, Simmons,
Union Bankshare, Columbia State, United Community, Glacier, Fulton

Table 4

```
.
                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference          S.E.
-------------+------------------------------------------------------------
      lcrann |    .0336208     -.132252        .1658729                .
        roae |   -.0240685     -.854613        .8305445                .
         npl |   -4.250511     6.546658       -10.79717                .
    capratio |    2.014331    -3.622479         5.63681                .
         liq |    .2730656    -1.685128        1.958194                .
         cof |    .5936043    -.5340392        1.127643                .
       reser |   -.2102116     .1306448       -.3408565                .
         fed |   -.2023813     .1669831       -.3693644                .
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =      678.43
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)
```

Table 5

```
.
                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference          S.E.
-------------+------------------------------------------------------------
      lcrann |   -.0457289    -.0455552       -.0001737                .
        roae |   -.0000675    -.0003499        .0002824         .000073
         npl |   -.0001103    -.0004265        .0003162        .0000818
    capratio |    .0205737     .1396004       -.1190267                .
         liq |     .877012     .8179898        .0590222                .
         cof |    .1671005     .1669399        .0001606                .
       reser |   -.1602126     -.179774        .0195614                .
         fed |    -.002465     .0092932       -.0117582                .
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       14.90
                Prob>chi2 =      0.0373
```