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Determinants of Commercial Banks Liquidity Risk in Kenya

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Abstract: **The Kenyan banking sector has experienced liquidity challenges over the years that have seen banks collapsing. The liquidity ratios have been fluctuating as per the bank annual supervision reports which if not mitigated could pose liquidity risk, hence contagion effect. The general objective of this study was to ascertain the determinants of commercial banks liquidity risk in Kenya. Panel data obtained from a representative sample of 37 licensed commercial banks for the period ranging 2008 to 2016 was obtained from Central Bank's website. The study employed a fixed effect regression analysis using E-views 9.5 software to determine the influence of capital adequacy, profitability, loan growth and interbank rates on commercial banks liquidity risk in Kenya. Relevant diagnostic tests were also conducted to identify for any presence of econometric problems before the model was considered fit for inferential analysis. A negative and significant effect of profitability on bank liquidity risk existed. A similar effect was realized with increase in bank capital adequacy which had a negative and significant effect on bank liquidity risk, same effect experienced with an increase in inter-bank rate though not significant. However, a unit increase in commercial bank loans had a positive and significant effect on liquidity risk. All the tests were conducted at 5% significance level. The study recommends the Central Bank of Kenya to closely monitor liquidity levels of commercial banks and adjust liquidity among the banks where the banks may be in such sudden needs.**

Keywords: **Bank Liquidity Risk, Capital Adequacy, Interbank Rate, Profitability, Loan Growth.**

1. INTRODUCTION

Commercial banks were traditionally tasked with the transformation of maturity and liquidity provision (Diamond and Dybvig, 1983). They transform short-term liquid liabilities into long-term illiquid assets. Through the several roles they conduct, they are exposed to liquidity risk. When the bank lacks sufficient liquidity to meet its obligation, it is said to be facing liquidity risk. Liquidity risk refers to the risk that a bank may not meet its obligations as the depositors call their funds at an inconvenient time causing fire sale of assets (Jenkinson, 2008). Therefore, liquidity risk occurs as a result of the significant role of banks in the maturity transformation of short-term deposits into long-term loans. Consequently, banks need to understand the determining factors of liquidity risk in order to mitigate occurrence of the situation.

According to Wojcik et al (2015), prior to the onset of the sub-prime crisis of 2008, liquidity risk was studied under the determinants of commercial bank's performance estimated at the level of margins (profits) generated by commercial banks. Lately, the determining factors of liquidity risk have begun gaining an immense attention from the financial institutions and regulators given the detrimental effects it has borne on the economy and globe at large. According to Ali (2004), liquidity risk is said to be the assassin of banks. Many banks have failed in the recent past as a result of adverse liquidity risk concerns. Jenkinson (2008), also records bank's reputation and performance to be negatively influenced by liquidity risk. In his study, he found that the depositors' confidence in a bank may deteriorate where funds are not made available to them. This in turns risks the bank's reputation.

Given the adverse effects that liquidity risk poses to the banking system and the financial system at large, different countries have drawn increased attention and control in ensuring smooth operation of their banking systems, causing the

establishment of International Supervisory Authority aimed at bank supervision. The Basel Committee on Banking Supervision (BCBS) was thus formed to deal with matters relating to bank supervisory. The committee deals with checking on the general strength of the banking institutions as well as their risk management skills. In that regard, the committee established certain bank supervisory accords known as Basel accords or agreements (Basel I, 1988; Basel II, 2004; Basel III; 2010). The accords are tasked with providing financial regulation standards such as capital adequacy for financial institutions. The committee has as well emphasized the importance of bank's liquidity creation. They have developed Basel III in response to the weakness in financial regulation witnessed by the financial crisis of 2007-2008. Basel III requirement is mandated with strengthening bank capital requirements by improving bank liquidity and minimizing bank leverage. Contrary to Basel I and Basel II whose main concerns are bank loss reserves levels that banks require to hold, Basel III majorly concentrates on the risk of a bank run, calling upon a bank to possess adequate high quality liquid assets to cover its total net cash outflows over 30 days (Liquid Coverage Ratio/LCR). This is aimed at boosting short term tolerance of the banks liquidity risk profile. LCR on the other hand, provides for a cushion to absorb shock and economic stress (Bank for International Settlements, 2013).

Kenya government has established various policies through the Central Bank of Kenya (CBK) aimed at streamlining the banking industry in order to avoid further bank liquidity strains. Central Bank of Kenya regulations requires commercial banks to maintain a liquidity buffer of twenty percent of their total deposit liabilities, matured and short term liabilities in liquid assets (CBK, 2014). Commercial banks are also required to maintain a Liquidity Coverage Ratio (LCR) that is greater or equivalent to one hundred percent. This is aimed at promoting resilience to potential liquidity shocks over a thirty-day horizon (CBK Risk Management Guidelines, 2013).

Despite establishment of the regulations, financial distress has still been witnessed among the commercial banks. In order to control such occurrences, it is vital to first understand the determining factors of bank liquidity risk. Scholars have emerged analyzing trends relating to bank liquidity in order to come up with significant policy lessons.

Lucchetta (2007) researched on the effect of interest rate on risk and liquidity management of the banks of European Union. The study found that interbank rate and bank size positively determined the liquidity and monetary policy whereas interest had a negative relationship with the liquidity level. Rauch et al. (2010) looked at the determinants of liquidity of German state-owned saving banks. The study reveals that bank size, profitability, and monetary policy interest were negatively associated while liquidity lag value was positively associated. The studies mentioned above examine bank specific factors and macroeconomic variables as the determinants of bank liquidity risk. In Kenya, Njeri (2013) examined the relationship between liquidity and financial performance of microfinance institutions. Kamau, Erick and Muriithi (2013), focused on how monetary policies, government expenditure and balance of payment status affected liquidity of commercial banks. Limited attention has been rendered towards the determinants of liquidity risk in Kenya despite the detrimental effects. In this study, we looked at the bank specific factors namely; capital adequacy, loan growth, profitability and interbank rate as the main determinants of bank liquidity risk in Kenya and adopted the measures recommended by Basel III in attaining bank liquidity risk.

2. LITERATURE REVIEW

2.1 Theoretical Review:

2.1.1 Financial Intermediation Theory:

Diamond et al. (1983) suggests that banks are exposed to liquidity risk when there is maturity transformation of short term deposits into long term loans. Under these theory depositors are seen to be risk averse making them uncertain on their expectation regarding future consumption needs. Thus, in the absence of an intermediary, all investors find themselves locked into illiquid long term investments that bear high proceeds only to those who continue late. For those that consume early, low payoffs are earned since early consumption calls for premature liquidation of long term investments. Diamond and Dybvig (1983), emphasized on the preference for liquidity under uncertainty economic agents to advocate for the existence of banks. They argued that banks existed in order to provide better liquidity insurance compared to the financial markets. In the case where agents need to consume at varied timeframes, banks can improve on a competitive market by delivering better risk sharing. However, given that banks are liquidity insurers, they face transformation risk and are exposed to the risk of a run on deposits. Therefore, the greater the liquidity created to the external public, the greater the risk for banks to meet losses from having to sell off illiquid assets to meet the customers' liquidity demands.

The financial intermediation theory was relevant to this study because it explained how liquidity creation through the existence of financial intermediaries causes liquidity risk. Liquidity creation will vary based on the risk appetite of the depositors whether they need their investments to yield high pay offs or low pay offs (profitability) and this will depend on the time horizons (Diamond and Dybvig, 1983). The maturity transformation of the short term deposits into long term deposits would have banks exposed to liquidity risk and early consumption by the depositors would require premature liquidation of the long term investments hence low pay offs (profitability). This theory enabled the research to link profitability with banking liquidity risk.

2.1.2 The Shift-Ability Theory of Liquidity:

H.G. Moulton (1918) posits that banks can possess credit instruments with a ready secondary market to act as a liquidity reserve in order to secure themselves against huge deposit withdrawals. Such instruments include but are not limited to commercial paper, treasury bills and prime bankers' acceptances. These instruments need to be marketable due to the short term nature of maturity and capital certainty. Also, the instruments should be easily shifted to other banks at the prevailing interbank rate for cash without significant loss in case of necessity disregarding the need to rely on maturities. In a case of general crisis when all banks are in liquidity need, the proposition requires that all banks should hold such instruments that are easily transferrable to the central bank who is the lender of last resort.

This theory was relevant to this study because it demonstrated how interbank rate could affect the available liquid in case of deposit withdrawals. It emphasized on the need to possess credit instruments that had a ready secondary market. Thus, this theory recognized that shift-ability, marketability or transferability of a bank's assets as a basis of ensuring liquidity.

2.1.3 Risk Absorption Theory:

Diamond and Dybvig (1983), proposed that higher capital ratios were positively linked to liquidity levels and encouraged banks to create liquidity. Liquidity creation exposed the banks to higher risk since the losses increases with the level of illiquid assets in order to meet the customers' liquidity requests (Allen and Gale, 2004), whereas bank capital enables the bank to absorb greater risk given banks will increase the capital ratios aimed at curbing high losses of liquidity risk. (Repullo, 2004). Under this body of knowledge, banks might raise their lending appetite in order to create high liquidity. Allen (2004), argued that with an increase in liquidity creation, so does the liquidity risk.

This theory was relevant to this study because it demonstrated how capital adequacy requirement was likely to influence liquidity creation. According to Repullo (2005), a requirement of higher capitals minimizes the risk on the bank loan portfolio thus reducing the liquidity buffer.

2.1.4 Inventory and Liquidity Buffer Theory of Capital:

Calem and Rob (1986) posit that a bank whose capital is close to the regulatory minimum capital ratio will be motivated to raise capital in order to minimize risk mainly to evade regulatory costs driven by breach of capital requirements. Buffer capital is the ratio of excess capital over risk weighted assets. It is the bank's non-regulatory internal capital that fluctuates over time as a reflection of the bank's reaction to market pressures in line with risk assessment in the assets including loans and securities portfolio. This theory stipulates that the magnitude of liquidity buffer indicates the foregone cost of possessing liquid assets compared to loans as well as the cost of raising funds within a short span. The size of liquidity needs to be positively related to the variability of the funding basis and the cost of raising additional funds. Based on this, commercial banks are enticed to hold on to a buffer of liquidity assets to enable them to sufficiently control the liquidity risk surrounding their balance sheet structure (Mugenyah, 2015).

The theory was significant to this study because it explained the mix of loan growth vis-a-vis liquid assets held. It showed the influence of loan growth on liquidity risk. The inventory theory predicts that the size of liquidity buffer should portray the cost of foregone return from possessing liquid assets in relation to loans, and the cost of raising funds within a short span (Santomero, et al., 1984).

2.2 Empirical Review:

2.2.1 Capital Adequacy:

Doriana (2013) researched on the determinants of bank liquidity risk within the context of Euro Area. The study analyzed link between liquidity risk, measured with LCR and NSFR, and other bank structure variables such as bank size, assets

quality, capitalization, and specialization. Bank capitalization was taken as the ratio of equity to total assets. The sample comprised of 1080 listed and non-listed Eurozone banks. OLS regression model was employed in the study based on the panel data. The study revealed that larger banks were highly exposed to liquidity risk, whereas banks that had higher capitals portrayed a better liquidity in the long run. The assets quality only affected the measure of liquidity risk in the short term. For specialization, banks that had deeply concentrated in lending activity displayed a more exposed funding structure.

Vodova (2013) studied the determinants of liquidity for commercial banks in Hungary. The period under study ranged from 2001 to 2010. The study employed a panel data regression analysis. Liquidity was taken as the ratio of total liquid assets to total assets, total deposits or total deposits plus short term borrowings. Capital adequacy was calculated as the share of equity on the banks' total assets. Bank liquidity was positively linked to banks' capital adequacy, interest rate on loans and bank profitability. The size of the bank, interest margin, monetary policy interest rate and interest rate on interbank transaction had a negative relationship with bank liquidity.

Kamau et al. (2004) studied on the regulatory impact of minimum capital requirements on bank risk behavior and capital levels in Kenya. They used the simultaneous equations approach in the study with the period ranging from 2000 – 2002. The study analyzed the relationship between capital adequacy ratio and the risk portfolio in the banking sector. Risk-based capital requirements were found to have been effective in raising capital for the capitalized bank while the effect was largely reduced for the less capitalized banks. The study also found out that regulatory constraints influenced bank behavior specifically for the capitalized banks.

2.2.2 Interbank Rate:

Doris (2017) studied on the impact of macroeconomic factors on liquidity risk of Albanian banks. Methodology employed was fixed effect regression analysis conducted for 13 Albanian banks for the period ranging from 2010 to 2014. Analysis of the panel data used was conducted using E-views 7.0 program. The non-stationarity of the data was eliminated using one-time lag of the independent variables. In the study, the dependent variable liquidity, was measured as the ratio of total liquid assets to short term liabilities. The explanatory macroeconomic variables used were; interbank interest rate, interest rate on loans, regulatory capital adequacy, non-performing rate, inflation rate, unemployment rate, GDP growth and public deficit. The prevailing short term interest rates was used as the proxy for interbank rate. Interbank rate was found to have a significance influence with a positive link to liquidity. Unemployment rate on the other hand had a significant and negative effect.

Shirazi et al. (2016) studied on bank liquidity and its effective factors in Iran. The study investigated the relationship between bank liquidity and internal and external factors influencing it by using multiple regression analysis for the panel data of 18 banks related to Islamic Republic of Iran banks for the period of 2000 to 2013. The study adopted a descriptive correlation design. Liquidity was measured in two ways. First, as a ratio of loans to total assets and secondly as a ratio of total liquid assets to total deposits and short term borrowings. Interest rate were taken as either daily short-term and long-term 1 year investments. The study found that interbank funds, capital adequacy, bank stability, income to cost ratio, amount of demanding deposits and savings, interest rates on daily short – term and long – term 1 year investments, number of internal branches and inflation rate had positive effect on banks' liquidity whereas assets quality and unemployment rate had negative influence on bank liquidity.

Tesfaye (2012) studied on bank liquidity determinants and how they impact financial performance in Ethiopia. The study adopted balanced fixed effect panel regression method. Data was obtained from eight commercial banks for the period ranging from 2000 to 2011. Liquidity was calculated as a ratio of liquid assets to total assets as well as a ratio of loans to deposits and short term financing. The weighted average yield on the existing kinds of Treasury bills (namely:28 days, 91 days and 182 days) was employed as the proxy for market interest rate. Capital adequacy, bank size, share of non-performing loans in the total volume of loans, interest rate margin, inflation rate and short term interest rate were found having a positive and statistically significant influence on the bank liquidity. Real GDP growth rate and loan growth portrayed a statistically insignificant effect on bank liquidity. Capital adequacy and bank size positively influenced financial performance. Non-performing loans and short term interest rate were negatively linked with financial performance. Interest rate margin and inflation were seen to have a negative but statistically insignificant effect on financial performance.

2.2.3 Profitability:

Lartey et al. (2013) studied the relationship that existed between liquidity and profitability of banks as listed on the Ghanaian Stock Exchange. Out of the nine banks listed in the stock exchange, seven were employed in the study. Descriptive study using the longitudinal time dimension specifically panel method was adopted. Secondary data was collected from financial reports of the seven listed banks using document analysis research procedure. Regression analysis of liquidity and profitability ratios was conducted. The study revealed that for the period ranging from 2005 to 2010, both the liquidity and the profitability were declining. A slight positive relationship existed between liquidity and profitability for the listed banks in Ghana.

Owolabi (2012), conducted a study on liquidity management and corporate profitability. The author asserted that there was a tradeoff between profitability and liquidity such that any slight increase in one variable would reduce the other, for instance, for any increase in liquidity there would be less profitability. The results were consistent with the standard finance theory which displays a negative relationship between liquidity and profitability. In this study, we expect to find a result consistent with the standard finance theory where liquidity is negatively related to profitability.

Maaka (2013) researched on the link between liquidity risk and performance of Kenya commercial banks. The study adopted a correlation research design. Secondary data was obtained from the balance sheets, income statements and notes of 33 Kenya commercial banks for the period ranging from 2008 to 2012. The study used multiple regression to analyze the impact of liquidity risk on banks' profitability. Significance of the regression model was determined using the F-test, with the variation in the response variable explained by the independent variables determined by the coefficient of determination, R^2. Profitability of Kenya commercial banks was found to be negatively influenced by a rise in liquidity gap and leverage.

2.2.4 Loan Growth:

Elma et al. (2017) researched on the determinant factors of excess liquidity in Bosnia and Herzegovina (B&H) banks. The general objective of the study was to obtain the determinants of excess liquidity. Dynamic panel analysis on the basis of generalized method of moments (GMM was employed. Nineteen commercial banks of B&H for the period ranging from 2006 to 2015 were used. Excess liquidity was taken as commercial banks' holding of cash and deposits at the central bank in excess of statutory requirements. The study found out that total loans, non-performing loans and bank size were the key determinants of excess liquidity. The increase of loans had a negative effect on excess liquidity. Poor credit growth enhanced accumulation of excess liquidity in the post crisis period. Bank size had a positive influence on excess liquidity.

Moussa et al. (2015) looked at the determinants of bank liquidity in Tunisia. Eighteen banks operating in Tunisia for the period ranging from 2000 to 2010 were used. The study collected secondary financial data from the websites of the professional association of banks in Tunisia over the employed period. Liquidity was measured as a ratio of liquid assets to total assets and total loans to total deposits ratio. Loan growth was measured using the percentage of loans in relation to total assets. Static and dynamic panel methods were conducted. It was revealed that total loans to total assets, and total deposits to total assets did not have a significant effect on bank liquidity. Financial performance, capital to total assets, operating costs to total assets, growth rate of GDP and inflation rate had a statistical significant influence on the bank liquidity of banks operating in Tunisia.

Belete (2015) employed a balanced fixed effect panel regression to study the factors affecting liquidity of commercial banks in Ethiopia for the period ranging from 2002 to 2013. Eight commercial banks were selected for the study. The study adopted a mixed research approach by combining documentary analysis and in-depth interviews. Liquidity was measured as the ratio of liquid assets to total deposits and total loans to total deposits. The annual change in total loans was used as a proxy for loan growth. It was found that loan growth had a negative and statistically significant relationship with banks' liquidity. Capital strength, interest rate margin and inflation were found to influence banks' liquidity positively and statistically significant. Profitability, bank size, non-performing loans, and GDP were statistically insignificant.

2.3 Conceptual Framework:

The conceptual framework in this study contributed in identifying the different variables being assessed, their relationship and how they are linked to the research question and problem statement.

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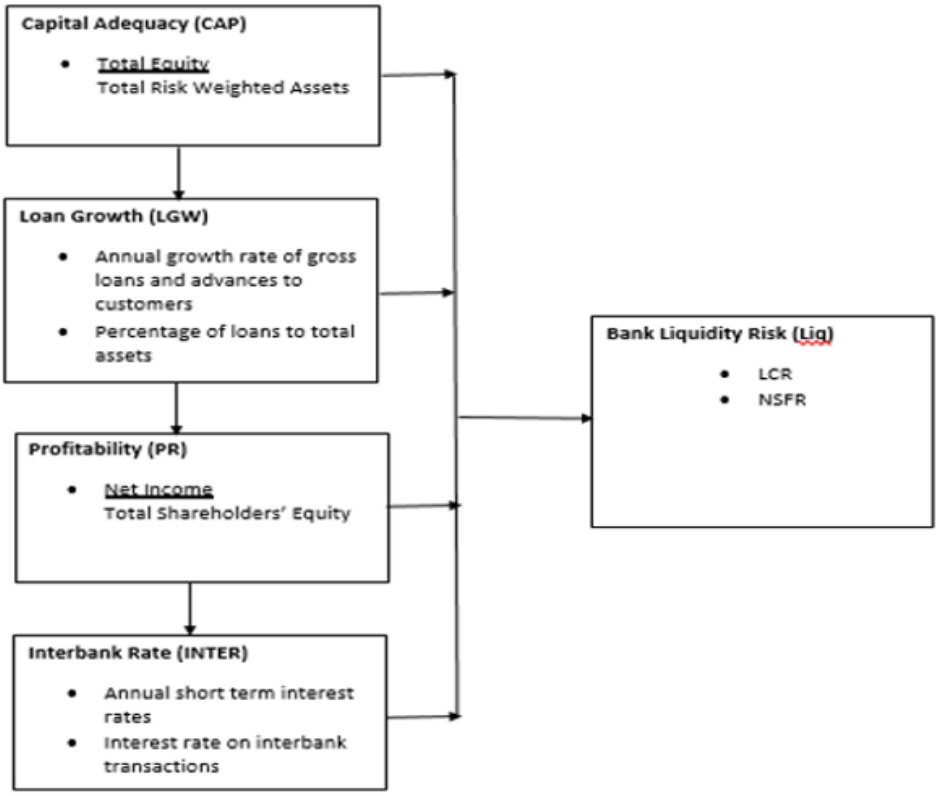

Figure 1: Conceptual framework

3. RESEARCH METHODOLOGY

3.1 Research Design:

The study employed a descriptive research design. Descriptive research design was more significant as it enabled the researcher to construct a profile on the determinants of commercial banks liquidity risk in Kenya. The descriptive research approach was preferred because it allows analysis and relation of variables unlike other forms of research design.

3.2. Target Population:

The study targeted the commercial banks in Kenya for the period ranging from 2008 to 2016 as licensed by the Kenyan Central Bank. This period was chosen mainly because it was the period after the global financial crisis where liquidity was the main concern. Banks that were in receivership, under liquidation and under statutory management were left out as they did not have sufficient data to conduct the study. The study therefore targeted 43 licensed commercial banks operating in Kenya within the period 2008-2016.

3.3. Sample Design:

The researcher used Yamane statistical formula to determine the appropriate representative sample. Ngechu (2004) was agreeable with Yamane method as being ideal where the sample size is sought for cases where the target population is either small or large since it provides a representative sample size at a reliability of 95% confidence level. Using Yamane formula, 37 Kenya commercial banks were used as the representative sample for the period ranging from 2008 to 2016.

3.4. Data Collection:

In this study the dependent variable was the liquidity ratio whereas the independent variables consisted of capital adequacy, profitability, interbank rate and loan growth. Secondary data for the period ranging from 2008 to 2016 was collected from bank annual reports as submitted to the Central Bank of Kenya. The obtained data was regarded as reliable and valid, given that all the financial statements published was audited by accredited audit firms and by the CBK auditors in line with the CBK requirements.

3.5 Data Processing:

For a significant and robust result of this study, econometric problems such as multicollinearity, heteroscedasticity and autocorrelation had to be checked for and eliminated. Normality of the residuals was also checked. Redundant Fixed Effect and Hausman tests were performed prior to conducting diagnostic tests on the study model. This was to enable the researcher to identify whether to employ either pooled OLS model, fixed effect model or random effect model.

3.5.1 Redundant fixed effect

H_0: *Pooled OLS is preferred to fixed effect model*

H_1: *Fixed effect model is preferred to pooled OLS model*

Decision Rule: Reject H_0 if p-value is less than significance level. Otherwise, do not reject H_0.

Decision: Reject H_0 since the p-value is less than the significance level of 0.05 (5%).

Conclusion: There is adequate evidence to infer that fixed effect model is preferable to pooled OLS model.

3.5.2 Hausman test:

H_0: *Random effect model is preferred to fixed effect model*

H_1: *Fixed effect model is preferred to random effect model*

Decision Rule: Reject H_0 if p-value is less than significance level. Otherwise, do not reject H_0.

Decision: Reject H_0 since the p-value is less than the significance level of 0.05 (5%).

Conclusion: There is adequate evidence to infer that fixed effect model is preferable to random effect model.

3.5.3 Multicollinearity:

Multicollinearity was detected by examining the correlation matrix provided by E-views software version 9.5. Where there is any correlation between two variables exceeding 80%, then serious multicollinearity can be suspected. In this study, we used correlation matrix to detect the seriousness of multicollinearity.

3.5.4 Heteroscedasticity:

A hypothesis test was conducted using E-views software version 9.5 and p-values were obtained to detect the heteroscedasticity problem. Where the p-value found is greater than 5% significance level, then the model does not have heteroscedasticity problem.

H_0: H*eteroscedasticity problem is absent*

H_1: H*eteroscedasticity problem is present*

Decision Rule: Reject H_0 if p-value is less than significance level. Otherwise, do not reject H_0.

Decision: Do not reject H_0 since the p-value is greater than the significance level of 0.05 (5%).

Conclusion: There is adequate evidence to infer that the Model does not consist of heteroscedasticity problem.

3.5.5 Autocorrelation:

Autocorrelation test was carried out by using E-views software version 9.5. P-values were obtained to examine whether there exists autocorrelation problem within the given model. Where the p-value obtained exceeds 5% significance level, then there is autocorrelation problem.

H_0: *There is no autocorrelation model*

H_1: *There is autocorrelation model*

Decision Rule: Reject H_0 if p-value is less than the significance level. Otherwise, do not reject H_0.

Decision: Do not reject H_0 since the p-value is greater than the significance level of 0.05 (5%).

Conclusion: There is inadequate evidence to infer that Model consists of autocorrelation problem.

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3.5.6 Normality of error term:

In this study Jarque-Bera test statistics was used.

H_0: *The error term is normally distributed*

H_1: *The error term is not normally distributed*

Decision Rule: Reject H_0 if the p-value for Jarque-Bera statistic is less than the significance level of 0.05 (5%). Otherwise, do not reject H_0.

Decision: Since the p-value for Jarque-Bera statistic is less than the significance level of 0.05 (5%), reject H_0 and conclude that the error term is not normally distributed.

3.6 Data Analysis:

Fixed effect regression analysis was applied to the data to detect the effect of the given determinants of commercial banks liquidity risk in Kenya. The predictor variables consisted of capital adequacy, profitability, loan growth and interbank rates. The response variable was bank liquidity risk measured by NSFR.

3.6.1 Fixed Effect Model:

Fixed effect model was used in the study to analyze the data collected. It was preferable as it was vital in examining the various factors on 37 commercial bank's liquidity regardless of time effect.

The equation assumed the below form:

```
Estimation Equation:
=========================
LIQ__NSFR_ = C(1)*CAP + C(2)*PR + C(3)*LGW + C(4)*INTER + C(5) + [CX=F]
```

Where: LIQ_NSFR represents Liquidity measured by NSFR

CAP represents capital adequacy

PR represents profitability

LGW represents loan growth

INTER represents interbank rate

C(1), C(2), C(3), C(4), C(5)…CX represents the coefficient for that specific independent variable

C(5) is the unknown intercept for each entity

[CX=F] is the fixed effect value

3.6.2 Statistical Test of Significance:

The F-test was used to determine the overall significance of the regression model.

H_0: The overall model is not significant

H_1: The overall model is significant

Where the probability of the F-statistic is less than significance level 0.05 (5%) then the H_0 is rejected and conclude that the overall model is significant. Otherwise, we do not reject H_0 and conclude that the overall model is not significant.

The variation in response variable Y as explained by the predictor/explanatory variable X was determined by the coefficient of determination, R^2. This was conducted at 5% significance level.

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4. DATA ANALYSIS

4.1 Model Determination:

4.1.1 Redundant Fixed Effect Test:

Table 4.1.1: Redundant Fixed Effect Test P-value obtained from E-views output

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	5.671440	(36,292)	0.0000
Cross-section Chi-square	176.546122	36	0.0000

This was conducted so as to determine the best estimated model. Since the p-value (p-value obtained is 0.00) is less than 5% significance level, we reject the null hypothesis that Pooled OLS is preferable to fixed effect model and conclude that Fixed Effect Model (FEM) is preferable to pooled OLS model.

4.1.2. Hausman Test:

Table 4.1.2: HausmanTest P-value obtained from E-views output

Correlated Random Effects - Hausman Test
Equation: Untitled
Test period random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	26.714200	3	0.0000

This was conducted in order to choose between Fixed Effect Model (FEM) and Random Effect Model (REM). Since the p-value (p-value obtained is 0.00) is less than 5% significance level, we reject the null hypothesis that Random effect model is preferable to fixed effect model and conclude that FEM is preferable to REM.

4.2 Diagnostic Tests:

4.2.1 Normality test of the residual:

A histogram of the residuals is vital in providing a graphical representation of the behavior of the random variables of estimation. A Jarque-Bera value of 3.839614 and a probability of 0.146635 in figure 4.1 below which is greater than 0.05 at 5% significance level is an indication that the residuals are normally distributed. Hence the null hypothesis of normality is not rejected.

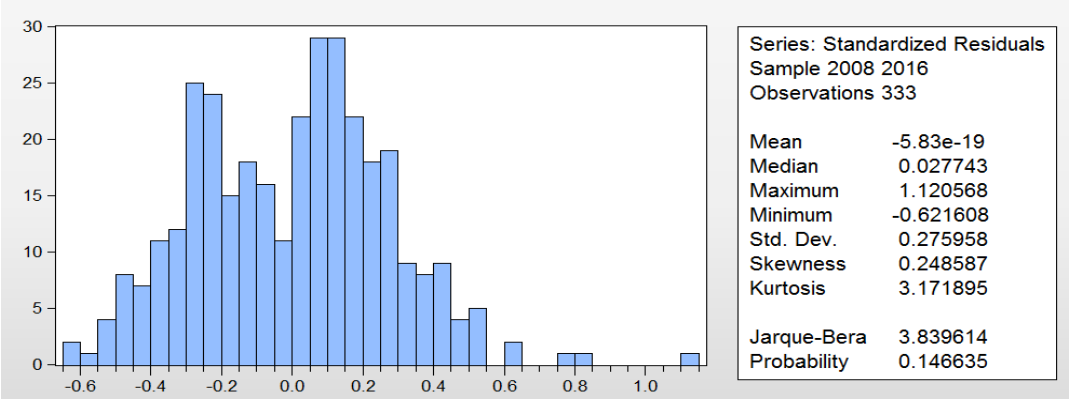

Figure 4.1-Histogram of residuals

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4.2.2 Multicollinearity:

Table 4.2 –Correlation matrix of explanatory variables

Covariance Analysis: Ordinary
Date: 05/28/18 Time: 15:45
Sample: 2008 2016
Included observations: 333

Correlation t-Statistic Probability	LIQ__NSFR_	CAP	LGW	PR	INTER
LIQ__NSFR_	1.000000				

CAP	0.674127	1.000000			
	16.60493	-----			
	0.0000	-----			
LGW	-0.551428	-0.523554	1.000000		
	-12.02600	-11.17995	-----		
	0.0000	0.0000	-----		
PR	0.055992	-0.025690	-0.082500	1.000000	
	1.020290	-0.467544	-1.506088	-----	
	0.3083	0.6404	0.1330	-----	
INTER	-0.003317	-0.038610	0.092302	0.022983	1.000000
	-0.060352	-0.702971	1.686491	0.418247	-----
	0.9519	0.4826	0.0926	0.6760	-----

This assumption is concerned with whether there exists a relationship between the independent variables. Table 4.2 above depicts correlation matrix results of multicollinearity test showing the relationships between explanatory variables. Deducing from the results shown in table 4.3, all the correlation coefficients between the explanatory variables were less than 0.8 in absolute terms (to one decimal place) and thus qualify the use of Gaussian (ordinary) regression since there is no severe multicollinearity problem (serial correlation) between the variables.

4.2.3 Heteroscedasticity:

Table 4.3 P-value obtained from E-views output

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	2.707952	Prob. F(4,4)	0.1790
Obs*R-squared	6.572784	Prob. Chi-Square(4)	0.1603
Scaled explained SS	1.549460	Prob. Chi-Square(4)	0.8178

In this study, the test was carried out using E-views software version 9.5 and p-values obtained to detect the heteroscedasticity problem. A test of constant variance using the Breusch_Pagan_Godfrey test in table 4.3 above revealed that there was no heteroscedasticity problem in the model since the p-values were greater than the significance value of 5%, hence we fail to reject the null hypothesis and hence infer that there was no heteroscedasticity problem.

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4.2.4 Autocorrelation:

Table 4.4 Regression output of the residuals and their lagged residuals

Dependent Variable: RESIDUAL
Method: Least Squares
Date: 03/06/18 Time: 21:33
Sample (adjusted): 2008: 2016
Included observations: 9

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LRESIDUALS	0.504054	0.216492	1.328279	0.0563
C	0.000384	0.053389	0.007186	0.9944

The linear relationship between the residual and their lagged residuals (LRESIDUAL) was established to determine a possibility of autocorrelation in the data. From the output in table 4.4 above, a p-value of 0.0563 which is greater than 0.05 (5% level of significance), a clear indication of absence of autocorrelation in the data.

4.3 Regression Analysis:

The response variable was liquidity risk (measured by NSFR) used to measure liquidity regressed against the explanatory variables namely capital adequacy, profitability, loan growth and interbank rate. The estimation output is represented as below in table 4.5

Table 4.5 Estimation model output from E-views

Dependent Variable: LIQ__NSFR_
Method: Panel Least Squares
Date: 05/28/18 Time: 16:39
Sample: 2008 2016
Periods included: 9
Cross-sections included: 37
Total panel (balanced) observations: 333

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CAP	3.833640	0.314986	12.17082	0.0000
PR	0.437221	0.165821	2.636702	0.0088
LGW	-0.725932	0.355176	-2.043864	0.0419
INTER	0.005981	0.005297	1.129136	0.2598
C	1.011779	0.240153	4.213063	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.713196	Mean dependent var	1.612719
Adjusted R-squared	0.673908	S.D. dependent var	0.576605
S.E. of regression	0.329267	Akaike info criterion	0.730965
Sum squared resid	31.65777	Schwarz criterion	1.199835
Log likelihood	-80.70560	Hannan-Quinn criter.	0.917930
F-statistic	18.15292	Durbin-Watson stat	2.049561
Prob(F-statistic)	0.000000		

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4.3.1 R-squared and adjusted R-squared:

An R^2 of 0.713196 from the above output shows that the four predictor variables above are able to account up to 71.32% of the total changes in commercial bank liquidity risk while 28.68% changes in liquidity risk are accounted for by other factors other than those explained above. The difference between R-squared and the adjusted R-squared are not far apart with a margin of 3.93%. This is an indication of low penalty of the adjusted R^2 on the overall R^2 since 3 out of 4 of the explanatory variables were found to be statistically significant in explaining liquidity risk. A Durbin Watson statistic of 2.049561 in table 4.5 above indicates that the residuals are not serially correlated (absence of autocorrelation) since the value is close to 2.

4.3.2 Estimation results of the dependent variable:

From the output in table 4.5 above, the following regression equation (equation 4.1) was established:

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Estimation Equation:
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LIQ__NSFR_ = C(1)*CAP + C(2)*PR + C(3)*LGW + C(4)*INTER + C(5) + [CX=F]

Substituted Coefficients:
========================
LIQ__NSFR_ = 3.83364008431*CAP + 0.437220671806*PR - 0.725932264431*LGW + 0.00598092692781*INTER + 1.01177907802 + [CX=F]
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From the regression model obtained above in table 4.6, an amount of 1.011779 of liquidity risk is constant or exogenous, meaning it does not depend on the levels of all the explained variables above. This amount is hence determined by other factors other than loans growth, inter-bank rate, profitability and capital ratio.

4.3.3 Effects of each variable on liquidity risk:

Holding all the other factors constant, a unit change in profitability affects liquidity positively by 0.437221 units. Thus an increase in the bank's profits increases the liquidity status of the bank. Increase in bank capital had a positive effect on liquidity, while increase in inter-bank rate had a positive impact on liquidity risk by 0.0005981 units. However, a unit increase in commercial bank loans reduces liquidity by 0.725932 units while a unit decrease in the advances reduced liquidity by the same amount. Inter-bank rate was not statistically significant in explaining liquidity in banks, even though it affected bank liquidity positively.

4.3.4 Significance of the variables in explaining liquidity risk:

The criteria for comparing whether the predictor variables were significant in the model was through comparing the obtained probability value and α=0.05 (significance level). If the probability value was less than α, then the predictor variable was significant otherwise it wasn't. Three of the predictor variables were statistically significant in the explaining banking liquidity namely; loan growth, bank profitability and capital ratio which had p-values of 0.0419, 0.0088 and 0.0000 respectively. However, inter-bank rate was found not statistically significant to banking liquidity since the p-value was 0.2598.

4.3.5 Overall significance:

It is important to establish that the variables in totality are significant in explaining commercial bank liquidity risk. This can be established through the overall F-statistic. The null hypothesis is that the overall model is not significant while the alternative states that it is significant. Since the probability of the F-statistic is 0.0000 which is less than 0.05 (5%) then the null hypothesis is rejected. Thus, the overall model is significant.

4.4 Discussion of Research Findings:

Table 4.6 Coefficients and p-values from the estimation model output

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CAP	3.833640	0.314986	12.17082	0.0000
PR	0.437221	0.165821	2.636702	0.0088
LGW	-0.725932	0.355176	-2.043864	0.0419
INTER	0.005981	0.005297	1.129136	0.2598
C	1.011779	0.240153	4.213063	0.0000

Liquidity risk was measured using the NSFR as per recommendations of Basel Committee for Banking Supervision (Bessis, 2009). For the purpose of discussion, liquidity measurement was a ratio for banks liquidity which meant that a higher value meant that banks hold higher liquidity ratio. Hence, the intuition on the liquidity risk exposure is opposite to the coefficient signs. The study used E-views software version 9.5 to conduct a multiple regression analysis of Panel data aimed at establishing the determining factors of liquidity risk in Kenya commercial banks.

4.4.1 Capital Adequacy (CAP):

The study found a positive and significant effect of capital adequacy on bank liquidity. Based on the intuition therefore, capital adequacy was negatively correlated with bank liquidity risk. This implies that an increase in capital adequacy ratio for commercial banks in Kenya is associated with a decrease in liquidity risk exposure. This result was parallel to the Risk Absorption Theory and consistent with the findings made by Repullo (2005), who concluded that a higher capital requirement lowers the riskiness of bank loan portfolio and reduces the liquidity buffer. Repullo suggested that with increase in the bank capital adequacy ratio, banks are able to absorb any great risk that comes by. However, the study findings were contrary to the findings by Diamond and Dybvig (1983) who proposed that higher capital ratios were positively related to liquidity levels with a positive impact on liquidity risk such that an increase in capital adequacy enhanced the ability of banks to create liquidity. Liquidity creation in turn increases the bank's exposure to risk given that its losses increase with the level of illiquid assets to meet the liquidity requests of customers. Banks have a higher appetite for illiquid assets or loans with increased capital adequacy as they assume that they have sufficient capitals to insure against any risk, hence enhancing the risk.

4.4.2 Profitability (PR):

The study found profitability to positively impact bank liquidity. By intuition also, profitability was negatively related with bank liquidity risk. This implies that an increase in profitability for commercial banks in Kenya is associated with a decrease in liquidity risk exposure. These findings correspond to the financial intermediation theory which suggests that banks exist as an intermediary to facilitate liquidity creation. Liquidity creation will vary based on the risk appetite of the depositors whether they need their investments to yield high pay offs or low pay offs (profitability) and this will depend on the time horizons (Diamond and Dybvig, 1983). The maturity transformation of the short term deposits into long term deposits would expose the banks to liquidity risk and early consumption by the depositors would require premature liquidation of the long term investments hence low pay offs (profitability). Thus low pay offs (profitability) would imply low levels of liquidity hence increased liquidity risk exposure. However, the findings above contradicted those by Vodova (2012) using ROE as a proxy for bank's profitability who found that profitability had a negative relationship with bank liquidity creation.

4.4.3 Loan growth (LGW)

The research found that loan growth had an inverse effect on liquidity. By intuition therefore, loan growth had a positive relationship with bank liquidity risk. This implies that an increase in loans for commercial banks in Kenya led to reduction in liquidity levels hence increased liquidity risk while loan decrease increased liquidity of banks thereby reducing liquidity risk. This is explained by the fact that loans are part of the banks illiquid assets, increasing the amount of loans implies increasing illiquid assets in the bank's asset portfolio. The findings were consistent with the Inventory and Liquidity Buffer Theory of Capita (Diamond and Rajan, 2001) which suggests that the magnitude of liquidity buffer should portray the cost of foregone return from holding liquid assets relative to loans, hence increased magnitudes of liquidity indicate foregone loans. Similar findings were echoed by Belete (2015) who studied on factors affecting liquidity of selected commercial banks in Ethiopia and found that loan growth had a negative and statistically significant relationship with banks' liquidity.

4.4.4 Interbank Rates (INTER)

The paper found that there exists a positive relationship between inter-bank rate and bank liquidity. By intuition also, interbank rates were negatively correlated with bank liquidity risk. This implies that an increase in the interbank rates for commercial banks in Kenya was associated with a decrease in liquidity risk exposure. This is explained by the fact that increase in the inter-bank rates increases the bank-earnings thus improving liquidity of the bank. The study findings are parallel to the research done by Vodova (2011) who studied on the determinants of liquidity of Czech Commercial banks and found out that interest rate on interbank transaction was positively related with bank liquidity such that higher interbank interest rate encouraged banks to invest money on the interbank market and balances with other banks were a part of liquid bank assets.

5. CONCLUSION AND RECOMMENDATION

This study was conducted to identify the determinants of liquidity risk for commercial banks in Kenya. The results of multiple regression analysis indicated that loan growth had a positive influence on bank liquidity risk measured by NSFR while capital adequacy, profitability and interbank rate had a negative effect on bank liquidity risk. Capital adequacy, profitability and loan growth were statistically significant at 5% confidence level while interbank rate was not statistically significant. The result of F test indicated that taken together capital adequacy, profitability and loan growth were significant determinants of liquidity risk. This therefore implies that more focus should be put on capital adequacy, profitability and loan growth because they are the significant variables.

The Central Bank of Kenya should improve on implementation of strict policies that require all the commercial banks to hold a minimum level of capital as well as a capital buffer relative to the liquidity levels. Capital adequacy ratio was found to have a negative and significant relationship with bank liquidity risk such that as the ratio of capital adequacy increases, the liquidity risk exposure reduces. As a result, banks will be discouraged from engaging in risky investments as they have to possess high capital. Alternately, banks can be advised to issue more shares to attract more shareholders. These shareholders' stakes will contribute to the bank's capital hence minimizing liquidity risks.

Commercial banks should concentrate in operations that guarantee them higher returns or profitability at the expense of minimizing liquidity risks. Profitability had a negative and significant effect on liquidity risk implying that where the profitability of the commercial banks was kept high the liquidity risk would be reduced. Thus, commercial banks can weigh out on investing in government securities relative to relying on issuance of loans. In the cases where loans are issued, the commercial banks should opt for cash covered loans or request for easily disposable collaterals prior to issuing loans. This would enhance liquidity levels thereby minimizing liquidity risk.

Commercial banks should not be profit oriented in such a way that their profits are utilized in giving more loans and investing in riskier assets, given that in the long run, the bank's performance would decline over time due to low quality assets. However, refraining from issuing loans would also be a loss in opportunity to maintain in the long run. Therefore, the bank management should aim at maintaining optimal loan levels issued as well as deposits retained.

The management of commercial banks should keep a close watch on the performance of loans and ensure that provisions are adequately met based on the level of performance. Loans should not grow at the expense of foregoing the minimum levels of stipulated liquidity and where there is a steady growth liquidity buffer should be maintained to cater for sudden and abrupt customer withdrawals.

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Appendix 2.0 Sample of Banks used in the study

NO.	Bank
1	African Banking Corporation Ltd
2	Bank Of Baroda (K) Ltd
3	Bank Of India
4	Barclays Bank Of Kenya Ltd
5	Citibank Na Kenya
6	Commercial Bank Of Africa Ltd
7	Consolidated Bank Of Kenya Ltd
8	Co-Operative Bank Of Kenya Ltd
9	Credit Bank Ltd
10	Development Bank Of Kenya Ltd
11	Diamond Trust Bank Kenya Ltd
12	Guardian Bank Ltd
13	Habib Bank Ag Zurich
14	I & M Bank Ltd
15	Kenya Commercial Bank Ltd
16	Middle East Bank (K) Ltd
17	National Bank Of Kenya Ltd
18	Nic Bank Ltd
19	Paramount Bank Ltd

20	Prime Bank Ltd
21	Stanbic Bank Kenya Ltd
22	Standard Chartered Bank Kenya Ltd
23	Trans-National Bank Ltd
24	Victoria Commercial Bank Ltd
25	Bank of Africa Ltd
26	Equity Bank Ltd
27	Ecobank Ltd
28	Family Bank Ltd
29	First Community Bank Ltd
30	Fina Bank Ltd
31	Fidelity Commercial Bank Ltd
32	Giro Commercial Bank Ltd
33	Gulf African Bank Ltd
34	Habib Bank Ltd
35	Housing Finance Co. of Kenya Ltd
36	K-Rep Bank Ltd
37	Oriental Commercial Bank Ltd