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# Effects of the Basel III Liquidity Risk Metrics on US Bank Performance and Stability


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# Effects of the Basel III Liquidity Risk Metrics on U.S. Bank Performance and Stability

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ABSTRACT:

This paper investigates the effects of Basel III's liquidity metrics on profitability and stability on a subset of U.S banks from 2002 to 2014. The profitability and stability of each of these banks were calculated under the scenario of shifting 1% of its overall assets from illiquid to liquid. The empirical findings demonstrate a negative relationship between holding higher liquidity and bank profitability. It finds that this negative relationship is disproportionate across the bank classes with savings banks losing profitability at almost twice the rate as national banks. Additionally, stability of savings banks is more adversely affected than of national banks.

Keywords: bank performance, Basel III, liquidity, liquidity coverage ratio, risk management

JEL Classification numbers: E44, G18, G21

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## I. Introduction

The main motivation for this paper is to provide empirical evidence on how larger liquidity cushions driven by Basel III's Liquidity Coverage Ratio (LCR) implementation may affect the overall banking community and different classes of banks in the U.S. The key hypothesis is that the new liquidity ratios will negatively impact bank's profitability and stability. My hypothesis is based upon previous published literature outlined in the next section. Bank profitability will be measure by its Return on Assets (ROA). Bank stability is proxied with a bank's Z score.

The implementation of Basel III's Liquidity Coverage Ratio on January 1, 2015 forced banks around the world to rethink and reevaluate their management of liquidity risk. Liquidity risk management was a backroom treasury function with very little front office attention until the financial crisis of 2007-2008 pushed the industry to the edge of the systemic breakdown cliff. Prior to the crisis, the majority of banks around the world relied on subjective judgment regarding liquidity levels and very little was done to force banks to shore up liquidity (Elliot, 2014). The Basel Committee swiftly released the *Principles for Sound Liquidity Risk Management and Supervision* (BIS, 2008) to set a global standard of liquidity risk management skills. The Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR) were key tools developed to stimulate more robust liquidity risk management throughout the global system and to prevent a repeat of the crisis (BIS, 2010)[1].

A model assessing bank profitability as a function of liquidity is utilized in this paper. This model leverages the term structure of interest rates and its relationship to liquidity by way of the

[1] See appendix for further background on Basel III's Liquidity Coverage Ratio (LCR)

liquidity preference theory to determine the impact on a bank's ROA. In order to conduct the empirical exercise, a database which isolates banks who have remained in business from Q1 2002 to Q2 2014 has been created from the FDIC database.

This paper is organized as follows: Section II reviews recent literature regarding the pros and cons of regulation, specific Basel III metrics, related critique of the Basel III metrics, and the relationship between liquidity and banking profitability. Section III outlines the data and empirical methods demonstrating the relationship between liquidity, profitability, and stability. Section IV discusses empirical evidence and Section V concludes with an overview of the findings as well as a discussion of possible future research. There is an appendix summarizing the Basel III regulation as it relates to liquidity.

## II. Literature Review

Basel III reforms were published as a response to the financial crisis of 2007/2008. It is the first attempt by international regulators to introduce consistent minimum standards for liquidity (Standard and Poor's, 2010). Two of the most controversial elements are the new liquidity requirements, the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR). The LCR addresses liquidity risk intended to safeguard banks with adequate liquidity to survive one month of stressed funding conditions. This metric is driving the reassessment of the types of products and services each bank holds, shifting many banks towards more liquid products. The NSFR addresses funding risk and is designed to promote structural changes that shift banking risk profiles away from short-term fund mismatches and toward more stable, longer term funding of assets (BCBS, 2010b). While the LCR has been actively in place in the marketplace since January 1, 2015, the NSFR has moved from its initial launch date of 2018 to be put aside for later discussion (Nicol, 2017). (See appendix for a more detailed explanation of the LCR and NSFR).

### Pros of Regulation

There is a body of literature in favor of regulation. A study of wealth effects in bank portfolios following the implementation of the 1988 Basel accord among banks in the Japan, Canada, and the UK finds that the regulatory intervention increase capital holdings and have a positive effect on banks (Wagster et al., 1996). Stringent regulations have also been negatively linked to non-performing loans (Barth et al, 2004) and positively linked to increased employee salaries (Molyneux and Thornton, 1992).

There is literature that critiques the absence of regulation. Previous to the financial crisis of 2007/2008, the market managed liquidity in a "crisis management" mode as opposed to proactive liquidity management with regulation. The markets relied on an existence of a "lenders of last resort" or a few large banks that most in the industry believed to be "too big to fail" (i.e., had the complete backing of the government). The industry had expectations of relying on these "lenders of last resort" creating a moral hazard. Banks could hold lower levels of liquid assets than financial fundamentals dictate, because they knew they could rely on these "lenders of last resort" (Repullo, 2005). Continual post crisis liquidity support to failed banks or close to failing banks fosters this disincentive for banks to manage liquidity prudently (Acharya et al., 2011).

The recent crisis of 2007/2008 proved that deposit insurance is not adequate enough to prevent bank runs. The runs were on federal funds (Afonso et al., 2011), interbank markets (Acharya and Merrouche, 2013), repo markets (Gorton, 2009), and securitized markets (Brunnermeier, 2009). These are all markets not backed by deposit insurance.

**Cons of Regulation**

There is evidence against regulation. Banks have been found to maintain target buffers above regulatory thresholds instead of working in the economy (Francis, 2010). Kantor and Holdsworth (2010) argue that regulations designed to prevent future crises should not be allowed to threaten the profitability of financial activity to the point where raising fresh capital from the private markets no longer makes economic sense.

In a related article by Hartwell (2015), a bank's performance is driven more by individual, banking factors rather than country specific regulations. He studies both ROA and ROE across countries during the time period of 2006 and 2012 and finds that investor protection – specifically

robust property rights law – are key to bank profitability. He makes a key observation that many countries could institute a multitude of policies that in time of crisis would be "dwarfed by the impact of US monetary policy… dependent on policies undertaken thousands of miles away." (Hartwell, 2015).

Liquidity regulations may lead banks to take on more risks in other areas (Diamond and Rajan, 2001). Empirical evidence in a panel of Canadian and U.S. Banks over the period of 1997 to 2009 displays a nonlinear relationship where holding liquidity is profitable for banks up to a point beyond which holding more liquid assets starts to diminish returns. It forces the bank to find the balance between resilience to liquidity shocks with the costs of holding lower-yielding liquid assets instead of higher yielding, but less liquid assets. (Bordeleau and Graham, 2010).

**Basel III Critique**

A wave of critical papers was published upon the release of Basel III. The underlying criticisms are in the details of applying a global mandate to a local problem. Key issues[2] include:

1. **30 day time period**: This period has been chosen as it represents the likely time in which a central bank needs to step in and counter a crisis.
2. **Specific weightings assigned to assets, liabilities, and off-balance sheet items**: Each institution works with the regulators regarding haircuts (or the amount to subtract from an asset with the remainder being as highly liquid) for each individual product.

[2] April Frazer, Managing Director and Global Head of Regulatory Advisory and Capital Structuring, Wells Fargo Securities, (phone interview, April, 2015)

3. **Assumption of large liquid financial markets**: The liquidity rules assume that sophisticated financial systems in advance economies. Emerging markets seem to be outside of this assumption and could cause issues in small national debts where there are few treasury bonds and bills are held as liquid assets.
4. **Distinction between Level I & Level II Assets:** Much like the product level haircuts above, each institution has discussions and negotiations as to which asset should go in which bucket

The regular stress tests will be costly (Elliot, 2014). In a McKinsey Working Paper (McKinsey, 2013), the firm estimates that the liquidity pressures due to Basel III will cost firms approximately 4% in lower return on common equity (ROCE) over the next 6 years. Basel III metrics are estimated to slow GDP growth in the range of -0.05 to -0.15 percentage points per annum. These costs are estimated due to the Basel III requirements (liquidity and capital combined) driving increased lending spreads by approximately 15 bps if there were no complimentary monetary response. The complimentary monetary response to counteract this affect would be a reduction or delay in increase in monetary policy rates between 30 and 80 bps (Slovik and Cournede, 2011). These higher costs for regulated entities will drive market shifts away from traditional banking to the shadow or unregulated banking sectors, Without the regulatory overhead, they will have a lower cost of funds and pass it along to the market with cheaper funding (Cosimano and Hakura, 2011).

There is a concern that these metrics will drive government bond favoritism (Blundel-Wignall and Atkinson, 2010) as the only way to maintain the high level of LCR given that state and sovereign government debt are labelled a Level 1 High Quality Liquid Assets. This would create an unintended over-concentration in government debt. This situation will create a

*"distorted inelastic demand"* from banks on government securities (Allen et al., 2012). They describe a scenario where governments and not a free market will decide on the allocation of these limited Level 1 securities. There are also global concerns for lower quality creditworthiness and smaller countries that could not fund its own domestic bank needs. They also posit that liquidity costs will actually increase from the ratios as large amounts of government debt will start to be locked up in banks' liquidity portfolios to cover the ratios.

A bank's traditional role as a liquidity transformer which reduces risk from mismatched assets and liabilities may be adversely impacted (King, 2013). Strict application of a liquidity coverage ratio of 100% backing by safe liquid assets will eliminate bank runs at the cost of negating the banks purpose in the marketplace as the creation of liquid claims on illiquid assets (Dermine, 2015).

The NSFR has also had its share of criticisms. Approximately two thirds of the 263 banks in a 2009 survey were not capable of calculating the ratio (BCBS, 2010c). In a study across 15 countries, the associated changes required to shift the more cost effective strategies to increase holdings of higher-rated securities to extend the maturities is estimated to reduce net interest margins by 70-88 basis points on average or around 40% of their year-end 2009 value (King, 2013).

**Liquidity and profitability relationship**

Liquidity is an intricate factor to study, because it has both endogenous and exogenous aspects. On the internal side, a bank is responsible to manage its own liquidity holdings as it sees fit to be able to service its customers. There are bank specific factors such as expenses, headcount,

operational expenses, and product offerings (Athanasoglou, 2005). On the external side, regulators have always put some sort of regulation on liquidity to stave off the high social and economic costs of bank runs (Diamond and Dybvig, 1983). These create a push and pull relationship. Regulators pulling up liquidity to limit the social cost mentioned above, but banks pushing down liquidity due to liquid assets such as cash tend to have lower yields than less liquid assets resulting in lower bank revenues (Roger and Vlcek, 2011). With Basel III, the regulators will be pulling more liquidity pushing down bank's profitability.

. The impact of bank profitability has far reaching effects. Bank runs a huge social cost (Diamond and Dybivig, 1983). Pawlowska (2016) reinforces the idea that "the banking sector does not affect the banks alone, but it is highly relevant for the economy as a whole." The theory behind this statement is that the banking system serves as a cushion to absorb any negative economic shocks and business cycle downfalls. Banks' profitability is important to a country as it safeguards the health for a country's economy. Notably, her paper finds no evidence for either a structure-conduct-performance (SCP) hypothesis or a relative market power (RMP) hypothesis. The most important factor that policy makers should focus on is improving the banking sector efficiency.

## III. Data and Model Analytics

Quarterly data for all US banks are downloaded from the FDIC's Bank Data & Statistics website from Q1 2002 to Q2 2014. We selected only banks that were active throughout the entire period. Where a bank was acquired by another, we added in the data under the surviving entity.

Five different grouping of banks are examined utilizing standard FDIC Bank Classifications. They are as follows:

1. N = National Commercial Banks with a national charter supervised by the Office of the Comptroller of the Currency (OCC)
2. SM = State commercial or savings banks supervised by the Federal Reserve
3. NM = State commercial banks and Fed nonmember supervised by the FDIC or OCC
4. SB = Savings banks with a state charter supervised by the FDIC
5. SA = State chartered thrifts supervised by the OTS prior to 2011; currently supervised by the FDIC or OCC

Because of our focus on domestic banks, the additional bank class of "OI" which represents U.S. branches of foreign chartered institutions was left out of this analysis.

| Bank Class | N | NM | SA | SB | SM |
|---|---|---|---|---|---|
| | | | | | |
| **Count** | 33,929 | 89,829 | 95 | 10,702 | 19,226 |
| | | | | | |
| **Asset Mean** | $ 7,746,251 | $ 531,961 | $ 23,532,103 | $ 810,970 | $ 2,987,427 |
| **Asset Median** | $ 225,078 | $ 16,987 | $ 133,636 | $ 393,053 | $ 226,274 |
| **Asset Std Dev** | $ 86,255,880 | $ 3,600,353 | $ 32,604,816 | $ 2,330,139 | $ 21,121,668 |
| **Asset Skewness** | 15.89972 | 32.81103 | 0.807624 | 12.26477 | 18.29523 |
| **Asset Kurtosis** | 275.3314 | 1333.302 | 1.876393 | 187.914 | 468.4399 |
| | | | | | |
| **NIM Mean** | 4.00 | 4.084343 | 3.142994 | 3.375824 | 4.00946 |
| **NIM Median** | 3.929687 | 4.018593 | 2.906688 | 3.368413 | 3.978528 |
| **NIM Std Dev** | 1.153643 | 0.938148 | 0.652775 | 0.679585 | 0.789837 |
| **NIM Skewness** | 27.83647 | 10.44519 | 1.093824 | 0.635892 | 2.44453 |
| **NIM Kurtosis** | 1510.665 | 347.9779 | 4.001542 | 9.631665 | 54.4319 |
| | | | | | |
| **ROA Mean** | 1.005898 | 1.035034 | 0.325708 | 0.558679 | 0.959052 |
| **ROA Median** | 1.029865 | 1.049249 | 0.486237 | 0.57601 | 1.005552 |
| **ROA Std Dev** | 0.919556 | 0.882572 | 0.928714 | 0.611909 | 0.903919 |
| **ROA Skewness** | -6.433774 | -2.332322 | -2.262832 | -8.502624 | -3.877507 |
| **ROA Kurtosis** | 192.3549 | 61.20685 | 8.939937 | 239.1306 | 74.70154 |

**Table 1: Summary data of US Banks during the study time frame segmented into their different FDIC classifications (dollars in '000s) (Source: FDIC, Author's own estimations)**

The database has the following data elements sourced from the FDIC:

- **Total Assets**: The sum of all assets owned by the institution including cash, loans, securities, bank premises, and other assets. This total does not include off-balance-sheet accounts.
- **Net Interest Margin**: Total interest income less total interest expense annualized as a percent of average earning assets.

- **Return on Assets (ROA)**: Net income after taxes and extraordinary items annualized as a percent of average total assets.
- **Equity Capital to Assets**: Total equity capital as a percent of total assets. This metric is used to calculate the z score and highly individualized to each bank.
- **FDIC Certificate Number**: The FDIC Certificate number is a unique identified in the FDIC database and used in this database as the unique identifier. In the case of bank mergers and acquisition through the study period, data was rolled up under the surviving parent (acquirer) bank.

We tested the liquidity-bank profitability relationship by comparing a bank's return of assets (ROA) to its calculated ROAadjusted which is the new ROA after a shift of 1% of its illiquid assets into liquid assets. In order to calculate the ROAadjusted, the data is run through a model (Handorf, 2014) which leverages the term structure of interest rates. This takes advantage of the liquidity preference theory which states that rates on future maturities have an embedded liquidity premium.

The model is specified as follows:

$$NI_i = ROA_i - LS_i * HLC_i + IIR_i * t_{iA}$$

Equation 1: Model utilized to determine overall net income impact (Handorf, 2014)

The variables are as follows:

- NI = the overall Net Income Decline for a specific bank
- ROA = the Return on Asset for a specific bank

- LS = the liquidity shift of 1% of total assets calculated as 1% * Total Assets for a specific bank; this 1% was applied consistently across all banks in the database
- HLC = the historical liquidity cost of 1.25% (Handorf, 2014)
- IIR = Income form the lower taxable income calculated as interest income reduction times marginal tax rate for a specific bank; taxable income is applied based upon their Net Interest Margin (see table 2). The model can be written in descriptive terms below in equation 2.

$$\text{Overall Net Income Decline} = \text{Original ROA (\$)} - \text{Liquidity Shift of 1\% (1\% * Total Assets)} * \text{Historical Liquidity Cost} + \text{Income from Lower Taxable Income (Interest income reduction * Marginal Tax Rate)}$$

Equation 2: Model utilized to determine overall net income impact in descriptive terms (Handorf, 2014)

The tax rate applied to each bank is dependent upon the Net Interest Margin (Handorf, 2014).

| Net Interest Margin | Tax Rate |
|---|---|
| Below 2.5% | 15% |
| 2.6-3.0% | 25% |
| 3.0 and above | 35% |

Table 2: Map of tax rates applied to ranges of Net Interest Margin

The Z Score is calculated according to the World Bank definition:

$$Z_i = \left( ROA_i + \frac{E_i}{A_i} \right) / \sigma(ROA_i)$$

Equation 3: Z score equation from the World Bank

Z Score = (ROA+(equity/assets))/sd(ROA)

Equation 4: Z score equation from the World Bank in descriptive terms

It should be noted that my time period was 2002-2014 which included 2007 and 2008 crisis data that may not accurately reflect each bank's "typical" behavior, distorting the accuracy of the obtained results. We did not run the regression with any dummy variables or additional modelling adjustments with our panel regressions with a deeper dive into the crisis years as a good future research topic.

## IV. Empirical Evidence

The overall analysis suggests that the U.S. banking profitability is negatively affected by liquidity regulation which requires a bank to hold more liquid assets. We also see that savings banks will have a more negative effect than the national banks. As you can see from Table 3, the difference between the Adjusted ROA (i.e., the ROA resulting from the 1% shift) and original ROA averages a decrease in ROA of approximately 0.009%.

| | N | NM | SA | SB | SM | Grand Total |
|---|---|---|---|---|---|---|
| **Avg ROA** | 0.981% | 1.010% | 0.326% | 0.559% | 0.959% | 0.965% |
| **Avg Adjusted ROA** | 0.972% | 1.001% | 0.316% | 0.549% | 0.950% | 0.956% |
| **Avg Differences in ROA** | -0.00893% | -0.00885% | -0.00997% | -0.00952% | -0.00889% | -0.00892% |

**Table 3: Summary of ROA, Adjusted ROA after Liquidity Shift, and the Average Difference between the Adjusted ROA (after the liquidity shift) and the Existing ROA (before the liquidity shift) (Source: FDIC, Author's own estimations)**

This seems relatively consistent across bank types in raw numbers, but a different trend reveals itself when looking at the percent change or the amount of decrease ROA relative to the original ROA. As shown in Figure 1, the overall group ROA decreases by 1.2% relative to the adjusted ROA. This decrease is not consistent across bank types with most banking types hovering around the -1.0% mark. Savings Banks (SB) lose at almost twice the rate as the national banks. Savings banks start out with lower ROAs so an additional loss of 1% of assets to liquidity creates an even larger divide for the adjusted ROA. Additionally, the tax savings driven by Net Interest Margins is on average less for Savings Banks. We will see this reflected in the below section on estimators.

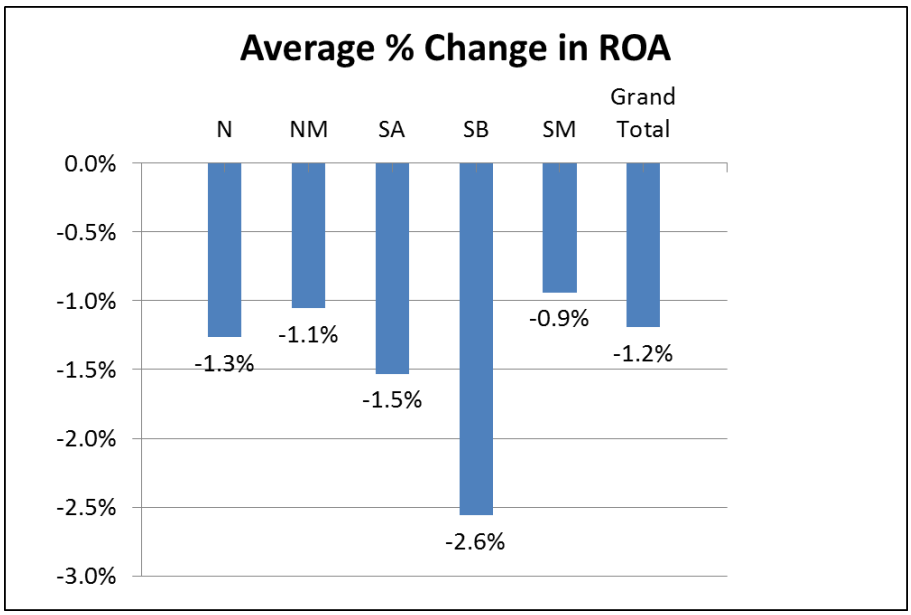


Figure 1: Average % change in ROA segmented by Bank Class (source: FDIC, World Bank, Author's own estimation)

Table 4 provides the estimators obtained using the generalized method of moments (GMM) technique. GMM was chosen due to the endogeneity within the factors (Wintoki, Linck, and Netter, 2012). Significance of less than 5% was found for the majority of estimators, but at small factors.

| **Dependent Variable:** | ROAadjusted | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| **Bank classes** | **All** | **N** | **NM** | **SA** | **SM** | **SB** |
| Asset | **1.17E-12** | 5.56E-13 | 1.11E-13 | -4.84E-11 | **1.20E-11** | **2.85E-10** |
| EQV | **0.000379** | **0.000275** | **0.000464** | **-0.003** | **0.000474** | **0.000291** |
| NIMY | **0.002473** | **0.001849** | **0.002341** | **0.005066** | **0.003506** | **0.000267** |
| C | **-0.0030223** | **0.000627** | **-0.00303** | -0.005499 | **-0.0081** | **-0.00588** |
| | | | | | | |
| Obs | 167,350 | 37,002 | 97,695 | 107 | 20,826 | 11,720 |
| R squared | 0.07123 | 0.04903 | 0.07060 | 0.15459 | 0.09016 | 0.06840 |
| Adjusted R squared | 0.07121 | 0.04895 | 0.07057 | 0.12997 | 0.09002 | 0.06816 |
| | | | | | | |
| **bold** indicates significance of 5% or less | | | | | | |

Table 4: GMM estimators for ROAadjusted variable

Of all the factors tested, the Net Interest Margin has the most effect across all asset classes. It is most prominent in the thrifts and state savings bank managed by the Fed. Assets do not drive a lot of the adjusted return from an absolute numbers perspective, but we also see a disproportionate weighting towards the savings banks. Equity capital assets ratio has a negative effect for the thrifts and small positive effects for all the other bank classes.

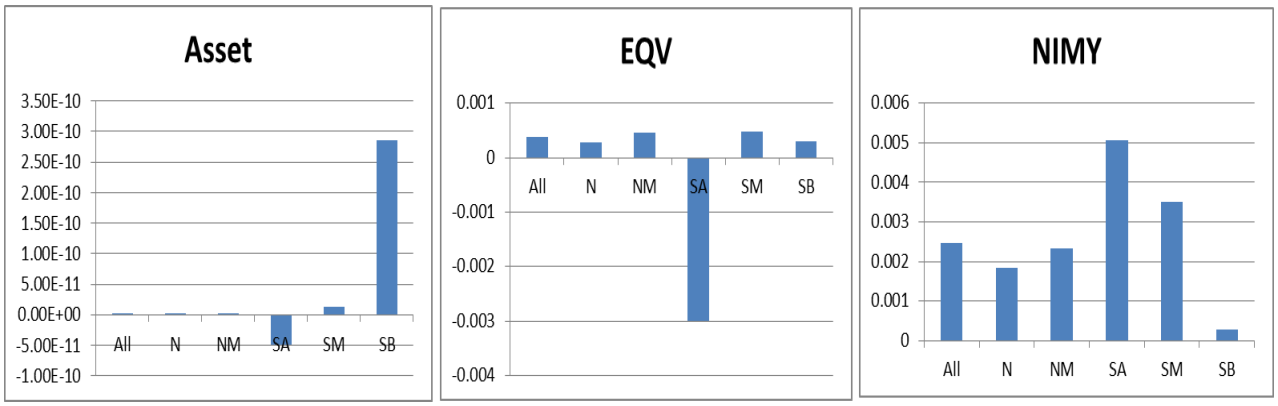


**Figure 2: Bar charts of estimators (all bank classes) for an adjusted Return on Assets post 1% shift of liquid to illiquid assets**

In order to estimate stability, we look at Z scores which capture the probability of default. Z scores are often used at the country level to assess the default risk of a country's banking system. In this study, the Z score was used on an individual bank level to assess each bank's default risk.. A "Before Z Score" has been calculated every year with the "before ROA" and an "After Z Score" calculated with the "adjusted ROA" (post liquidity shift). As shown in Figure 3, the savings banks forego more stability than the rest of the classes. It is worth noting that the SA class or the thrifts lose less stability than the overall average stability loss.

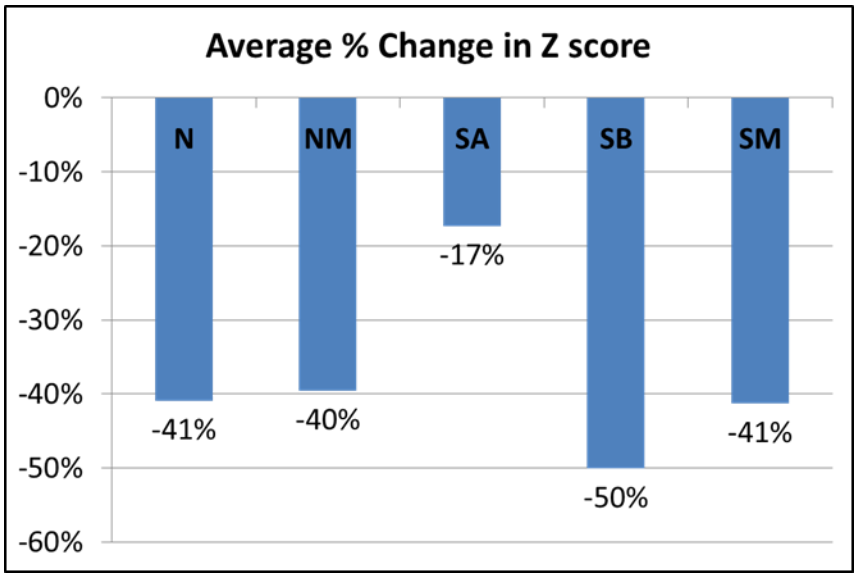


Figure 3: Average change in Z score from liquidity shift of 1% of liquid to illiquid assets segmented by bank class (Source: Author's own estimations based upon FDIC and World Bank data)

In our GMM analysis, we see significance of less than 5% for a majority of estimators. In this analysis, state commercial banks (NM) seem to feel the effects of the liquidity shift more than the other bank classes.

| **Dependent Variable:** | Z Score Adjusted | | | | | |
|---|---|---|---|---|---|---|
| | **All** | **N** | **NM** | **SA** | **SM** | **SB** |
| Asset | **6.48E-07** | **7.51E-07** | **1.19E-05** | **3.68E-11** | 1.82E-12 | **8.35E-11** |
| EQV | **-153.8416** | **-68.6388** | **-1.12E+02** | 8.45E-05 | **-0.00178** | **-0.0017** |
| NIMY | **84.93561** | **33.21595** | **118.2772** | 0.000545 | **0.001316** | **0.001574** |
| C | **-401.8325** | **-1279.76** | **-971.2778** | **-0.005499** | **0.004696** | **0.0027** |
| | | | | | | |
| Obs | 153,962 | 33,952 | 89,889 | 107 | 19,250 | 10,772 |
| R squared | 0.15881 | 0.01255 | 0.03560 | 0.15459 | 0.11218 | 0.13551 |
| Adjusted R squared | 0.15879 | 0.01246 | 0.03557 | 0.12997 | 0.11204 | 0.13527 |
| | | | | | | |
| **bold** indicates significance of 5% or less | | | | | | |

Table 5: GMM estimators for Z score adjusted variable

Net interest margin drives Z score in the positive direction for the state and national commercial banks (N and NM). We see little or insignificant lift driven for other bank classes.

Similarly, assets affect state commercial banks and national banks the most, but with an overall small factor across all bank classes. Equity capital assets have a negative effect for the national banks and state commercial banks.

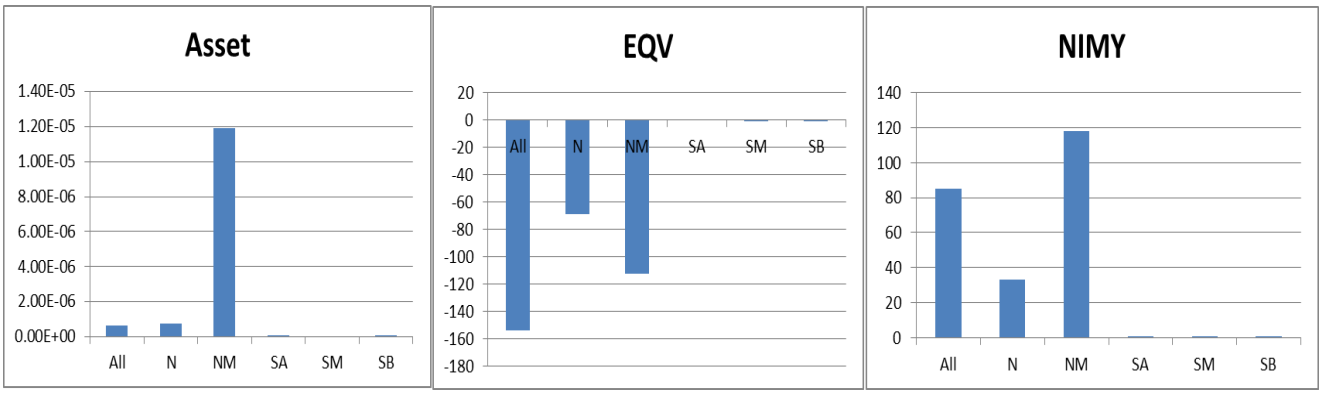


Figure 4: Bar charts of estimators (all bank classes) for an adjusted Z scores post 1% shift of liquid to illiquid assets

## V. Conclusions

Liquidity continues to be in the spotlight due to the financial crisis of 2007-2008 where a once theoretical systemic crash became reality in part due to poor liquidity risk management practices. To try and avoid the reoccurrence and stimulate prudent liquidity risk practices, the Basel Committee on Bank Supervision has introduced key principles of liquidity risk management for the industry to follow and key metrics to utilize as tools. The Liquidity Coverage Ratio (LCR) was introduced in 2010 and has a phased implementation plan since its launch in January 2015. The Net Stable Funding Ratio (NSFR) was also introduced in 2010 with a suggested launch in 2018, but has since been postponed.

Our research examines the relationships between liquidity and ROA in an effort to understand what direction the industry may turn given the increased liquidity cushion due to the

implementation of the LCR. The empirical tests show that all types of banks lose out in the shifts of increasing 1% of their assets from an illiquid to liquid instrument. The average ROA loss is 1.5% for that 1% shift with the biggest losers to be the savings banks (SB) losing almost double the average at 2.6%. Stability reflects this same trend with savings banks losing approximately 50% in stability while other banks lost smaller amounts of stability with the average loss of 38%. In associated GMM analyses, we see that the state run thrifts and savings banks are the most affected for profitability. On the stability side, we see that net interest margins and equity capital to assets ratio drive most of the behavior.

There are many avenues of research that can follow this study. Future research includes further understanding if the liquidity cost in the term structure has changed since the Financial Crisis. A study of banks who have not survived the entire period would perhaps magnify the liquidity shift affects as some may have exited the industry due to the higher operational costs. This study also modelled a constant 1% liquidity shift across the sample which may not accurately reflect today's banking requirement. The percentage could be refined based upon a varying percentage of liquidity shift based upon the makeup of each bank's assets. And finally, a future study to rerun the analysis in this paper with post LCR launch data.

Appendix: *Basel III LCR Background*

The Basel Committee has worked hard since the previous financial crisis to create an environment to minimize the chances of systemic risk as experienced in 2008. Prior to the crisis, liquidity was fairly cheap with costs around 10 bps in the interbank market and available in seemingly unlimited amounts and currencies. During the crisis, banks experienced rapid reversals of liquidity with those cheap interbank costs rising to above 50-60 bps. (McKinsey, 2008). Additionally, banks in the US lost a total of $1.3B in bank runs despite FDIC insurance coverage. The crisis surfaced the US banking system's inherent lack of sound liquidity risk management which broke under the extreme stress of the situation (BIS, 2008).

In 2008, the Basel Committee published their initial guiding principles (BIS 2008) to stimulate a higher standard level of liquidity risk management. The 44 page document lays out 17 guiding principles regarding how managers should prudently manage liquidity risk and the roles that supervisors will play. As an encore to that strategic and theoretical document, the Basel committee published its first version of liquidity management metrics called the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR) (BIS, 2010). The goal of both the Liquidity Coverage Ratio (LCR) and a Net Stable Funding Ratio (NSFR) was to encourage a more resilient banking environment that could absorb liquidity shocks and prevent true financial damage that would affect the global economy (BIS, 2010).

The Liquidity Coverage Ratio (LCR) is defined as the amount of unencumbered high-quality assets (HQLA) to equal or exceed 100% of its total net cash outflows over a 30 day period stress test. Assets are split into level 1 and level 2 assets (BIS 2013). Level 1 assets are extremely liquid assets such as cash, central bank reserves, and government guaranteed short term marketable

securities. Level 2 assets include riskier and less liquid public securities with differing levels of haircuts depending on their risk. The metric is defined as follows:

$$\text{LCR} = \frac{\text{High Quality Liquid Assets (HQLA) amount}}{\text{Total Net cash outflow amount}}$$

The LCR roll out started in January 2015 a minimum of an LCR equaling 60% building with equal annual steps to reach 100% by January 2019.

The Net Stable Funding Ratio (NSFR) is a longer term ratio to address liquidity mismatches, focusing on both on and off balance sheet activities (BIS, 2014). The ratio aims to reduce the chances of disruptions from creative balance sheet management techniques that might slowly erode away a liquidity position. Assets under scrutiny with this ratio include short term exposure to banks and other financial institutions with particular mention about derivatives and assets posted as initial margin for derivative contracts. The NSFR originally submitted for launch in 2018 is now postponed to a later unspecified date.

The metrics are to be employed in a variety of stress tests including deposit run-offs, loss of wholesale funding capacity, loss of short term financing with certain collateral and counterparties, and other increases in outflows due to contractual and market volatility factors. These tests are to be run on a regular basis from daily to annually depending on the bank and types of assets.

The LCR is applied across all banks in the US by the Federal Reserve as part of the Enhanced Prudential Standards (EPS) package. This is also be applied not just to banks but also to bank *holding* companies with over $50B in assets. (Federal Reserve, 2014)

Supervisors will be looking for the data from these metrics and associated stress tests on at least a monthly basis, creating a greatly increased level of regulatory reporting which presents

certain operational and strategic challenges. The calculation of these metrics varies from daily, monthly, and annually depending on the asset with intraday calculations given much attention in the latest definition of the tools. As imagined, there are significant informational systems and reporting processes that need to be in place in order for this timely and accurate monitoring. The pre-crisis centralized Treasury systems may no longer work for institutions that need to be responsive to both customers and regulators. In a McKinsey and Company bank survey, all participants required liquidity risk measurement system upgrades including more sophisticated liquidity modeling and dashboards to give real time (intraday) limits and early warning indicators (McKinsey, 2008).

**References**:

Acharaya, Viral V., Shin, Hyun Song, Yorulmazer, Tanju (2011). "Crisis resolution and bank liquidity." *Review of Financial Studies*, Volume 24, p 2166-2205.

Afonso, Gara., Kovener, Anna, Schoar, Antoinette (2011). "Stressed, not frozen: the federal funds market in the financial crisis." *Journal of Finance* 66, 1109-1139.

Allen, W., Chan, K.K., Milne, A., and Thomas, S., (2012). "Basel III: is the cure worse than the disease?". *International Review of Financial Analysis,* Volume 25, p. 159-166.

Alvarez, A., Fabiani, C., Freeman, A., Heuser, M., Poppensieker, T., and Santomero, A., (2008). "Liquidity: Managing an undervalued resource in banking after the crisis of 2007-2008", *McKinsey Working Papers on Risk*, Risk Practice (Number 5).

Bank of International Settlements (2008). Basel Committee on Bank Supervision - Principles for Sound Liquidity Risk Management and Supervision. Retrieved from: http://www.bis.org/publ/bcbs144.pdf.

Bank of International Settlements (2010): Basel Committee on Bank Supervision - Basel III: International framework for liquidity risk measurement, standards, and monitoring. Retrieved from: http://www.bis.org/publ/bcbs188.htm.

Bank of International Settlements (2013): Basel Committee on Bank Supervision - Basel III: The Liquidity Coverage Ratio and liquidity risk monitoring tools. Retrieved from http://www.bis.org/publ/bcbs238.pdf.

Bank of International Settlements (2014): Basel Committee on Bank Supervision - Basel III: The net stable funding ratio. Retrieved from http://www.bis.org/bcbs/publ/d295.pdf.

Barrios, Victor, and Blanco, Juan (2003). "The effectiveness of bank capital adequacy regulation: A theoretical and empirical approach." *The Journal of Banking & Finance*, Volume 27, Issue 10, p. 1935-1958.

Basel Committee on Banking Supervision, (2010b). "Basel III: A Global Regulatory Framework for more Resilient Banks and Banking Systems".

Basel Committee on Banking Supervision (2010c). "Results of the Comprehensive Quantitative Impact Study.".

Barth, James, Capiro, Gerard Jr., and Levine, Ross (2004). "Bank regulation and supervision: what works best?". *Journal of Financial Intermediation*, Vol. 13, p. 205-248.

Blundel-Wignall, A. & Atkinson, P., (2010). "Thinking Beyond Basel III: Necessary Solutions for Capital and Liquidity". *Organization of Economic Cooperation and Development Journal: Financial Market Trends,* Volume 2010 – Issue 1.

Bordeleau, Etienne and Graham, Christopher (2010). "The Impact of Liquidity on Bank Profitability." The Bank of Canada Working Paper, No. 38, December, 2010.

Brunnermeier, Markus K. (2009). "Deciphering the 2007-2008 liquidity and credit crunch." *Journal of Economic Perspectives*, Volume 23. p. 77-100.

Buehler, K, Peter Noteboom, P., & Williams, D., (2013). "Between deluge and drought: The future of US bank liquidity and funding – Rebalancing the balance sheet during turbulent times", *McKinsey Working Papers on Risk*, Number 48.

Cornett, M. M., McNutt, J., Strahan, P., & Tehranian, H., (2011*)* "Liquidity Risk Management and Credit Supply in the Financial Crisis". *Journal of Financial Economics***,** Volume 101, Issue 2, p. 297–312.

Dermine, Jean (2015). "Basel III leverage ratio requirement and the probability of Bank runs". *Journal of Banking & Finance*, 53 (2015) 266-277.

Diamond, Douglas & Dybvig, Philip (1983).. "Bank Runs, Deposit Insurance, and Liquidity", *The Journal of Political Economy*, Vol 91, No. 3, p. 401-419.

Diamond, Douglas W., Rajan, Raghuram G., (2001). "Liquidity risk, liquidity creations, and financial fragility: a theory of banking." *The Journal of Political Economy* 109, 287-327.

Elliot, Douglas J. "Bank Liquidity Requirements: An Introduction and Overview", The Brookings Institution, June 23, 2014; downloaded on April 18, 2017 from https://www.brookings.edu/research/bank-liquidity-requirements-an-introduction-and-overview/.

Federal Reserve Press Release (2014): Retrieved from http://www.federalreserve.gov/newsevents/press/bcreg/20140218a.htm.

Francis, William (2010). "On the Behavior and determinants of risk-based capital ratios: revisiting the evidence from UK banking institutions." *International review of finance*, Volume 10, Issue 4, p. 485-518.

Gorton, Gary B. (2009). "Information, liquidity and the (ongoing) panic of 2007." *American Economic Review* 99, 567-572.

Handorf, William, (2014). "The cost of bank liquidity". *Journal of Banking Regulation*, Vol 15, p. 1-13.

Hartwell, Christopher (2015). "Apres le deluge: Institutions, the Global Financial Crisis, and Bank Profitability in Transition." *Open Economics Review*, Volume 26:497-524.

Kantor, Brian and Holdsworth, Christopher (2010). "Lessons from the Global Financial Crisis (or why capital structure is too important to be left to regulation)". *Journal of Applied Corporate finance,* Volume 22, Issue 3, p. 112-122.

King, Michael (2013). "The Basel III Net Stable Funding Ration and Bank net interest margins." *Journal of Banking and Finance* 37 (2013) 4144-4156.

Molyneux, Philip and Thornton, James (1992). "Determinants of European bank profitability: A note." Journal of Banking and Finance, Volume 16, p. 1173-1178.

Nicol, Drew (2017), "US Treasury takes aim at post-crisis regulation in Trump-ordered review." Securities Lending Times, June 13, 2017. Pulled on 6/14/2017 from: http://www.securitieslendingtimes.com/securitieslendingnews/article.php?article_id=221360.

Pawlowska, Malgorzata, (2016). "Market structure, business cycle and bank profitability: evidence on Polish Banks". *Bank & Credit*, 47(4), 2016, 341-364.

Repullo, Rafael (2005). "Liquidity, risk taking, and the lender of last resort." *International Journal of Central Banking* 2, 47-80.

Roger, S., & Vlcek, J. (2011). "Macroeconomic costs of higher bank capital and liquidity requirements." *IMF Working Paper*, May 2011.

Slovik, Patrik. & Cournede, Boris. (2011), "Macroeconomic Impact of Basel III", *OECD Economics Department Working Papers*, No. 844.

Standard & Poor's, (2010). "Standard & Poor's Response to the Basel Committee's Proposals on Bank Capital and Liquidity", April 15, 2010.

Wagster, John, Cooper, Kerry, and Kolari, James (1996). "Market Reaction to National Discretion in Implementing the Basel Accord." *The Journal of Financial Research*, Vol 19, No. 3, p. 339-357.

Wintocki, M. Babajide, Linck, James, and Netter, Jeffry (2012). "Endogeneity and the Dynamics of Internal Corporate Governance." *Journal of Financial Economics*, Volume 105, Issue 3, p. 581-606.

World Bank, Bank Z-Score for United States [DDSI01USA645NWDB], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/DDSI01USA645NWDB, December 29, 2016.