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**Firm-level Determinants of Liquidity:
The Case of NSE-Listed Kenyan Banks**

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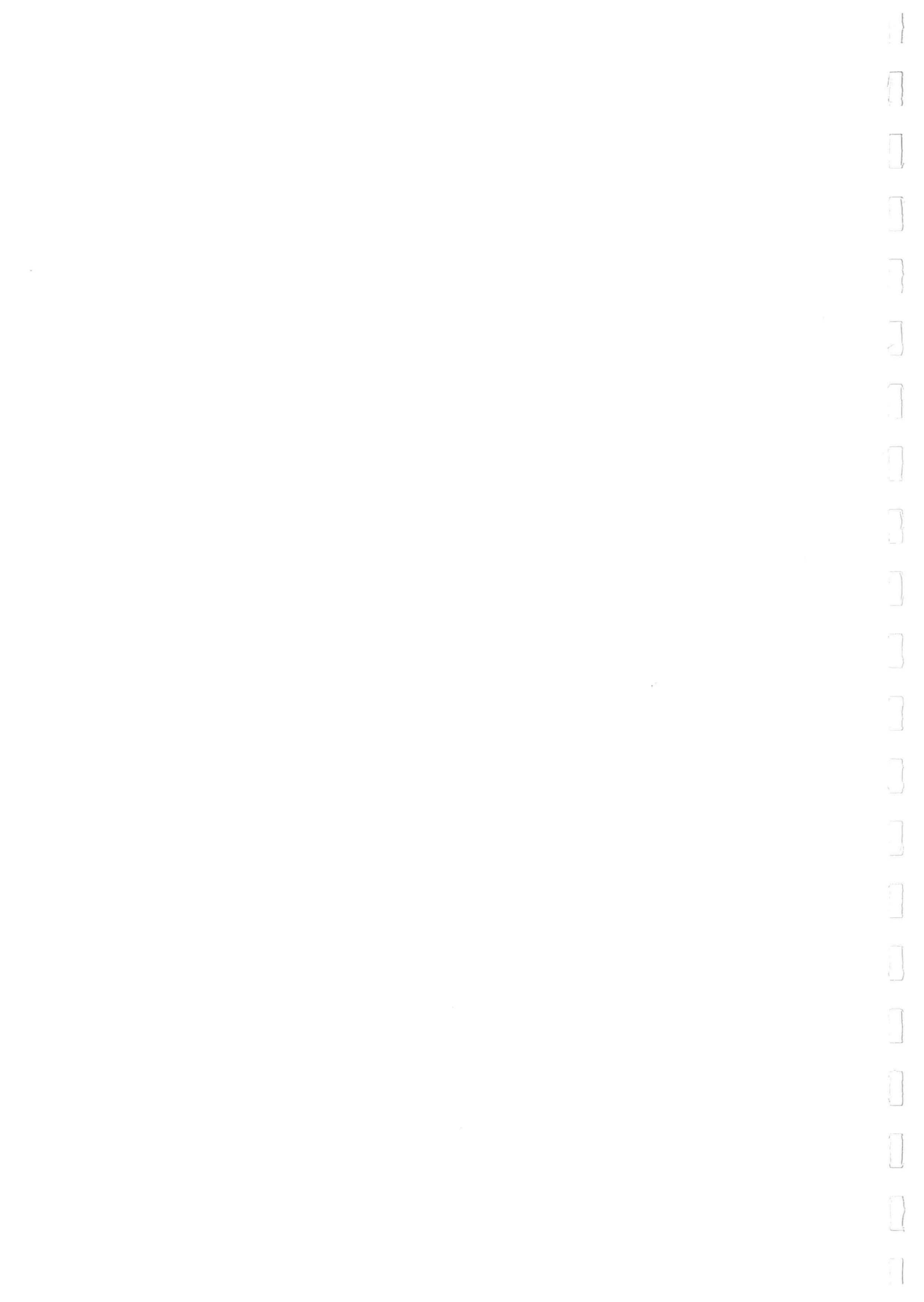
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DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the Research Proposal contains no material previously published or written by another person except where due reference is made in the Research Proposal itself.

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Abstract

What are the key determinants of Liquidity in Kenyan Commercial banks? In the aftermath of the Global Financial Crisis as well as recent events in the Kenyan context, Liquidity and its management have been a crucial concern to industry thought leaders and policymakers. (Mwangi, 2014) and (Mugenyah, 2015) began the conversation in the Kenyan context. However, a more rigorous study is required to advance the debate and the current paper seeks to do just that. A panel data methodology is adopted with bank-fixed effects on a sample of 11 banks and 10 time periods. Two liquidity indicators serve as regressands and a set of core bank indicators as regressors. The author attempts to identify the 'best set' of core bank indicators that ultimately predict or determine liquidity in Kenyan Commercial Banks. Net Loans to Total Assets Ratio, Tier 1 Capital Ratio and Total Capital Ratio emerged as the most significant factors, highlighting the key role that bank specialization and Capital Adequacy play in the liquidity management function of listed Kenyan Commercial Banks.

1. Introduction

1.1. Background

February 2008. The Bank for International Settlements (BIS) publishes *the 'Principles for Sound Liquidity Risk Management and Supervision'*, a handbook that was developed to serve a pressing need for regulation and management of liquidity risk all across the developed world. This publication, and subsequent related documents, came to be popularly known as 'Basel III'. Basel III reflected the emphasis on and drive towards common measures and standards for liquidity risk and its management.

March 2008. Bear Stearns, a well-respected and storied firm on Wall Street, is embroiled in a crisis, facing near collapse. A sudden liquidity squeeze caused by its large exposure to devalued mortgage-backed securities led to a wave of panic among firms associated with Bear and even to the exodus of a growing number of its trading counterparties. (Shorter, 2008). This string of events led to a drop in Bear's cushion of liquidity reserves and spurred the resulting intervention by the Federal Reserve and J.P Morgan Chase, the second largest lender in the United States.

September 15, 2008. Lehman Brothers Holdings, Inc., the fourth-largest U.S. investment bank at the time, filed for bankruptcy. Thus began the largest bankruptcy in U.S history then and since. Its demise was attributed to the firm's significant exposure to the subprime mortgage and real estate market, the initial source of the financial crisis that began the previous year. Ultimately, the unanimous conclusion was that it was an inability to secure funding that was Lehman's undoing (Wiggins et.al, 2014).

June 2015 to April 2016. Almost 6 years later, a string of 3 bank failures in the Kenyan Banking sector occur in the span of 9 months. All 3 banks were put under receivership by the Central Bank of Kenya (CBK), with a consensus emerging that liquidity played a key role in these events.

These anecdotal accounts serve to lay the groundwork for the main thrust of this study, which will attempt to establish, through multiple regression analysis, the key drivers of firm-level liquidity risk from a sample of listed commercial banks in Kenya. In this chapter, a detailed description of each of the key events mentioned above will be made, including a statement of the problem to be examined and the motivation and justification for the study. In Chapter 2, a review of the literature will expound on the definitions of key terms as well as on major theories on liquidity management. Core bank indicators used shall also be identified and subsequently categorized. Issues regarding the particular methodological approach shall be covered in Chapter 3 thus wrapping up the research proposal.

1.2. Motivation

The Global Financial Crisis of 2007-8 was a watershed moment in the financial world in the sense that it revealed systemic weaknesses in the regulatory and capital market structures of global and domestic financial markets. In the aftermath of the crisis, there was a general sense that banks had not fully appreciated the importance of liquidity risk management and the implications of such risk for the bank itself, as well as the wider financial system. (Mwangi, 2014). This spurred the development of new regulations encouraging higher capital requirements, less bank interconnectivity and more importantly, more rigorous liquidity risk management practices.

In the local context, a string of 3 bank failures in the span of 9 months raises important questions about the current liquidity positions and liquidity risk management strategies employed by Kenyan Banks. This motivates an academic study into liquidity risk management in general and an analysis of the Firm-level determinants of liquidity risk in listed Kenyan commercial banks in particular. This is what this current project aims to achieve.

A number of pioneering studies on liquidity risk and its management in the local context have been made. (Mwangi, 2014) looked into the effect of liquidity risk management on the performance of commercial banks listed on the Nairobi Securities Exchange (NSE). Adopting a descriptive study design and applying multiple regression analysis, (Mwangi, 2014) found that liquidity risk had a significant negative relationship with financial performance in the sample of commercial banks. In a separate study, (Mugenyah, 2015) examined the determinants of liquidity risk in Kenyan commercial banks. Through a descriptive study design coupled with multiple regression analysis, (Mugenyah, 2015) analyzed data from the listed banks' financial statements finding that all but one of the core bank indicators he identified exhibited a strong and significant relationship with liquidity risk.

Two criticisms by the author regarding these empirical studies are that (1) the methodological approach adopted was not rigorous or comprehensive enough and that (2) the period of study was too short (less than 5 years). In this regard, the author of this proposal intends to expand the scope of the period under study (2004-2014). Moreover the methodological approach shall endeavor to be more comprehensive and rigorous, using a battery of sophisticated diagnostic tests. Hence, using a larger time horizon and enhanced methodology, the goal of the study is to ultimately advance the understanding of liquidity risk management in listed Kenyan Banks.

1.3. Problem statement

Liquidity risk management is one of the key lessons learnt from the Global Financial Crisis. The market turmoil that began in mid-2007 re-emphasized the importance of liquidity to the functioning of financial markets and the banking sector (BCBS, 2011). In February 2008, the Basel Committee on Banking Supervision published '*Liquidity Risk Management and Supervisory Challenges*'. The difficulties outlined in the paper highlighted that many banks had failed to take account of a number of basic principles of liquidity risk management when liquidity was plentiful (BCBS, 2011). With the collapse of banks once regarded as 'too big to fail' by industry experts, many recognized the deficiency in measures to control this key metric.

Banks play a crucial role in any economy, acting as providers of capital as well as playing a key role in maturity transformation (Diamond & Dybvig, 1983). In its role as an agent in maturity transformation, a bank will be faced with the inevitable problem of a liquidity mismatch where long-term illiquid assets are used to fund short-term liquid liabilities. The implication of this characteristic is that liquidity risk is inherent in the very structure of banks (Diamond & Dybvig, 1999).

In Kenya, a string of 3 bank failures in the span of 9 months raised multiple concerns about the stability of the banking sector. Although there is yet to be a consensus on the causes of such failures, this study argues that a common consequence was a failure in liquidity risk management to mitigate or prevent these crises.

It has been noted by the author that academic research on the topic of liquidity risk management in the Kenyan context is sparse at best. Accordingly, this study seeks to help in filling that gap by attempting to identify drivers of liquidity risk in banks. In conducting this investigation, a set of liquidity risk metrics and core bank indicators will be specified. Multiple regression analysis will be implemented to establish any significant relationships between variables as well as to specify a predictive model for firm-level liquidity risk. This work will contribute to the conversation on liquidity risk in the Kenyan Banking sector and endeavors to influence key decision-making in banks.

1.4. Objectives and Questions

1.4.1. Research Objectives

- i. To identify key Firm-level determinants of liquidity in listed, Kenyan commercial banks.
- ii. To evaluate the impact of these key determinants on firm-level liquidity in listed, Kenyan commercial banks.

1.4.2. Research Questions

- i. What are the key Firm-level determinants of liquidity in listed Kenyan commercial banks?
- ii. What is the impact of these key determinants on firm-level liquidity in listed Kenyan commercial banks?

1.5. Justification

The Global Financial Crisis of 2007-8 was seen by many observers at the time to be a crisis sparked off by two major events in the banking sector: the near-collapse and bankruptcy of Bear Stearns (Bear) and Lehman Brothers (Lehman) respectively. At Bear, the bank holding company's reserves were steadily eroded as confidence in the robustness and survival value of the bank dimmed. Bear had to be 'rescued' by the Federal Reserve and J.P Morgan Chase through a private agreement. Lehman suffered a bigger blow, failing to raise sufficient funds to operate, thereby being forced to file for bankruptcy in September 15th 2008 (Wiggins et.al 2014). Publications like the *'Principles for Sound Liquidity Risk Management and Supervision'* in 2008 by the Bank for International Settlements (BIS) established the importance of liquidity risk management in banks and to bank regulators worldwide. In Kenya, 3 bank failures occurring under 9 months proved a keen illustration of banks' fragility with regard to failure to acquire funding sources in a timely manner and, most importantly, weathering bank runs (Diamond & Dybvig, 1983).

Consequently, in the global marketplace, liquidity risk and its management has become central to the objective of promoting bank resilience to acute stress scenarios, both in the short term and the long-term (BCBS, 2011). In a KPMG report, the anticipated effects of the introduction and implementation of Basel III - the liquidity risk management framework established by the Basel Committee for Banking Supervision (BCBS) - included the crowding out of weaker banks, significant downward pressure on bank profitability as well as reduced lending capacity in the long-term in individual banks. This is considered as the necessary cost of reduced risk of a systemic banking crisis in the financial system, such as the one seen during the Global Financial Crisis (KPMG, 2011).

The above discussion serves to motivate studies into liquidity risk and its drivers in the Kenyan Banking Sector. It is argued that such studies would serve to rehabilitate public confidence in the stability and resilience of Kenyan commercial banks. Such studies would also serve as a basis for proper, local-based liquidity risk management policies and programs at individual banks. Thus the focus of this research paper is to identify and measure the significance of determinants of liquidity risk at the firm level in listed commercial banks in Kenya.

A few forays have been made in examining this issue through efforts by (Mugenyah, 2015) and (Mwangi, 2014). The basic methodological approach is the same in terms of regression of one liquidity risk metric against multiple core bank indicators. However, the sample size in the current study is smaller - limited to listed banks - and the period of study is longer (11 years). Moreover, a more rigorous methodological approach has been applied to obtain results that are more defensible.

2. Literature Review

2.1. Introduction

2.1.1. *The Global Macroeconomic Context*

2.1.1.1. The Global Financial Crisis & Liquidity Risk

'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. The crisis again drove home the importance of liquidity to the proper functioning of financial markets and the banking sector.'

(BCBS, 2011).

The remark above by the Basel Committee for Banking Supervision (BCBS) is illustrative of the key role of liquidity risk and its management in current financial markets. The Basel Committee went on to describe the effects of the crisis and its key lessons – 'The rapid reversal in market conditions illustrated how quickly liquidity can evaporate...The banking system came under severe stress...necessitated central bank action to support...money markets and...individual institutions'. The Committee also expressed the opinion that liquidity risk had not got its fair share of concern: '...there is a general sense that banks had not fully appreciated the importance of liquidity risk management and the implications of such risk for the bank itself, as well as the wider financial system. (BCBS, 2011)'

This led to a general consensus and an international desire for common measures and standards for liquidity risk, thus spurring the BCBS to publish various works relating to liquidity risk management, the first of which was called '*Principles for Sound Liquidity Risk Management and Supervision*' in 2008 – unofficially known as 'Basel III'. (Mwangi, 2014) described the effect it had on policy makers, suggesting that the introduction of Basel III led them to suggest more liquidity holdings in banks to help self-insure against potential liquidity or funding difficulties. Two major cases during the Global Financial Crisis would help to put this discussion on Basel III in perspective and to demonstrate the urgent need for it at the time. They are the near-collapse and eventual bail-out of Bear Stearns and the bankruptcy of Lehman Brothers.

2.1.1.1.1. *Bear Stearns*

In March 2008, Bear Stearns (Bear), the fifth largest investment banking firm in the U.S, was battered by what its officials described as a sudden liquidity squeeze related to its large exposure to devalued mortgage-backed securities (Shorter 2008). Rumors about European financial institutions that had stopped transacting with Bear made their North American counterparts nervous, leading to announcements by some US-based fixed-income and stock traders of their intention to halt their involvement with Bear.

What followed was a deluge of departures, withdrawals or draw-downs from multiple other trading counterparties like hedge funds, large investment banks, money market funds and institutional investors. According to Shorter (2008), this ongoing activity contributed to a precipitous and alarming drop in Bear's cushion of liquidity reserves.

Bear's liquidity crisis and the resulting Fed intervention sent alarms throughout the stock markets over Bear's fragility. It also led to concerns about the potential precariousness of other major financial institutions (Shorter, 2008). This marked the beginnings of a global phenomenon that we now know the Global Financial Crisis of 2007-8.

2.1.1.1.2. *Lehman Brothers*

On September 15, 2008, Lehman Brothers Holdings, Inc. (Lehman) sought Chapter 11 protection, initiating the largest bankruptcy proceeding in United States (U.S.) history. At the time, Lehman was the fourth-largest U.S. investment bank, with 25,000 employees worldwide.

Lehman's demise was a seminal event in the financial crisis, a global phenomenon that began in the U.S. subprime mortgage industry in 2007, spread to the credit markets, and then burned through the world's financial markets. The crisis resulted in significant and wide losses to the economy. And this was despite the unprecedented efforts of the U.S. Federal Reserve, the U. S. Treasury, the Federal Deposit Insurance Corporation (FDIC), and the central banks of the world's developed countries to intervene and stabilize their economies (Wiggins, 2014).

March 2006 marked a change in business strategy for Lehman. The firm went on an aggressive acquisition strategy in the housing market, despite rumors that it had peaked. (Wiggins 2014) mused that they must have hoped to capitalize on their significant experience in the real estate sector. What was 'new' about Lehman's strategy was that it involved acquiring assets as investments as opposed to what they traditionally did, which involved acquisitions and securitization, effectively moving the assets to 3rd parties.

In this way, they retained all the investments' risk and return on its books in hopes of greater profits (Wiggins, 2014).

Targeted growth areas were its proprietary businesses – commercial real estate, leveraged loans and private equity which, as (Wiggins 2014) noted, put more capital at risk in the event the investments turned sour. It is also crucial to note that these areas were also significantly more illiquid than Lehman's traditional lines of business.

Through 2006, Lehman aggressively bought real estate assets. Its first big blow came in August 2007, when it announced the closure of its main subprime origination platform – **BNC Mortgage** – reflecting declines in US housing prices and a difficult financial environment. At the end of its 2007 fiscal year, Lehman held \$ 111 billion in real estate assets, a number that was more than 4 times its equity position.

2.1.1.2. Basel III

2.1.1.2.1. *Overview*

“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.”

(BCBS 2011, Sec. B – Introducing a Global Liquidity Standard)

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. The crisis again drove home the importance of liquidity to the proper functioning of financial markets and the banking sector (BCBS, 2011). Moreover, rapid reversals in market conditions helped illustrate the temporary nature of liquidity and the long-lasting character of illiquidity. As the banking system came under severe stress, central banks had to step in to support both the functioning of the money markets as well as some individual institutions.

The difficulties experienced by some banks were due to lapses in basic principles of liquidity risk management (BCBS, 2011). In response to this situation, the Basel Committee for Banking Supervision (“The Committee”) published in February 2008 the ‘Principles for Sound Liquidity Risk Management and Supervision’, a publication that would be popularly referred to as ‘Basel III’.

Basel III provided detailed guidance on the risk management and supervision of funding liquidity risk and was targeted at helping promote better risk management in this critical area. Further, The Committee developed two minimum standards for funding liquidity to help strengthen its liquidity framework. The first standard was the Liquidity Coverage Ratio (LCR) whose main objective was to promote short-term resilience of a bank’s liquidity risk (BCBS, 2011). The second standard was called the Net Stable Funding Ratio (NSFR) whose main objective was to promote resilience over a longer time horizon by “...creating additional incentives for a bank to fund its activities with more stable sources of funding on an ongoing structural basis” (BCBS, 2011).

2.1.1.2.2. *Anticipated impact*

In analyzing the anticipated impact of the Basel III document in financial markets and institutions, a report by KPMG summed up its insights into two categories; impact on individual banks and on the financial system in general.

As far as individual banks are concerned, raising the required capital to comply with Basel III standards might result in the departure or consolidation of smaller and, by extension, weaker banks. The increased cost of funding would also put significant pressure on the bank profitability as margins tightened. Moreover, a shift towards longer-term funding arrangements is likely to be observed, given the fact that Basel III emphasized the negative role played by short term funding in the global financial crisis.

Concerns raised by ratings agencies about these types of assets as well as their constant revaluation by Lehman would contribute to significant write-offs throughout 2008 (Wiggins, 2014).

The near collapse of Bear Stearns in March 2008 raised fears that Lehman would be next. It faced higher costs of credit as its perceived financial position worsened, with some lenders withdrawing their funds, refusing to roll over repos (or repurchase agreements), demanding bigger haircuts (or discounts) and even refusing to accept all but a narrow type of collateral. These demands severely restricted Lehman's access to funding (Wiggins, 2014) thereby putting the firm in a very precarious position and facing imminent collapse.

The weekend of September 12-14, 2008 saw a meeting of the CEOs of major Wall Street Investment banks with other regulators to hammer out a private sector solution for Lehman. Unfortunately, due to multiple reasons, the emergency meeting failed to yield results. This meant that Lehman would not be able to raise enough funds to open for business the next day. Realizing this, the Lehman Board of directors voted to file for Chapter 11 bankruptcy protection which was done on September 15, 2008.

Lehman's significant exposure to the US subprime mortgage and real estate markets was a key factor that led to its demise. When these markets slowed down, they sparked a retraction in funding for short-term loans, on which Lehman, like most investment banks, relied practically on a daily basis.

Since Lehman's long term assets were funded by short-term debt borrowed in the billions of dollars - \$200 billion - each day in the overnight wholesale funding markets, its collateral base quickly became toxic to Lehman's lenders, leading to an erosion in Lehman's ability to continue to carry out its short-term obligations.

(Wiggins, 2014) noted that hesitation or stricter standards by a small number of lenders could (and did) cause significant funding problems for the firm. Ultimately, it was an inability to secure funding (or liquidity) that was Lehman's undoing.

Regarding the effects on the financial system, the risk of a systemic banking crisis would be radically reduced. Enhanced liquidity buffers coupled with higher risk management standards and greater capability would reduce institutional interconnectivity thus whittling down systemic risks. Additionally, in the longer run, it is expected that the significant increases in liquidity requirements would lead to either the decline in the capacity for bank lending activities or a spike in lending costs. Furthermore, investors may turn away from investing in bank debt or equity issuances expecting low returns since dividends may have to be slashed to enable the rebuilding of capital bases. Lastly, inconsistent application and implementation of Basel III across different jurisdictions might engender international arbitrage hence disrupting the overall stability of the financial system.

2.1.2. The Local Context

2.1.2.1. Dubai Bank

In July 14th 2015, Dubai bank came under the radar of the Central Bank of Kenya (CBK or The Regulator) by breaching its daily cash reserve ratio requirements. The situation deteriorates continuously since then thus raising red flags with The Regulator. In Aug 14th 2015, the bank was put under receivership with CBK citing serious capital and liquidity shortfalls in the bank's position. The regulator also pointed out the bank's weak corporate governance structures given the fact that its problems stemmed from not so legitimate activities by the Chairman and Managing Director. On Aug 24th 2015, The Kenya Deposit Insurance Corporation (KDIC) recommended the liquidation of the bank which, considering the magnitude of weaknesses in the bank's position, seemed like the only feasible option in their considered opinion.

2.1.2.2. Imperial Bank

On October 13th 2015, the CBK puts Imperial Bank Limited (IBL) under receivership citing significant shortfalls in IBL's capital position as well as the clear misrepresentation of IBL's financial position in the firm's annual report. On Dec 2nd 2015, Kenya Commercial Bank (KCB) and Diamond Trust Bank (DTB), two large Tier I lenders, stepped in to provide depositors with access to their deposits in a structured manner with a cumulative pay-out ratio estimated at 59%. On March 7th 2016: IBL (Uganda) sold its shares to Exim bank Ltd (Uganda) for the sum of approximately \$6.8m, signaling the imminent wind-up of the bank in neighboring countries. On June 21st 2016, NIC Bank (Kenya) got involved to provide depositors access to a portion of their deposits in a structured manner as well as play the role of *Asset and Liabilities Consultant*. In this position, NIC would be involved in the assessment of assets and liabilities, provide support for the recovery of IBL's loans as well as give guidance on other assets and on staffing.

2.1.2.3. Chase Bank

On April 7th 2016, Chase Bank (Kenya) was put under receivership following liquidity issues at the financial intermediary as a result of a run on the bank. The bank run was fueled by social media reports that circulated a week before its closure about its imminent collapse. This followed the re-publishing of its financial results for the year ended 2015 where the bank recorded a steep drop in profitability and a disclosure of close to 14 billion shillings lent to insiders, a figure well above statutory limits. In addition, a sudden change in management where the bank's Chairman and CEO both resigned shook public confidence in the viability of the bank's financial position. On April 20th: KCB, stepped in as a 'Manager' for the bank. It reaches an agreement with the Central Bank of Kenya (CBK) on modalities to reopen Chase Bank Ltd and eventually acquire a majority stake in the bank. KCB's status as a major player in the Banking sector was meant to lend credibility to the bank reopening and to restore public confidence in the stability of the local banking sector as a whole.

2.2. Theoretical Framework

2.2.1. Key definitions

2.2.1.1. Liquidity

(Nikolau, 2009) argued that liquidity (in general) relates to the ability of an economic agent to exchange his or her existing wealth for goods and services or for other assets. In this sense, liquidity can be understood as a *'flow concept'* where it would indicate financial flows among the central bank, commercial banks and markets. By extension, the inability to realize these flows would constitute *'illiquidity'*.

The particular variant of liquidity that is crucial to this paper's discussion is *'funding liquidity'* which is defined by the Basel Committee on Banking Supervision (BCBS) as the ability of a bank to fund increases in assets and meet obligations as they come due, without incurring unacceptable losses (BCBS, 2008). A related definition is given by (Borio, 2000), (Strahan, 2008) or (Brunermeier and Pedersen, 2007) who all define funding liquidity as the ability to raise cash at short notice either via asset sales or new borrowing. Looked at from a different angle, (Nikolau, 2009) defined funding liquidity as the ability to settle obligations with immediacy. Thus a bank is illiquid if it is unable to settle obligations in time (Drehmann & Nikolau, 2008).

2.2.1.2. Liquidity sources

(Nikolau, 2009) identified three key sources of liquidity for financial intermediaries. The first source identified was the bank's depositors, who entrust their money to the bank. The financial markets constitute the second liquidity source which comprise of the asset market, where the bank can always go to sell its assets or to generate liquidity through securitization or loan syndication, and the interbank market, arguably the most important source of bank liquidity. Lastly, a bank can also choose to get liquidity directly from the central bank through cash reserves held and the discount window.

2.2.1.3. Funding Liquidity Risk

Following our discussion of funding liquidity, the concept that captures 'the inability of a financial intermediary to service their liabilities as they fall due' (Nikolau, 2009) would be called funding liquidity risk.

(BCBS, 2008) went further and defined funding liquidity risk as 'the risk that the firm will not be able to meet both unexpected and expected current and future cash flow and collateral needs without affecting either daily operations or the financial condition of the firm'.

2.2.1.4. Maturity Transformation

(Matz & Neu, 2007) identified maturity transformation as one of the two primary economic functions that banks provide. The seminal paper by (Diamond & Dybvig, 1983) gave the first explicit analysis of the demand for liquidity and the 'transformation service' provided by banks. This 'transformation service' involves taking liquid short-term deposits (liabilities) and lending out illiquid long-term loans (assets). Putting it differently, banks can transform illiquid assets (loans) into more liquid demand deposits (Diamond & Dybvig, 1983).

As (Gambacorta, 2003) noted, assets typically have longer maturities with respect to liabilities, hence the term 'maturity transformation'. The fundamental role played by banks in maturity transformation makes them inherently vulnerable to funding liquidity risk, both of an institution-specific nature and that which affects markets as a whole (BCBS, 2008).

This is because of the fact that, on a strict contractual basis, banks always have far more obligations (liabilities) due on demand or within a very short time frame than they have assets due on demand or maturing within a very short time frame (Matz & Neu, 2007; Bonfim, 2012)

2.2.1.5. Liquidity Risk Management

A bank should have a sound process for identifying, measuring, monitoring and controlling liquidity risk. This process should include a robust framework for comprehensively projecting cash flows arising from assets, liabilities and off-balance sheet items over an appropriate set of time horizons (BCBS, 2008).

Effective liquidity risk management helps ensure a bank's ability to meet cash flow obligations, which are uncertain as they are affected by external events and other agents' behavior. According to the Basel Committee, effective liquidity risk management refers to the set of policies and practices that help ensure a bank's ability to meet its cash flow obligations. Liquidity risk management is of paramount importance because a liquidity shortfall at a single institution can have system-wide repercussions (BCBS, 2008). This was evident during the Global Financial Crisis of 2007-8 in the high profile bank failures in the case of Lehman Brothers and Bear Stearns.

2.2.2. *Theories of Liquidity Management*

This section looks at the key theories that have shaped current understanding of liquidity and its management in financial institutions. They include the Commercial loan theory, Shiftability theory, and Anticipated Income theory and Liability Management.

2.2.2.1. Commercial Loan Theory (or Real Bills Doctrine)

The theory states that a commercial bank should only advance short-term, self-liquidating, productive loans to businesses i.e. short-term commercial paper.

The short-term constraint is crucial since banks settle their obligations or liabilities on demand. They cannot meet these obligations if assets are tied up for long periods of time. In other words, banks need a continual and substantial flow of cash moving through them and this can only be maintained if banks limit their lending activities to short-term maturities.

The self-liquidation criterion refers to the property loans have to liquidate themselves (or turn into a positive cash inflow for the bank). In this case, since loans fund productive activities - i.e. the financing of production and movement of goods through the various stages of manufacture, storage, transportation and distribution - they self-liquidate only when such productive goods are eventually sold.

The implication of this point of view for regulator action is that a central bank should only lend to banks on the security of such short-term loans in order to ensure sustainable liquidity levels in commercial banks as well as sufficient money supply in the whole economy. However, a criticism against this theory is that it entails a misconception of how loans are created i.e. on the goods themselves rather than on the value of the goods. In addition, this value is subject to fluctuations depending on the health of the economy.

2.2.2.2. Shiftability theory

The central thesis of this theory is that the liquidity of a bank is dependent on its ability to shift its assets to another party without any material or capital loss when the need for liquidity arises i.e. a bank having 'shiftable assets'. It therefore implies that banks can accumulate and maintain a substantial amount of these 'shiftable assets' without needing to worry about maturity i.e. it was acceptable to hold assets with long-term maturities provided they are 'shiftable'. Generally though, shiftable assets are most often assets with short-term maturities. A perfectly shiftable asset is one that is immediately transferable without capital loss when the need for liquidity arises. This definition is applicable to short-term market instruments (or investments) such as T-bills and bills of exchange.

The theory's main innovation was broadening the list of assets that qualify as legitimate for bank ownership by redirecting the attention of banks and banking authorities from loans (as in the Real Bills doctrine) to investments (T-bills and bills of exchange). Putting it differently, the fundamental source of liquidity became bank's secondary sources i.e. money markets.

The main shortcoming was not with the theory itself but with the bank management practices that grew out of the theory. The key weakness was that in as much as it was possible for a single bank to maintain needed liquidity by shifting its assets, the situation becomes untenable if all banks behaved this way (the fallacy of composition).

This implied that problems of liquidity in the whole banking system are not solvable at the micro-level, i.e. through individual banks, but rather at the macro-level, through regulator action. This justifies the need for quick and decisive action by regulators in the event of a liquidity crisis.

2.2.2.3. Anticipated Income theory

According to this theory, banks should plan on loan liquidation based on the anticipated income of the borrower, regardless of the nature and character of the borrower's business. The main consequence of this is that banks could make long-term and non-business loans. This principle was contrary to the 'Real Bills doctrine' which emphasized that loans be short-term and productive (or business-related). This departure from doctrine was justified by the rationale that even a 'real bill' is repaid out of the future earnings of the borrower i.e. their anticipated income.

A secondary implication was that given the nature and frequency of future income flows, the loan would be repaid in instalments as opposed to being repaid in a lump sum. This contradicted the Commercial loan theory, where the loan was liquidated only after goods had been sold i.e. in a lump sum payment.

2.2.2.4. Liability Management

The major innovation of this theory was in rethinking the way banks traditionally sourced for liquidity. It asserted that banks could acquire liquidity by creating additional liabilities against itself in the event of a liquidity need. They could do this by borrowing reserves in the money market. The creation of such liabilities includes the issuing of time certificate of deposits, borrowing from other commercial banks, borrowing from the central bank, issuing of shares to raise capital funds and finally ploughing back the bank's profits through retained earnings.

As a result of this innovation, 'liquidity management' was considered parallel to 'liability management'. In other words, bank could go out into the market and 'buy money' or 'buy liquidity' in the form of liabilities such as various bank-related money market instruments in order to meet loan requests or to pay demand deposits i.e. to service their liquidity needs.

2.3. Core Bank Indicators

The table below outlines the metrics to be used in the research study. The major categories of core bank indicators that will be examined include **liquidity**, **solvency**, **profitability**, **size**, **efficiency** and **specialization**.

Liquidity metrics	
	<i>Liquid asset ratios (LAR)</i>
	<i>Deposit runoff ratio (DRR)</i>
	<i>Loans to Deposits ratio (LDR)</i>
Solvency metrics	
	<i>Total Capital ratio (TCR)</i>
	<i>Tier 1 Capital ratio (T1CR)</i>
Size metrics	
	<i>Absolute size (LogBA)</i>
Profitability metrics	
	<i>Return on Assets (ROA)</i>
	<i>Net Interest Margin (NIM)</i>
Efficiency metric	
	<i>Cost-to-income ratio (CIR)</i>
Specialization metric	
	<i>Net Loans-to-Total Assets Ratio (NLTAR)</i>

2.4. Discussion of Previous research

Two empirical studies were identified as closely correlated to the nature and general direction of the author's study.

(Mwangi, 2014) sought to determine the effect of liquidity risk on the performance of commercial banks listed on the Nairobi Securities Exchange. Adopting a descriptive study design and taking data from listed commercial banks for the period 2010 to 2013, (Mwangi, 2014) applied regression analysis in identifying the effects of a specified set of liquidity and other indicators on bank performance. The results found were that the liquidity risk metric had a significant negative relationship with financial performance of commercial banks in the sample. Although the main focus of (Mwangi, 2014) was on determining the commercial effect of various liquidity and other metrics, it assisted in clarifying the research methodology as well as in defining the set of indicators used in the current study.

(Mugenyah, 2014) aimed to establish the determinants of liquidity risk in commercial banks in Kenya. Implementing a descriptive study design and taking data from the financial statements of listed commercial banks for the period 2010 to 2014, (Mugenyah, 2014) applied regression analysis to identify key drivers of liquidity risk. The conclusion made was that most performance metrics identified were significant drivers of liquidity risk with the key exception being the capital adequacy ratio. (Mugenyah, 2014) was much more aligned with the objectives of the current study the author found the methodology lacking in rigour and the sample period (2010-2014) too short.

This research report aims to improve on both studies identified above by expanding the set of core bank indicators and liquidity risk metrics as well as the sample period (2004-2014). The methodological approach applied shall also strive to be more comprehensive and rigorous. Ultimately the current study aims to obtain a more rigorous model of liquidity risk with increased predictive power.

3. Research Methodology

This chapter sets out to present the methodology used to further the topic of interest. Since we are working with cross-sectional time-series data (or panel data), we employ the fixed effects model with implementation on STATA, a statistical software.

The period under study is from 2006 to 2015. The sample of banks taken is the 11 currently listed on the Nairobi Securities Exchange (NSE). All the data required was collected from the annual financial statements.

3.1. Model Specification

The following is simple representation of the model:

$$\begin{aligned} \text{Liquidity Indicator}_{it} = & \alpha_0 + \alpha_i + \beta_1 \text{Profitability}_{it} + \beta_2 \text{Capital Adequacy}_{it} + \beta_3 \text{Efficiency}_{it} \\ & + \beta_4 \text{Specialization}_{it} + \beta_5 \text{Absolute Size}_{it} + v_{it} \end{aligned}$$

Where:

*Liquidity Indicator*_{it} is one of the 2 liquidity indicators (loan to deposit ratio & liquid assets ratio) that was subsequently analyzed, α_0 is a constant, α_i is the bank-fixed effect and v_{it} is the estimation residual. As explanatory variables, a set of core bank indicators on capital adequacy, size, profitability, efficiency and specialization was used. *Profitability*_{it} includes the net interest margin and return on assets. *Capital Adequacy*_{it} refers to the Tier 1 capital ratio and Total capital Ratio. *Efficiency*_{it} is measured by the cost-to-income ratio. *Specialization*_{it} is a measure of the extent to which a bank specializes in lending, by considering net loans as a percentage of total assets, while *Absolute Size*_{it} is measured by the log of Assets for each bank i in time period t .

3.2. Key Assumptions for Fixed effects¹

- a. Each explanatory variable changes over time and no perfect linear relationship exists among the explanatory variables
- b. For each t , the expected value of the idiosyncratic error given the explanatory variables in all time periods and the unobserved effects is zero

$$E(u_{it}|X_i, \alpha_i) = 0$$

- c. The homoscedasticity(constant variance) assumption

$$\text{Var}(u_{it}|X_i, \alpha_i) = \sigma_u^2$$

- d. For all $t \neq s$, the idiosyncratic errors are uncorrelated (conditional on all explanatory variables and α_i):

$$\text{Cov}(u_t, u_s|X_i, \alpha_i) = 0$$

- e. Conditional on X_i and α_i , the u_{it} are independent and identically distributed as Normal $(0, \sigma_u^2)$

¹ (Wooldridge, 2009)

3.3. Methodology

Given the nature of panel (or longitudinal) data, we apply advanced panel data methods and diagnostics in our analysis. Below is an outline of the key steps followed in our analysis:

- 1) Taking balance sheet data, create a .dta file.
- 2) Feeding the data into STATA, set the data as panel data (xtset) with 'Bankname1' as the panel or cross-sectional variable and 'Yr' as the time variable.
- 3) Defining the core bank indicators as our initial list of independent variables (\$xlist): see "Operationalization of variables".
- 4) Running both fixed effects (fe) and random effects (re) regressions of our dependent variables (liquidity ratios) to obtain a set of 6 models.
- 5) Using the Hausman test to decide between the 'fe' and 're' models and settling on the subset of *fe* models.
- 6) Carrying out a 'goodness of fit' test on our *fe* models and choosing the two best ones.
- 7) Narrowing down on the 'best set' of independent variables. This is done by carrying out a number of diagnostic tests on the models our and sieving out the variables that prove insignificant.
- 8) This 'best set' is now assumed to represent the determinants of liquidity in Kenyan commercial banks.
- 9)

3.4. Diagnostic tests

The tests below were applied in *step 6* of the Methodology in sieving out insignificant variables. They were used sequentially hence were interpreted as 'levels' which variables would attempt to 'reach'.

- Level 1: A typical *fe* regression
- Level 2: Allowing for Heteroscedasticity (code: *fe robust*)

3.5. Specification of variables

Variable	Measurement
Dependent variables	
Loan to deposit ratio (LDR)	Gross Advances/Customer Deposits
Liquid asset ratio (LAR)	Liquid assets/ Total Assets
Deposit runoff ratio (DRR)	Liquid assets/Customer Deposits
Independent variables	
Total capital ratio (TCR)	Tier 1 + Tier 2 capital/ Risk Weighted Assets
Tier 1 capital ratio(T1CR)	Tier 1 capital/ Risk Weighted Assets
Log of bank assets (LogBA)	Ln (Bank Assets)
Return on assets (ROA)	Profit Before Tax/Total Assets
Net interest margin (NIM)	Net interest income/Earning assets
Cost-to-income ratio(CIR)	Operating expenses/Operating Income
Net loans to total assets ratio(NTAR)	Net Advances/Total Assets
Specification of liquid assets	
Liquid assets = Cash in hand + Balances with Central bank + Financial Investments/Investment Securities + Balances/Placements with other banks - Balances/Loans due to other banks	

4. Results and Discussions

4.1. Summary Statistics

This section will cover the key results from our analysis described in *Section 4* as well as providing a narrative to explain and contextualize them.

Table 1 provides summary statistics of core bank indicators for all the banks in the sample. There is substantial variation in the bank size as measured by Total Assets, even though the sample consisted of banks classified as Tier 1 (9 billion for the smallest bank and approximately 558 billion for the largest). Substantial dispersion is also observed in the capital adequacy ratios (Tier 1 & Total Capital Ratios). There is markedly less dispersion in the profitability ratios (net interest margin & return on assets) as well as in the Cost-to-income ratio. Average values for Cost-to-income ratio and Net Loans to Total Assets are almost equal at 57%.

Table 1 Bank's characteristics

%	Mean	min	p25	p50	p75	p99	max
Total Assets	138,278,625	9,133,831	57,688,384	120,771,146	184,825,000	490,338,324	558,094,154
Total Capital Ratio	21.4	12.6	16.2	19.1	23.7	47.3	58.9
Tier 1 Capital Ratio	18.8	10.3	14.8	16.2	20.5	40.9	45.7
Net Interest Margin	7.40	1.18	5.59	7.47	9.29	12.3	12.6
Return on Assets	4.38	1.31	3.39	4.33	51.4	7.86	18.9
Cost-to-Income Ratio	57.7	32.8	46.9	56.5	66.6	86.7	87.3
Net Loans to Total Assets Ratio	57.8	18.9	52.9	59.8	65.4	79.1	79.5

Table 2 provides summary statistics for the liquidity indicators used in the regressions. From Panel A, there is markedly more range in the Loans to Deposits ratio than in the Liquid Assets Ratio. Panel B shows how the mean of the two indicators evolved over time. Two time periods look significant at first glance: 2006-7 exhibited a significant jump in liquidity and 2010-11 a steeper than usual drop in liquidity on average.

Table 2 – Liquidity Indicators – Summary Statistics

Panel A – Global Summary Statistics											
Statistics	N	mean	min	p25	p50	p75	p99	max			
Loans to Deposits Ratio	110	84.1	30.3	76.6	83.1	90.8	138.1	148.6			
Liquid Assets Ratio	110	30.7	9.03	25.1	30.2	35.5	69.71	71.86			
Panel B – Liquidity Indicators over time(mean)											
Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Loans to Deposits ratio	86.43	78.4	79.97	78.62	78.37	84.82	84.28	86.92	90.69	92.6	84.11
Liquid Assets ratio	27.41	31.1	29.99	34.01	35.25	26.79	31.49	30.63	31.22	28.6	30.65

4.2. Size and Significance

Table 3 summarizes the results regarding the magnitude and statistical significance of the determinants of liquidity indicators.

For each liquidity indicator, there were 2 rounds of panel regressions (denoted 1a & 1b) in which insignificant determinants were dropped after the first round with only the significant ones forming the set of independent variables in the second round. Each regression assumed bank-fixed effects.

Table 3 - Determinants of Liquidity Indicators

Dependent Variable	Loans to Deposits ratio		Liquid Assets Ratio	
	Coefficients (1a)	Coefficients (1b)	Coefficients (2a)	Coefficients (2b)
Net Interest Margin	1.335	-	-0.395	-
Return on Assets	-0.812	-	0.147	-
Cost to Income Ratio	-0.227	-	.00248	-
Net Loans to Total Assets Ratio	1.367	***	1.498	***
Tier 1 Capital Ratio	-1.407	**	-1.380	**
Total Capital Ratio	1.383	**	1.461	**
Log Assets	-0.00797	-	0.0387	-
Constant	0.233	-0.0789	0.143	0.789
Number of Observations	110	110	110	110
R2 within	0.732	0.704	0.717	0.641
R2 between	0.486	0.712	0.261	0.335
R2 overall	0.583	0.705	0.400	0.435

According to the table, the ideal set of regressors for each dependent variable became:

- 1) **Loans to Deposits Ratio:** Net Loans to Total Assets Ratio, Tier 1 Capital Ratio and Total Capital Ratio
- 2) **Liquid Assets Ratio:** Net Loans to Total Assets Ratio and Tier 1 Capital Ratio

Return on Assets

Return on Assets as a measure of profitability exhibits a positive relationship with liquidity where higher profitability is consistent with higher liquidity levels. This contradicts our *a priori* assumption where a tradeoff exists between liquidity and profitability. (Bonfim & Moshe, 2012) had results that were consistent with our *a priori* assumptions. The contradiction in the ROA can be looked at as two-stage process. First and foremost, given a fixed level of loans, an increase in deposits can spur acquisition of financial investments such as government securities or increases in the placements to other banks. This leads to an infusion of liquid assets into the bank hence a boost in liquidity, which explains the movements in LDR and LAR. Secondly, as the level of liquid assets expands, interest earned from these securities also increases, thereby boosting profit before tax and increasing profitability through ROA.

Tier 1 Capital Ratio

Results from (Bonfim & Moshe, 2012) corroborate with those found here as far as Tier 1 Capital ratio is concerned. The contradiction between anticipated and actual results can be explained this way: an investment in liquid assets, which are- by definition- less risky, would result in a drop in the level of Risk Weighted Assets and an increase in the Tier 1 Capital ratio.

Log Assets

According to results from (Bonfim & Moshe, 2012), bank size (as measured by **Log Assets**) is inversely related to liquidity. This expectation is upended in our analysis where **Log Assets** exhibits a positive relationship with liquidity i.e. bigger banks are more liquid. A potential explanation for this contradiction could be that bigger banks can afford to be more liquid in that their profitability is not as adversely affected as it would be in the case of smaller banks.

Cost-to-income Ratio

(Bonfim & Moshe, 2012) had results consistent with our *a priori* assumption where more expensive (i.e. less efficient) banks end up being less liquid. Our results are, at the very least, puzzling since they contradict this assumption wherein less efficient banks are *more liquid*. A potential explanation for this contradiction remains elusive and can be a starting point for future research.

4.3. Sign: Anticipated and Actual Results

Some assumptions were made as to the expected nature of the relationship between the core bank indicators and liquidity indicators.

With regard to profitability (net interest margin & return on assets), it was assumed that the greater the amount of liquid assets a bank held, the less profitable it would be on average. In other words, there would be a tradeoff between profitability and liquidity hence a negative relationship.

As far as efficiency (cost-to-income ratio) was concerned, banks that were less skilled at managing their costs might ultimately end up holding less liquid assets and vice versa. Consequently, lower efficiency would result in lower liquidity, i.e. a direct relationship between liquidity and efficiency.

Bank specialization (net loans to total assets ratio) related to the lending function of a bank. It was assumed that the more specialized a bank was, i.e. having a higher proportion of assets as loans and advances, the less liquid they would ultimately be.

Capital adequacy (Tier 1 & Total Capital ratios) reflects a bank's ability to absorb losses. It was assumed that a bank with greater levels of capital adequacy would hold less liquid assets (an inverse relationship). This is because a bank would have a greater ability to absorb losses hence requiring fewer resources tied up in liquid assets.

As far as Bank Size (log Assets) was concerned, it was assumed that larger banks required less liquid assets as buffers against potential deterioration given economies-of-scale advantages. This translates to an inverse relationship where greater size comes with lower liquidity levels.

The table below summarizes the assumed relationships and how they eventually turned out:

Independent variable	Dependent variable				Comments/Remarks
	Anticipated		Actual		
	Loans to Deposits Ratio	Liquid Assets Ratio	Loans to Deposits Ratio	Liquid Assets Ratio	
Net Interest Margin	+ve	-ve	+ve	-ve	Consistent with <i>a priori</i> assumption
Return on Assets	+ve	-ve	-ve	+ve	Contradicts <i>a priori</i> assumption
Cost-to-Income Ratio	+ve	-ve	-ve	+ve	Contradicts <i>a priori</i> assumption
Net Loans to Total Assets Ratio	+ve	-ve	+ve	-ve	Consistent with <i>a priori</i> assumption
Tier 1 Capital Ratio	+ve	-ve	-ve	+ve	Contradicts <i>a priori</i> assumption
Total Capital Ratio	+ve	-ve	+ve	-ve	Consistent with <i>a priori</i> assumption
Log Assets	+ve	-ve	-ve	+ve	Contradicts <i>a priori</i> assumption

5. Conclusions, Limitations & Recommendations

5.1. Conclusions

From the discussion above, we can conclude that of all the core bank indicators, Net Loans to Total Assets (NLAR), a measure of specialization, is by far the most significant determinant of the liquidity position in listed Kenyan Commercial Banks. This underlines the basic fact that the proportion of loans to total assets is an extremely important metric in managing the liquidity position in a bank's balance sheet.

Tier 1 Capital Ratio, as a measure of capital adequacy, comes a close second, though the nature of its relationship to the liquidity indicators is puzzling and contradicts our a priori assumption. Total Capital Ratio is a distant third, since it's only significant with Loans to Deposits Ratio as the liquidity indicator.

5.2. Limitations & Recommendations

The key limitation faced in this study was that the sample was limited to listed commercial banks. Since this set consists of firms categorized as 'Tier 1' banks, any conclusions made can only properly apply to that set.

Hence, as a recommendation for future research, expanding the sample to include 'Tier 2' and 'Tier 3' banks would provide more robust results that can be widely applicable.

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7. Appendices

7.1. Summary statistics

Variable		Mean	Std. Dev.	Min	Max	Observations
nim	overall	.0739675	.0261163	.0118502	.1261746	N = 110
	between		.0248611	.0232469	.1053089	n = 11
	within		.0107247	.0361044	.113075	T = 10
roa	overall	.0437617	.020324	-.0130579	.188871	N = 110
	between		.0114179	.0263555	.0605471	n = 11
	within		.0171307	.0043484	.1802851	T = 10
cir2	overall	.5769522	.1350792	.3275045	.8729203	N = 110
	between		.118972	.4024469	.7986379	n = 11
	within		.072531	.338062	.7904781	T = 10
nlar	overall	.5757447	.1256905	.0692284	.7947214	N = 110
	between		.1063028	.3831205	.7387417	n = 11
	within		.0736944	.2618526	.9259697	T = 10
tlcapratio	overall	.2121014	.280861	.1026073	3.04777	N = 110
	between		.1088455	.1472174	.5193937	n = 11
	within		.2607945	-.1802622	2.740477	T = 10
totlcapratio	overall	.2468529	.3747109	.1262115	4.053038	N = 110
	between		.1477295	.1688625	.671195	n = 11
	within		.3469672	-.297312	3.628696	T = 10
logBA	overall	18.44295	.8456219	16.027	20.14	N = 110
	between		.615143	17.1059	19.3726	n = 11
	within		.6065638	16.51815	19.58115	T = 10

Table 1

7.2. Hausman tests on fe/re pairs given all 3 liquidity ratios

7.2.1. Ldr fe/re

```

. hausman ldrfe ldrre, sig

```

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b)	(B)		
ldrfe				
ldrre				
ldrfe	1.931253	.4057958	1.525457	.5705843
ldrre	-.8764524	-.6071995	-.2692529	.1618771
ldrfe	-.374809	-.174444	-.2003649	.0939907
ldrre	1.093993	1.140731	-.0467372	.064825
ldrfe	-1.454735	-1.767772	.3130372	.1158751
ldrre	1.119181	1.355515	-.2363343	.0873027
ldrfe	-.0116297	-.0122338	.0006041	.0077503

b = consistent under Ho and Ha; obtained from xtreg
 B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

$\chi^2(7) = (b-B)'[(V_b-V_B)^{-1}](b-B)$
 = 27.85
 Prob>chi2 = 0.0002

Table 2

7.2.2. Lar fe/re

```
. hausman larfe larre, sig
```

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) larfe	(B) larre		
nim	-.6163401	-.9616313	.3452912	.3631666
roa	.183389	.2944054	-.1110164	.1006344
cir2	.0007441	-.0321107	.0328549	.0592028
nlar	-.8934702	-.7519233	-.1415469	.0406847
tlcapratio	.4534036	.5787808	-.1253771	.0720886
totlcapratio	-.3298777	-.4209434	.0910657	.0542895
logBA	.0383934	.0255954	.012798	.0049026

b = consistent under Ho and Ha; obtained from xtreg
 B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
 = 24.66
 Prob>chi2 = 0.0009

Table 3

7.2.3. Drr fe/re

```
. hausman drrfe drrre, sig
```

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) drrfe	(B) drrre		
nim	-.2753986	-1.739011	1.463612	.7038878
roa	.0214067	.4129214	-.3915147	.219449
cir2	.0027852	-.0248088	.027594	.1205559
nlar	-1.29344	-.9831719	-.3102679	.084678
tlcapratio	.1022059	.1125793	-.0103734	.1579705
totlcapratio	-.0457393	-.0443529	-.0013864	.1192372
logBA	.0672456	.0376429	.0296028	.0098376

b = consistent under Ho and Ha; obtained from xtreg
 B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
 = 23.48
 Prob>chi2 = 0.0014

Table 4

7.3. Goodness of fit for fe models given all 3 liquidity ratios

```
. est stats ldrfe larfe drrfe
```

Model	Obs	ll(null)	ll(model)	df	AIC	BIC
<u>ldrfe</u>	110	69.43366	137.1824	8	-258.3649	-236.7611
<u>larfe</u>	110	117.9076	180.7199	8	-345.4398	-323.8359
<u>drrfe</u>	110	74.70108	122.841	8	-229.6819	-208.0781

Note: N=Obs used in calculating BIC; see [\[R\] BIC note](#)

Table 5

7.4. Model 1(ldr)

7.4.1. After Round 1

```
. est table x100 x110, star stats(N)
```

Variable	x100	x110
nim	1.9312529*	1.9312529
roa	-.87645236	-.87645236
cir2	-.37480895**	-.37480895
nlar	1.0939934***	1.0939934***
tlcapratio	-1.4547352***	-1.4547352*
totlcapratio	1.1191812***	1.1191812*
logBA	-.01162971	-.01162971
_cons	.56971802	.56971802
N	110	110

legend: * p<0.05; ** p<0.01; *** p<0.001

Table 6

7.4.2. After Round 2

```
. est table x200 x220, star stats(N)
```

Variable	x200	x220
nlar	1.2018078***	1.2018078***
tlcapratio	-1.3997747***	-1.3997747**
totlcapratio	1.0805229***	1.0805229**
_cons	.17929203*	.17929203**
N	110	110

legend: * p<0.05; ** p<0.01; *** p<0.001

Table 7

7.4.3. Goodness of fit summary

. est stats x100 x110 x200 x220						
Model	Obs	ll(null)	ll(model)	df	AIC	BIC
<u>x100</u>	110	69.43366	137.1824	8	-258.3649	-236.7611
<u>x110</u>	110	69.43366	137.1824	7	-260.3649	-241.4615
<u>x200</u>	110	69.43366	125.2157	4	-242.4315	-231.6295
<u>x220</u>	110	69.43366	125.2157	3	-244.4315	-236.33

Note: N=Obs used in calculating BIC; see [R] BIC note

Table 8

7.5. Model 2 (lar)

7.5.1. After Round 1

. est table y100 y110, star stats(N)		
Variable	y100	y110
nim	-.61634005	-.61634005
roa	.18338902	.18338902
cir2	.00074414	.00074414
nlar	-.89347019***	-.89347019***
tlcapratio	.45340365	.45340365*
totlcapratio	-.3298777	-.3298777*
logBA	.03839336***	.03839336
_cons	.13521929	.13521929
N	110	110

legend: * p<0.05; ** p<0.01; *** p<0.001

Table 9

7.5.2. After Round 2

. est table y200 y220, star stats(N)		
Variable	y200	y220
nlar	-.83252369***	-.83252369***
tlcapratio	.37341963	.37341963
totlcapratio	-.27572169	-.27572169
_cons	.77467815***	.77467815***
N	110	110

legend: * p<0.05; ** p<0.01; *** p<0.001

Table 10

7.5.3. Goodness of fit summary

```
. est stats y100 y110 y200 y220
```

Model	Obs	ll(null)	ll(model)	df	AIC	BIC
<u>y100</u>	110	117.9076	180.7199	8	-345.4398	-323.8359
<u>y110</u>	110	117.9076	180.7199	7	-347.4398	-328.5364
<u>y200</u>	110	117.9076	169.0433	4	-330.0865	-319.2846
<u>y220</u>	110	117.9076	169.0433	3	-332.0865	-323.9851

Note: N=Obs used in calculating BIC; see [\[R\] BIC note](#)

Table 11

