ANALYSIS OF BANK FAILURE: AN APPLICATION OF CVAR METHODOLOGY ON LIQUIDITY

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Abstract

In this paper, balance sheet liquidity data was analyzed comprising of 157 Class I and 234 Class II banks. Class I banks are categorized as those with tier 1 capital in excess of $4 billion and internationally active while Class II banks are the rest. A Cointegrated Vector Autoregressive (CVAR) approach was used on balance sheet liquidity data to ascertain the behavior of variables in relation to bank failure. The study also demonstrated the nature of each of the variables containing estimated Basel III and Traditional liquidity measures for Class I and II banks. The estimated Basel III liquidity standards were made up of the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR) while the liquidity measures involved Government Securities Ratio (GSR) and Brokered Deposit Ratio (BDR). Results showed that a response of Net Stable Funding Ratio to a shock in Liquidity Coverage Ratio decreased in the first quarter and a steady continuous increase in the next quarters was observed. A shock on the Liquidity Coverage Ratio therefore would cause banks to increase their level of Net Stable Funding Ratio. This explains why the Liquidity Coverage Ratio is considered for a short term stress period of 30 calender days while the Net Stable Funding Ratio will be considered for a longer stress period of 1 year when fully implemented by banks.

Keywords: Basel III, Cointegration, Credit Risk, Liquidity, Securitization

1. INTRODUCTION

According to BCBS (June, 2011) and BCBS (December, 2010), strong capital requirements are a necessary condition for banking sector stability but by themselves are not sufficient. A strong liquidity base reinforced through robust supervisory standards is of equal importance but there has however been no internationally harmonized standards in this area to date. The Basel Committee has therefore introduced internationally harmonized global liquidity standards, BCBS (July, 2013). As with the global capital standards, the liquidity standards will according to BCBS (July, 2011) establish minimum requirements and will promote an international level playing field to help prevent a competitive race to the bottom. The Committee observed that during the early liquidity phase of the financial crisis, many banks despite adequate capital levels still experienced difficulties because they did not manage their liquidity in a prudent manner, (BCBS, September 2012 and BCBS, July 2013).

The crisis again drove home the importance of liquidity to the proper functioning of financial markets and the banking sector (Hu and Hong, 2012; Drehmann and Nikolaou, 2010). Subsequent to the crisis, asset markets were resistant and funding was readily available at low cost and the rapid reversal in market conditions illustrated how quickly liquidity can evaporate and that illiquidity can last for an extended period of time, BCBS (January, 2013). The banking system came under severe stress, which necessitated central bank action to support both the functioning of money markets and, in some cases, individual institutions according to BCBS (December, 2010) and BCBS (June, 2011). The difficulties experienced by some banks were due to lapses in basic principles of liquidity risk management, Gorton (2010). In response, as the foundation of its liquidity framework, the Basel Committee in 2008 published Principles for Sound Liquidity Risk Management and Supervision, BCBS (September, 2008). The Basel committee introduced two ratios to create a more resilient financial sector. These ratios include the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR), (BCBS, June 2011; BCBS, July 2013 and BCBS, October 2014). The main objective of the LCR according to BCBS (January, 2013) is to promote short-term resilience of the liquidity risk profile of banks by ensuring that the banks have an adequate stock of non-burdened high-quality liquid assets (HQLA) that can easily be

converted into cash in private markets to meet their liquidity needs for a 30 calendar day liquidity stress scenario. According to BCBS (October, 2014), the Net Stable Funding Ratio (NSFR) on the other hand aims to promote resilience over a longer period of time by creating additional incentives for banks to fund their activities with more stable sources of funding on an ongoing basis. In this regard, the NSFR supplements the LCR and has a time horizon of one year and provides a sustainable maturity of assets and liabilities, (BCBS, July 2011 and BCBS, October 2014). These liquidity measures are to be phased in stage by stage beginning in January 2015 to 2019, BCBS (January, 2013).

The LCR will improve the banking sector's ability to absorb shocks arising from the financial sector to the real economy whilst implications of the LCR on financial markets, credit extension and economic growth have been taken into consideration with regard to ongoing strains in some banking systems, (BCBS, January 2013 and BCBS, July 2013). The NSFR impact on the financial market according to BCBS (October, 2014) will include limiting overreliance on short-term wholesale funding, encouraging better assessment of funding risk across all on and off-balance sheet items and thereby promote stability of the banking and economic system as a whole.

A destabilizing element of the crisis was the pro-cyclical amplification of financial shocks throughout the banking system, financial markets and the broader economy, (TingTing, 2011; Fender and Scheicher, 2009). The tendency of market participants to behave in a pro-cyclical manner was amplified through a variety of channels, including through accounting standards for both mark-to-market assets and held-to-maturity loans, margining practices, and through the build-up and release of leverage among financial institutions, firms, and consumers, (BCBS, May 2010 and BCBS, September 2012). The Basel Committee introduced a number of measures to make banks more resilient to such pro-cyclical dynamics, BCBS (June, 2011). These measures will in turn help ensure that the banking sector serves as a shock absorber, instead of a transmitter of risk to the financial system and broader economy according to BCBS (September, 2009). In addition, the Committee introduced a series of measures to address pro-cyclicality and raise the resilience of the banking sector in good times, (TingTing, 2011 and BCBS, June 2011). These measures objectives such as; to dampen any excess cyclicality of the minimum capital requirement; to promote more forward looking provisions; to conserve capital to build buffers at individual banks and the banking sector that can be used in stress and achieve the broader macro-prudential goal of protecting the banking sector from periods of excess credit growth, BCBS (July, 2009).

The Basel II framework increased the risk sensitivity and coverage of the regulatory capital requirement and one of the most pro-cyclical dynamics has been the failure of risk management and capital frameworks to capture key exposures such as complex trading activities, re-securitizations and exposures to off-balance sheet vehicles in advance of the crisis (BCBS, July 2009 and BCBS, July 2011).

The association between global liquidity and asset prices has rarely been investigated using the CVAR framework. It appears that the potential relations between asset returns and liquidity have solely been studied by means of OLS regressions, SVAR models and in some cases panel co-integration tests (Giese and Tuxen, January 2007; Roman et al., 2012). This study proposes the use of a CVAR analysis as it allows for accountability of non-stationarity of the data, i.e. looking for co-integration properties in the data, and at the same time disentangle short- and long-run dynamics as was proposed by, (Giese and Tuxen, 2009; Johansen and Juselius, 1990). In this regard, the study aims to establish whether there is a link between bank failure and liquidity as well as whether market wide risk in the form of traditional liquidity risk measure was a contributor to the 2007-2009 financial crisis.

2. LITERATURE REVIEW

During the 2007-2009 financial crisis outburst, the notion of funding liquidity frequently was pointed out in relation to asset prices, Attila (2012). The funding or balance sheet liquidity can be explained as the ability of a financial institution to settle obligations with as immediate as possibly without major setbacks (Drehmann et al., 2010 and Petersen and Mukuddem-Petersen, 2014). This notion fundamentally supposes that funding conditions should be an essential part of asset and financial stability valuation process, Attila (2012). In the core of rapidly evolving financial theory, it is inherently not unexpected that there are difficulties with the identification of liquidity and as a consequence with its measurement, (Attila, 2012; Petersen and Mukuddem-Petersen; Roman et al., 2012). Discovering an appealing relationship between asset prices and monetary or credit aggregates seems interesting but only after the 2007-2009 financial crisis was a suitable answer arrived at, Drehmann et al. (2010). According to Borio and Lowe (2002), continuous rapid credit growth coupled with enormous increases in asset prices seems to increase the possibility of an occurrence of financial instability. On the other hand, rapid credit growth, on its own, creates uncertain risk to the stability of the financial system and the same can be said to be true for quick growths in asset prices or investments, (Attila, 2012; Borio, 2000; Borio and Low, 2002). The combination of events, such as the coordinated occurrence of fast credit growth and rapid increases in asset prices that increases the likelihood of financial risk, rather than any one of these events alone, Borio and Lowe (2002). The key feature of the development of financial systems since the 1970s has according to (Borio, 2000 and Alexander, 2001) been the rapid expansion of financial markets. The importance of liquidity has been acknowledged by central banks in respect to both monetary and financial stability, (Attila, 2012 and Borio, 2000). An example can be given by yield curves that are commonly used to extract information about market participants' expectations concerning inflation and process depending crucially on the liquidity of the underlying market, namely the treasury and bond market, (Borio, 2000 and Hoover et al., 2008). In the case of financial stability, central banks use asset prices in the monitoring of liabilities in the financial system, as they include information about market participants assessment and risk pricing, Borio (2000).

Market-based institutions[1] overtook the dominant role in the supply of credit from commercial banks and these market-based financial institutions were deeply involved in securitization and actively used capital and financial markets to satisfy their funding needs, (Attila, 2012 and BCBS, July 2011). In such a way, market-based liabilities such as repos and commercial paper are better indicators of credit conditions that influence the economy, (Attila, 2012 and BCBS, December 2010). As a result, from the point of view of financial stability measures of collateralized borrowing, such as the weekly series of primary dealer repos can prove very useful, (Borio, 2000 and BCBS, July 2011). In order to protect against losses in case of default of borrower, lenders apply haircut on pledged assets, which is the difference between the current market price of the security and the price at which it is sold, Gorton (2010). The system of repurchase agreement is built on trust of the value of the underlying asset and in the case of questioning the value of collateralized assets, the trust fades from the markets resulting in higher haircuts, (Gorton, 2010 and BCBS, September, 2009). In addition, haircuts addresses the risk that if the holder of the bond in repo, the depositor, has to sell a bond in the market to get the cash bank, he may face a better informed trader resulting in a loss[2], Gorton (2010). The risk in this case is endogenous to the trading practice, which is not the danger of loss due to default, Gorton (2010). One way to protect against this endogenous adverse selection risk is to require overcollateralization, (Attila, 2012 and Gorton, 2010).

Preliminaries about the Liquidity Coverage Ratio

According to BCBS (December, 2010), the LCR standard aims to ensure that a bank maintains an adequate level of unencumbered, high-quality liquid assets that can be converted into cash to meet its liquidity needs for a 30 calendar day time horizon under a significantly severe liquidity stress scenario specified by supervisors. At a minimum, the stock of liquid assets should enable the bank to survive until day 30 of the stress scenario, by which time it is assumed that appropriate corrective actions can be taken by management and supervisors or the bank can on the other hand be resolved in an orderly way, (BCBS, July 2013 and BCBS, July 2011). The LCR is given by the formulae:

$$\frac{Stock\ of\ high-quality\ liquid\ assets}{Total\ net\ cash\ outflows\ over\ the\ next\ 30\ calender\ days} \geq 100\%$$

The Liquidity Coverage Ratio (LCR) as pointed out by the BCBS in, (BCBS, December 2010 and BCBS, May 2010) builds on traditional liquidity coverage ratio methodologies used internally by banks to assess exposure to contingent liquidity events. In this case, the total net cash outflows for the scenario are to be calculated for 30 calendar days into the future and the standard requires that the value of the ratio be no lower than 100%[3], (BCBS, July 2011 and BCBS, January 2013).

For the promotion of more medium and long-term funding of the assets and activities of banking organizations, the Basel Committee has developed the Net Stable Funding Ratio (NSFR), BCBS (October, 2014). This metric establishes a minimum acceptable amount of stable funding based on the liquidity characteristics of an institutions assets and activities over a one year horizon, (BCBS, December 2010 and BCBS, October 2014). The NSFR is designed to act as a minimum enforcement mechanism to complement the LCR and reinforce other supervisory efforts by promoting structural changes in the liquidity risk profiles of institutions away from short-term funding mismatches and toward more stable, longer-term funding of assets and business activities, (BCBS, June 2011 and BCBS, December 2010).

Preliminaries about the Net Stable Funding Ratio

The Net Stable Funding Ratio (NSFR) standard is structured to ensure that long term assets are funded with at least a minimum amount of stable liabilities in relation to their liquidity risk profiles and it aims to limit over-reliance on short-term wholesale funding during times of resilient market liquidity and encourage better assessment of liquidity risk across all on and off-balance sheet items, (BCBS, December 2010; BCBS, June 2011 and BCBS, October 2014). In addition, the NSFR approach offsets incentives for institutions to fund their stock of liquid assets with short-term funds that mature just outside the 30-day horizon for that standard, (BCBS, July 2013 and BCBS, October 2014). The NSFR is given by the formulae:

$$\frac{Available\ amount\ of\ stable\ funding}{Required\ amount\ of\ stable\ funding} \geq 100\%$$

The NSFR is formed on the basis of traditional net liquid asset and cash capital methodologies used widely by internationally active banking organizations, bank analysts and rating agencies, (BCBS, July 2009 and BCBS, October 2014).

According to House et al. (2016), holding large liquid assets makes sense from a financing perspective but also brings forth an economic trade-off. Liquid assets tend to be less profitable for banks and maintaining the buffer effectively ties up more of their balance sheets which in the process restructures financial institutions' ability to lend, (BCBS, December 2010 and BCBS, July 2011). However regulators emphasize they had taken into consideration this trade off when they opted to soften their original liquidity coverage ratio proposals, BCBS (July, 2011). In this regard, banks will now be able to include a host of assets from Residential Mortgage Backed Securities (RMBS) to different types of corporate bonds when building their buffers which will go on until the full implementation in 2019, BCBS (July, 2011).

Furthermore, according to House et al. (2016), some of the shortcomings identified of relying entirely on central banks as lenders of last resort to extend liquidity to solvent banking institutions in times of crisis may encourage firms to hold less liquidity on their own which might ultimately make them vulnerable to runs. It should be noted that it is not easy during the financial crisis for the central bank to determine which institutions are insolvent and those experiencing temporary liquidity shortage, BCBS (January, 2013) . While insuring deposits may

1 broker–dealers, investment banks

2 relative to the true value of the security

3 ie the stock of high–quality liquid assets should at least equal total net cash outflows

reduce the risk of runs on deposits, uninsured short-term funding is still susceptible to runs as was witnessed in the 2007-2009 financial crisis, (BCBS, December 2010 and BCBS, January 2014).

3. METHODOLOGY

To empirically analyse the dynamic interactions among the variables of interest with regard to bank performance in the new proposed Basel III liquidity framework, the model was estimated by using the Co-integrated Vector Autoregressive (CVAR) procedure, developed by Johansen and Juselius, (1990). According to Hoover et al. (2008), the CVAR approach insists on careful stochastic specification as a necessary groundwork for econometric inference and the testing of economic theories. In the time series data, the probability approach requires careful specification of the integration and cointegration properties of variables in the system of equations, (Koop et al., 1996 and Hoover et al. 2008). The CVAR approach in this artcle includes, stationarity testing, cointegration analysis and Granger Causality testing. The study makes use of EMERG global liquidity data, similar to that used by Petersen et al. (2013). This data consists of observations for the London Interbank Offered Rate (LIBOR) based banks for the period 2002-2012. The study in this regard uses databases consisting of individual banks' income statements. Furthermore, the study includes a total of 391 LIBOR-based Basel II compliant banks from 36 countries[4] made up of 157 class I and 234 class II banks. In addition, bank failure data was obtained from the deposit insurance schemes of the 36 countries from the period 2002-2012. In the United States for example, bank failure data was obtained from the Federal Insurance Corporation. The period 2002-2012 was selected for the study because EMERG global liquidity data could not be used to accurately calculate the LCR and NSFR prior to 2002 which is similar to the data used by other studies such as Wu and Hong (2012). Emphasis should be given that calculating the LCR and NSFR using the available public data goes without difficulties as it is limited in terms of format and granularity between EMERG global banking data and the information required for determining Basel III LCR and NSFR.

Model Specification

The data used in this study is similar to the EMERG data used for similar studies on Basel III such as the study by Petersen and Mukuddem-Petersen (2014), on Basel III liquidity and its regulations as well as Roman et al. (2012), on Bank's Capital and Liquidity Creation. It gives the desired values of bank liquidity; hence it was applied to model default risk of assets and for econometric analysis. The data gives quarterly observations of variables for Class I and II banks from the period 2002Q1 to 2012Q4 comprising of estimated Basel III liquidity standards comprising Net Stable Funding Ratio (NSFR) and Liquidity Coverage Ratio (LCR), as well as Traditional liquidity measures in the form of Government Securities Ratio (GSR) and Brokered Deposits Ratio (BDR). Therefore the study adopts the following econometric model for bank failure with regard to the estimated Basel III standards and traditional liquidity measures:

$$Bank\ Failure = f(NSFR, LCR, GSR, BDR) + \varepsilon$$
$$NSFR_t = \alpha + \beta_1 LCR_t + \beta_1 GSR_t + \beta_3 BDR_t + \varepsilon_t$$

where:
NSFR = Net Stable Funding Ratio
LCR = Liquidity Coverage Ratio
GSR = Government Security Ratio
BDR = Brokered Deposit Ratio
β = Intercept Parameters
ε = Normally distributed error term

The liquidity coverage ratio, net stable funding ratio, government securities ratio and brokered deposit ratio were calculated using the following formulas:

$$\frac{Stock\ of\ high-quality\ liquid\ assets}{Total\ net\ cash\ outflows\ over\ the\ next\ 30\ calender\ days} \geq 100\%$$

$$\frac{\text{Available amount of stable funding}}{\text{Required amount of stable funding}} \geq 100\%$$

$$\text{GSR} = \frac{Loans}{Deposits} \qquad BDR = \frac{Brokered\ deposits}{Domestic\ deposits\ above\ 10\%\ threshold, adjusted\ for\ asset\ growth\ rate\ factor}$$

Strengths and Weaknesses of the Data

The data gives quarterly observations of estimated traditional balance sheet liquidity comprising of Basel III liquidity data in the form of Net Stable Funding Ratio (NSFR) and Liquidity Coverage Ratio (LCR) as well as liquidity measures made up of Government Securities Ratio (GSR) and Brokered Deposits Ratio (BDR) for Class I and II banks from the period 2002Q1-2012Q4. Some of the strengths of this data includes the interesting fluctuation of different balance sheet variables in trillions of dollars prior to the market collapse of 2007-2012. In addition, the data has already been transformed into logs, making the variables independent of their units and comparable to each other and in order to reduce the effect of residual heteroscedasticity. However, the data has shortcomings such as the time period for which it represents which is 10 years in this case. It might be difficult to forecast the behaviour of banks with the proposed Basel III changes in liquidity with minimal observations especially for the period after the financial crisis considering that most of the changes will fully be implemented in the year 2019. Econometric analysis enabled the study establish how the independent variables affected or impacted the respective dependent variable which was the NFSR in this case when regression and correlation tests were conducted.

4. EMPIRICAL RESULTS

4 Australia (5,2), Austria (2,6), Belgium (1,2), Brazil (3,1), Canada (7,3), China (7,1), Czech Republic (4,3), Denmark (1,3), Finland (0,14), France (5,5), Germany (8,25), Hong Kong (1,8), Hungary (1,2), India (6,6), Indonesia (1,3), Ireland (3,1), Italy (2,11), Japan (14,5), Korea (6,4), Luxembourg (0,1), Malta (0,3), Mexico (1,8), Netherlands (3,13), Norway (1,6), Poland (0,5), Portugal (3,3), Russia (0,3), Saudi Arabia (4,1), Singapore (5,0), South Africa (4,5), Spain (2,4), Sweden (4,0), Switzerland (3,5), Turkey (7,1), United Kingdom (8,5), and United States (35,66).

Table 1. Descriptive Statistics for Estimated Traditional Liquidity Measures

Parameter	NSFR	LCR	GSR	BDR
Mean	0.937550 0.959670	0.750527 0.773422	14.20897 14.40467	2.371149 2.432092
Median	0.940000 0.962500	0.748840 0.774060	14.84535 15.05465	2.423043 2.492325
Maximum	0.992690 1.016400	1.026760 1.061340	16.58310 16.81690	4.428780 4.491220
Minimum	0.879840 0.90090	0.540400 0.514560	11.22090 11.37910	1.119600 1.198330
Std.Dev	0.023357 0.023991	0.136743 0.143466	1.618854 1.639070	0.759057 0.778322
Skewness	0.005426 -0.004725	-0.002109 -0.029288	-0.250406 -0.245797	0.365017 0.315371
Kurtosis	3.167401 3.133101	1.793564 1.855692	1.780825 1.787296	2.964153 2.823904
JB	0.051591 0.032643	2.668429 2.406930	3.184866 3.184866	0.979433 0.979433
Prob.	0.974534 0.983811	0.263365 0.300152	0.203430 0.208124	0.612800 0.674956
Sum	41.25221 42.22550	33.02320 34.03056	625.1948 633.8054	104.3306 107.0120
Sum Sq.Dev	0.023458 0.024750	0.804045 0.885042	112.6896 115.5216	24.77521 26.04877
Observations	44 44	44 44	44 44	44 44

In Table 1, the NSFR and BDR show positive skewness while the LCR and GSR portray negative skewness. The NSFR and LCR mean values stand at 93.76% and 75.05% respectively for class I banks while the values of class II banks are given by 95.97% and 77.34%. The kurtosis value for the variables is equivalent to 3 or lower which in turn shows that the distribution is flat in this case. Furthermore, the P-values of the risk measures are greater than 5% which shows normality. However, the normality test gives the more accurate results when the observations are large and in this data set it is very sensitive to the number of observations. The descriptive results show in a way that the LCR seems to have satisfied the Basel III minimum liquidity standards of 100% but emphasis should be given that conclusions are hard to derive in the absence of empirical evidence in support of NSFR compliance with Basel III requirements until the phase in period 0f 2015-2019 has been completed.

The Basel Committee on Banking Supervision (BCBS) reluctance to align the two ratios' implementation dates may be due to regulatory concerns regarding short-term wholesale funding or due to the view that the NSFR is more maintainable than the LCR.

The study further tests for the stationarity status of all the variables in the model in order to determine their order of integration.

Table 2. Stationarity Test Results for Class I Estimated Basel III Liquidity Measures

Variable		ADF test statistic at level	ADF test statistic at 1st difference	Result
LCR	Intercept	-1.115959 (-2.931404)	-5.382705* (-2.933158)	I(1)
NSFR	Intercept	-2.879233 (-2.931404)	-7.512755* (-2.933158)	I(1)
GSR	Intercept	-1.127572 (-2.931404)	-6.629503* (-2.933158)	I(1)
BDR	Intercept	-1.880787 (-2.933158)	-5.300611* (-2.933158)	I(1)
		PP test statistic at level	**PP test statistic at 1st difference**	
LCR	Intercept	-1.115959 (-2.931404)	-5.377240* (-2.933158)	I(1)
NSFR	Intercept	-2.883220 (-2.931404)	-8.592902* (-2.933158)	I(1)
GSR	Intercept	-1.138511 (-2.931404)	-6.628121* (-2.933158)	I(1)
BDR	Intercept	-1.590563 (-2.931404)	-5.341996* (-2.933158)	I(1)

Note: I(1) indicates unit root and stationarity after first difference
** Denotes significance at 5% level and the rejection of the null hypothesis of non-stationarity.*

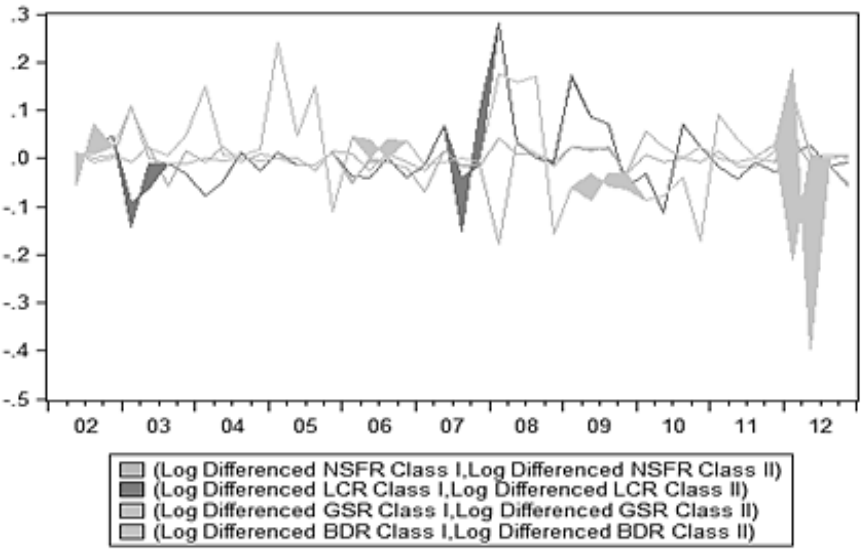
Table 3. Stationarity Test Results for Class II Estimated Basel III Liquidity Measures

Variable		ADF test statistic at level	ADF test statistic at 1st difference	Result
LCR Class II	Intercept	-1.196122 (-2.931404)	-5.483439* (-2.933158)	I(1)
NSFR Class II	Intercept	-2.912241 (-2.931404)	-7.392878* (-2.933158)	I(1)
GSR Class II	Intercept	-1.138699 (-2.931404)	-6.685446* (-2.933158)	I(1)
BDR Class II	Intercept	-1.717819 (-2.931404)	-6.174256* (-2.933158)	I(1)
		PP test statistic at level	**PP test statistic at 1st difference**	
LCR Class II	Intercept	-1.196122 (-2.931404)	-5.460584* (-2.933158)	I(1)
NSFR Class II	Intercept	-2.875632 (-2.931404)	-8.118934* (-2.933158)	I(1)
GSR Class II	Intercept	-1.151767 (-2.931404)	-6.685045* (-2.933158)	I(1)
BDR Class II	Intercept	-1.717819 (-2.931404)	-6.174430* (-2.933158)	I(1)

Note: I(1) indicates unit root and stationarity after first difference
**Denotes significance at 5% level and the rejection of the null hypothesis of non-stationarity.*

The ADF results in Tables 2 and 3 indicate the non-stationarity of the series when the variables are defined at levels. However, at first difference the series removes the non-stationarity components in all cases and the null hypothesis of non-stationarity is rejected at the 5% significance level which implies that all the variables are integrated of order one, I(1). At the same time, PP tests are also reported in both tables and they are not essentially different from the ADF results. The Bartlett Kernel according to Newey and West (1987) were chosen for the lag truncations. The results after first-difference strongly reject the null hypothesis of the presence of a unit root implying that the series are integrated of order one.

Figure 1. Log Area Bands for Traditional Liquidity Standards and Measures



Because of the difficulty in predicting or forecasting the impact of NSFR due to insufficient data, the area band does not show much activity for this trend. The estimated liquidity measures of LCR, GSR and BDR however show some interesting movements especially during the 2007-2009 financial crisis period. Changes in the liquidity measures were observed around the 2007-08 phase of the crisis and BDR which comprises large denomination deposit sold by a bank to a brokerage which in turn divides it into smaller pieces for sale to its customers. The decrease in the BDR can be attributed to reduced capital and liquidity as a result of the decline in the practice of securitization for capital generation by banks during that period due to strict measures imposed by financial regulators.

The cointegration analysis results of Class I bank liquidity are presented in Tables 4 and 5 respectively.

Table 4. Unrestricted Cointegration Rank Test (Trace)

Hypothesized no. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob**
None*	0.465873	54.95981	47.85613	0.0093
At Most 1	0.262374	28.62072	29.79707	0.0679
At Most 2*	0.207397	15.83936	15.49471	0.0444
At Most 3*	0.134713	6.077166	3.841466	0.0136

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
** denotes rejection of the hypothesis at the 0.05 level*
***MacKinnon-Haug-Michelis (1999) p-values*

Table 5. Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized no. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob**
None	0.465873	26.33909	27.58434	0.0715
At Most 1	0.262374	12.78136	21.13162	0.4725
At Most 2	0.207397	9.762196	14.26460	0.2280
At Most 3*	0.134713	6.077166	3.841466	0.0136

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
**denotes rejection of the hypothesis at the 0.05 level*
***MacKinnon-Haug-Michelis (1999) p-values*
Tables 6 and 7 present cointegration results for Class II banks.

Table 6. Unrestricted Cointegration Rank Test (Trace)

Hypothesized no. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob**
None*	0.483266	56.90476	47.85613	0.0056
At Most 1	0.248656	29.17520	29.79707	0.0589
At Most 2*	0.222961	17.16776	15.49471	0.0277
At Most 3*	0.144861	6.572646	3.841466	0.0104

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
**denotes rejection of the hypothesis at the 0.05 level*
***MacKinnon-Haug-Michelis (1999) p-values*

Table 7. Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized no. of CE(s)	Eigenvalue	Max-Eign Value	0.05 Critical Value	Prob**
None*	0.483266	27.72955	27.58434	0.0479
At Most 1	0.248656	12.00744	21.13162	0.5469
At Most 2	0.222961	10.59511	14.26460	0.1757
At Most 3*	0.144861	6.572646	3.841466	0.0104

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
**denotes rejection of the hypothesis at the 0.05 level*
***MacKinnon-Haug-Michelis (1999) p-values*

In Table 4, the trace statistic shows 3 cointegrating equations at 5% significance level while the maximum eigenvalue test in Table 5 shows 1 cointegrating equation at all levels in Class I bank liquidity. The trace test are advantageous if there are atleast two more cointegrating relations in the process than specified under the null hypothesis. Based on the two tests undertaken, the trace test is preferred because it has more cointegrating ranks. The hypothesis of no cointegration in the trace test at none is rejected because the probability 0.0093 is less than 5% and the trace statistic 54.95981 is greater than the critical value 47.85613 at 5% significance level. The same can be said for At most 2 and At most 3 in the trace test. For the maximum eigenvalue, only At most 3 has a probability 0.0136 which is less than 5% and a trace statistic 6.077166 which is greater than the critical value 3.841466 at 5% significance hence showing the presence of cointegration in the series. For Class II banks, the trace test in Table 6 shows the presence of 3 cointegrating equations and the maximum eigenvalue in Table 7 shows 2 cointegrating equations. This points to the existence of a possible long run relationship between the dependent and independent variables in both Class I and II bank liquidity however this is not explored further due to setbacks in acquiring data for a longer time span of at least 20 years and above. A change in the independent variables given by LCR, GSR and BDR will have an effect or impact on the NSFR.

Causality results for the Basel III liquidity standards and traditional liquidity measures are given in Table 8 below.

Table 8. Granger Causality Test Results

Null Hypothesis	Obs	F-Statistic	Prob.
LCR does not GC NSFR	42	4.67881	0.0154
NSFR does not GC LCR	42	0.99859	0.3781
GSR does not GC NSFR	42	3.22953	0.0510
NSFR does not GC GSR	42	3.69710	0.0344
BDR does not GC NSFR	42	1.16531	0.3230
NSFR does not GC BDR	42	3.14460	0.0548
GSR does not GC LCR	42	3.68711	0.0347
LCR does not GC GSR	42	4.90443	0.0129
BDR does not GC LCR	42	4.76004	0.0145
LCR does not GC BDR	42	3.29004	0.0484
BDR does not GC GSR	42	2.37035	0.1075
GSR does not GC BDR	42	0.81661	0.4497

According to the granger causality test results, the null hypothesis that LCR does not granger cause NSFR is rejected due to the low p-value given by 0.0154 which is less than the 5% significance level. The test results further show that the null hypothesis that NSFR does not granger cause LCR is accepted given by the high p-value of 0.3781. The null hypothesis that GSR does not granger cause NSFR is accepted given by the high p-value of 0.3230. The granger causality test therefore shows that estimated LCR has an impact on the NSFR while the GSR and BDR have similar impacts on the LCR. Therefore any changes in the traditional liquidity measures have direct or indirect impact on the Basel III liquidity standards considered in this study.

5. CONCLUSION

The NSFR is yet to be implemented by the Basel committee and aim of this study was to establish the link between bank failure and estimated liquidity standards such LCR as well as traditional liquidity measures comprising of GSR and BDR. In addition the study took into account market wide liquidity risk in the form of traditional measures as a possible contributor to the previous 2007-2009 financial crisis. Changes to any of the independent variables will definitely affect the NSFR as evidenced by the existence of co-integration. The Error correction term size in the Vecm indicates the speed of adjustment of any disequilibrium towards a long run equilibrium and it was found to be negative which is economically significant for the restoration of equilibrium. It confirms the unavailability of setbacks in the long run equilibrium relationship between the dependent and independent variables. This in turn suggests that any short term fluctuations between the independent and the dependent variables gives rise to a stable long run relationship between the variables.

The BCBS should insure that it imposes high penalty charges for banks that do not have sufficient capital and liquidity but are in the business of securitizing assets. There should be a minimum capital and liquidity level set up for each bank to adhere to before they indulge in securitization practices. Governments of each respective country should insure that they set up regulatory boards that will insure sound banking principles are followed by each bank operating in the country. In addition, governments should have strict guidelines for non-bailing of defaulting banks, a process which will encourage banks to hold enough capital and increase their liquidity to safe levels. In addition, Class II banks have to be regulated with the same measures taken on Class I banks. Some of the Class II banks qualify to trade internationally and have capital reserves similar to those of Class I banks. These Class II banks can therefore securitize and trade assets without notice from regulators which in turn contributes to the risk of default for these structured asset products and in turn results in bank failure. The BCBS should consider increasing the NSFR stress scenario period from one year to one year six months considering it shall be the last line of defence for banks after using the LCR. This will help banks keep enough reserves and liquidity avoiding situations of government bailouts

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