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CAPITAL ADEQUACY OF BANKS IN GHANA: DOES LIQUIDITY TRANSFORMATION MATTER?

BY

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DECLARATION

I do hereby declare that this thesis is the outcome of my own study and has not been submitted by any person or group of persons for any academic award in the University of Ghana or any other tertiary institution in or outside Ghana. I duly acknowledge all references used in this study.

I solely bear responsibility for any shortcomings.

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CERTIFICATION

This is to certify that this thesis has been supervised in accordance with the prescribed procedures of the University of Ghana

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DR. AGYAPOMAA GYEKE-DAKO DATE
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(Supervisor)

DEDICATION

This thesis is dedicated to my dear mum **Hajia Afishata Alhassan**, my beloved brother **Mr. Abdul Aziz Alhassan**, and my spiritual father, **His Royal Highness Chief Kul-Naa Yakubu**.

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LIST OF ABBREVIATIONS

AB	Arellano - Bond
APA	American Psychology Association
AR	Autocorrelation
ATMs	Automated Teller Machines
BB	Berger and Bouwman
BCBS	Basel Committee on Banking Supervision
BFIs	Bank Financial Institutions
BHCs	Bank Holding Companies
BIS	Bank for International Settlements
BoG	Bank of Ghana
CAR	Capital Adequacy Ratio
CRSK	Credit Risk
DEP	Total Deposits
DMBs	Deposit Money Banks
EFTPOS	Electronic Funds Transfer at Point of Sale
ERP	Economic Recovery Programme
FDIC	Federal Deposit Insurance Corporation
FI Centre	Financial Intelligence Centre

GDP	Gross Domestic Product
GAB	Ghana Association of Bankers
GMM	Generalized Method of Moments
GhIPSS	Ghana Interbank Payment and Settlement System
INFL	Inflation Rate
LCR	Liquidity Coverage Ratio
LMI	Liquidity Mismatch Index
LQTR	Liquidity Transformed
Lt	Litas
LTG	Liquidity Transformation Gap
MFIs	Microfinance Institutions
NBFIs	Non Bank Financial Institutions
NIM	Net Interest Margin
NSFR	Net Stable Funding Ratio
OBS	Off Balance Sheet
OLS	Ordinary Least Squares
PwC	PricewaterhouseCoopers
PNDCL	Provisional National Defense Council Law
P/L	Property Liability
P&L	Profit and Loss

QAT	Qualitative Asset Transformation
RCBs	Rural and Community Banks
ROA	Return on Assets
ROAA	Return on Average Assets
ROAE	Return on Average Equity
ROE	Return on Equity
RWAs	Risk-Weighted Assets
SIZE	Bank Size
SSA	Sub-Sahara Africa
UAE	United Arab Emirates
U.S	United States
UGBS	University of Ghana Business School
VIF	Variance Inflation Factor
WDI	World Development Indicators

ABSTRACT

Financial intermediation has been the main activity and source of revenue for banks worldwide. However, when it takes the form of liquidity transformation, banks must exercise caution since this could affect their liquidity and solvency levels. On the basis of this, the study investigates the extent to which banks in Ghana transform liquidity and the influence (if any) of liquidity transformation on bank solvency.

This study takes into account 20 banks in Ghana and spans for 10 years (2006-2015). It considers banks which have data on at least three out of the five bank level variables captured in the model and had operated in Ghana for a minimum of three years. Dynamic panel models were specified and estimated using the system Generalized Method of Moments estimator. The outcome of this study indicates that banks in Ghana engage in significant liquidity transformation. It also reveals that liquidity transformation is positively associated with improvements in bank solvency, transformed either with or without off-balance sheet activities.

The research recommends that banks adjust their capital levels proportionately whenever liquidity transformation rises. This will help avert liquidity risk and improve solvency levels. It also recommends that banks adopt the measures of liquidity transformation used in the study to help them quantify their liquidity transformation activities for management purposes, and that Bank of Ghana should equally apply these measures to enhance its liquidity and solvency regulations.

Keywords: Capital adequacy, liquidity transformation, Dynamic panel models, Generalised Method of Moments estimator

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The roles of banks in the growth and development of the economy of Ghana are, by far, indispensable. Key among them is financial intermediation, which is the reason for banks' existence (Oino, 2014). Financial intermediation involves linking up surplus and deficit units in an economy. According to Incoom (1998), economic progress is realized when there is an efficient redistribution of temporary free resources of surplus units to meet the short-term needs of deficit units in an economy. This is the essence of financial intermediation. Modern theory of financial intermediation has it that banks' existence is justified by two key intermediation functions they perform in an economy, namely: risk transformation and liquidity creation (Berger & Bouwman, 2009) and these functions are termed collectively as the banks' qualitative asset transformation (QAT) function, since they alter the nature of financial resources which flow from fund providers to fund users (Bhattacharya & Thakor, 1993).

Transformation of risk does coincide with the creation of liquidity; an instance is where banks finance risky illiquid loans with riskless liquid deposits (Berger & Bouwman, 2009). Maturity transformation may also stem from banks' provision of liquidity when they finance long-lived assets with short-lived deposits (Bhattacharya & Thakor, 1993). In transforming risk, banks generate financial resources from investors who are risk-averse and use them to fund risky investments of borrowers. They generate these funds from the risk-averse investors by making low-risk or risk-free bank products such as deposit accounts available to them.

The second aspect of the banks' qualitative asset transformation function is liquidity creation or liquidity transformation which involves the banks' use of liquid liabilities such as demand deposits held by depositors for precautionary or transactionary purposes to finance assets which are relatively illiquid. Liquidity transformation, according to Deep and Schaefer (2004), is the scaled difference between banks' liquid liabilities and liquid assets. Liquidity in this context refers to the ease with which an asset or a liability can be converted into cash at minimal or no costs. Banque de France (2008) describes liquidity as an elusive notion that is easier to recognize than define and provides three meanings to liquidity. First, it is the ease with which a financial instrument can be exchanged for cash without loss of value. Second, market liquidity is the ability of the market to trade a given volume of securities without significantly influencing their prices. In terms of monetary policy, liquidity is the quantity of fully liquid assets in circulation in an economy.

Banks create liquidity on or off balance sheet. Off balance sheet liquidity transformation involves the provision of guarantees, loan commitments and similar claims that give bank customers the opportunity to draw down funds when they need them. However, once a customer draws on a commitment, it becomes an on balance sheet loan (Kashyap, Rajan, & Stein 2002; Berger & Bouwman, 2006). On balance sheet liquidity creation occurs as banks give depositors the option to withdraw on demand rather than keeping illiquid loans if they were to lend directly to the public without the intervention of banks (Diamond & Dybvig 1983; Berger & Bouwman, 2006).

There are inherent costs and benefits in the bank liquidity transformation function. On the one hand, it facilitates smooth consumption for depositors and uninterrupted production for

borrowers and investors, thereby creating economic value (Deep & Schaefer, 2004). On the other, it increases banks' vulnerability to customer runs. The more banks create liquidity, the more they increase their exposure to the failure of honouring unanticipated customer withdrawals (Distinguin, Roulet & Tarazi, 2012). Liquidity transformation that involves a very large amount of illiquid assets such as corporate and commercial loans has the tendency of dwindling banks' capital base and causing bank runs if those loans turn out to be non-performing. This can create turmoil in the banking industry with serious ramifications on macro-economy because the banking industry appears to be the spine of the financial system of every economy.

Bank runs generate real economic problems because they can cause even "healthy" banks to fail, thereby inducing loan recalls and the termination of productive investments (Diamond & Dybvig, 1983). This can be avoided where banks are adequately capitalised. This is because, bank operations are grounded on public confidence enhanced by bank stability and solvency (capital adequacy). Highlighting this, Ogere, Zachariah, and Inyanget (2013) observed that the capital adequacy ratio is essentially a significant determinant of bank soundness and safety. A bank is said to be sound and safe if it is able to honour its long-term financial commitments towards its stakeholders without difficulties.

1.2 Research Problem

The traditionally perceived function of banks as transformers of liquidity is deeply rooted in the presumption that bank depositors depend on demand deposits to solve immediate liquidity problems, and organisations concurrently secure long-term funds in the form of bank loans for their illiquid investments (Deep & Schaefer, 2004). Clarifying this, Diamond (2007) indicates that banks grant loans that are difficult to quick sell at reasonable prices and offer deposit

accounts that make funds available to depositors at all times. The result of this is liquidity mismatch where bank liabilities are more liquid than assets. This compels banks to fire sell illiquid assets to cater for customers' liquidity needs. The action is to mitigate if not completely avert liquidity risk emanating from liquidity transformation and similar activities. Fire sale of illiquid assets involves disposing them of quickly at cheaper prices. In terms of bank lending, it may mean renegotiating or remodeling a long-term loan agreement with a customer where interest on loan has to be drastically reduced to induce quick payment. This diminishes bank capital and can result in bank meltdown if done habitually.

Though banks' financial intermediation role has been highlighted in the literature, not much attention has been given to their liquidity transformation function. Thus, empirical studies on liquidity transformation are quite scanty (Horváth, Seidler & Weill 2012) and the available ones have given little attention to capital and the liquidity transformation nexus (Berger & Bouwman 2009). Generally, there is paucity of empirical literature on bank liquidity and capital relationship (Novokmet & Marinović, 2016). Some studies have concentrated on liquidity transformation theories but ignored the impact on bank capital. However, those studies in some instances involve capital ratios in estimations of some elements of liquidity transformation (Berger & Bouwman 2009). Those that include capital in their estimations fail to accentuate the link between the two; rather they highlight other issues. Others have also ignored the capital element and explained the link among liquidity transformation, deposit insurance and bank runs (e.g. Diamond and Dybvig, 1983; Diamond & Dybvig, 2000; Deep & Schaefer 2004). The scarcity of literature on liquidity transformation and bank solvency nexus is more conspicuous in developing countries such as Ghana where the effect of liquidity transformation appears to be under estimated. Yet the competitive nature of the banking industry drives banks into

undertaking risky activities including liquidity transformation. The presence of strong competition in the Ghanaian banking industry is evidenced in the survey conducted by the PwC and GAB in 2014 where 82% of banks in Ghana ranked competition ahead of all other drivers of the banking industry. Incoom (1998) also argues that the strong competition in the banking industry of Ghana compels banks to carry out functions which are not stated in their constitutions of establishment. In an attempt to beat the competition, banks meet demands of a variety of borrowers including those who borrow on long-term basis, with funds at their disposal. Since deposits constitute the majority of banks' available funds (liquid liabilities), there is the tendency of granting such long-term loans out of deposits thereby transforming liquidity and increasing liquidity risk. Liquidity risk threatens bank short-term soundness (liquidity position) and long-term stability (solvency). It is against this backdrop that the study intends to determine the extent to which banks in Ghana transform liquidity and whether indeed their solvency (capital adequacy) is threatened by liquidity transformation.

1.3 Research Purpose and Objectives

The purpose of this study is to ascertain if liquidity transformation / creation has an influence on capital adequacy of banks in Ghana.

The study is bent on achieving the following specific objectives:

(i) To determine the extent to which commercial banks in Ghana transform liquidity

(ii) To assess the effect of liquidity transformation on bank solvency in Ghana

1.4 Research Questions

(i) To what extent do commercial banks in Ghana finance illiquid assets with liquid liabilities to facilitate economic growth?

(ii) Does liquidity transformation have an influence on bank capital adequacy?

1.5 Significance of the Study

The study contributes to research, practice, and policy in the following ways:

Research: this study goes beyond the existing studies on liquidity creation by delineating the specific influence of liquidity transformation on solvency and stability of banks in Ghana. This is a major contribution to the literature as it could be an avenue for future researchers to deal with same beyond country level and in other financial sectors.

Practice: Decision makers and managers in the banking fraternity could refer to this study as they deliberate on issues of striking a balance between what bank deposits are used for and the meeting of the withdrawal needs of customers on the one hand, and bank safety and soundness on the other.

Policy: Government representative in the banking sector of Ghana, the central bank, regulates liquidity position of banks using the cash reserve ratio. This study could provide an input into the central bank's decisions on the adjustment of the cash ratio of banks, given the impact of this on banks' liquidity and stability.

1.6 Scope and Limitations of the Study

1.6.1 Scope

The study considers 20 out of 29 banks which were in existence in Ghana as of December 2015 and spans for 10 years. The purpose is to examine the influence of liquidity transformation on solvency of banks in Ghana. Thus, considering all the banks could provide a more representative outcome. For the want of data, the representative sample of 20 banks is used.

1.6.2 Limitations

The study does not take into account liquidity transformation by banks in other parts of the world and in other financial institutions such as Savings and Loans companies, microfinance institutions, insurance companies, mortgage companies, and the Stock Exchange are not considered owing to operational differences and differences in regulatory requirements. Longer study duration, especially, beyond 2015 could give more insights into the long-term effect of liquidity transformation on bank solvency. However, as of the time of collecting the data, 2016 financial reports of almost all the banks under consideration were not available, hence the choice of 2015 as the end of the period of study. Another issue of concern regarding this study is the classification of bank liquid assets and liquid liabilities. The classification is based on the Berger and Bouwman (2009) as well as Deep and Schaefer (2004) measures of bank liquidity transformation in the United States, the most known measures of liquidity creation. Contextually, it may be argued that liquidity of a bank asset or liability is country-specific, thus, what is considered liquid in the banking industry of the United States may not be seen as such in that of Ghana owing to regulatory issues. This study however, considers the generic meaning of the liquidity of a financial instrument, which is its nearness to cash, irrespective of contextual differences.

1.6.3 Future research

Further studies could consider the influence of liquidity transformation on the solvency and stability of NBFIs such as Savings and Loans companies, microfinance institutions, mortgage companies, and insurance companies over a longer period. Also, a similitude of the current study in an extended location such as a continent would broaden the horizon of knowledge and understanding of the concepts of liquidity transformation and bank stability.

1.7 Chapter Outline

The research is presented in six chapters. This chapter (**chapter one**) is an introduction to the study. It comprises background of the research, research problem, research purpose, research objectives, research questions, significance of the study, scope and limitations of the study, and chapter outline.

Chapter two is an overview of the banking industry of Ghana. It entails an introduction, the general overview, regulatory reforms, financial performance, as well as macroeconomic indicators of Ghana and a conclusion.

Chapter three reviews the literature on bank solvency and liquidity transformation. It looks at the concept of capital adequacy and bank safety, the measures of bank solvency and liquidity, the theories of liquidity transformation, as well as the empirical review of the literature on bank liquidity transformation and capital adequacy.

Chapter four gives the methodology adopted in the study. It is composed of the population, data source, sampling technique, sample size, data collection, data processing, specification of models for data analysis, and model estimation techniques.

Chapter five presents the results, discussion of results, and evaluation of the study objectives relative to the findings.

Chapter six comprises the conclusion, summary, and recommendations.

The APA (American Psychology Association) style of referencing is adopted in acknowledging the academic or scholarly papers reviewed for this research.

Subsequent to referencing are the appendices which comprise the materials used in the study.

1.8 Conclusion

The research investigates whether bank liquidity transformation matters in determining capital adequacy of banks in Ghana. It aims at establishing the specific impact of liquidity transformation on bank solvency. This chapter has given an overview of liquidity transformation and capital adequacy in relation to bank financial intermediation and specified the objectives expected to be achieved at the end of the study.

CHAPTER 2

OVERVIEW OF THE GHANAIAN BANKING INDUSTRY

2.1 Introduction

This chapter gives an insight into the background of the banking industry of Ghana. It looks at the significant changes which have occurred in the industry in terms of regulatory reforms, application of technology, risk management and financial performance. Also considered in the chapter are macroeconomic indicators which have some influence on the banking industry in Ghana.

2.2 General Overview

Tagged as the spine of the financial system, the banking industry of Ghana has undergone and is still undergoing significant changes since 1953 when the Bank of the Gold Coast (now the GCB Bank and the Bank of Ghana) was established. Some of the changes witnessed include the enactment of the Banking law of 1989 (PNDCL 225) later repealed by S.91 of the Banking Act 2004 (Act 673), the adoption of Policy Rate in 2002 in place of the BoG Prime Rate. The setting of the banks' minimum operational capital at GH¢ 7 million upon the issuing of Universal Banking License to banks in 2003, the phasing out of the 15% banks' secondary reserve requirement in 2006, BoG's licensing of three (3) new Deposit Money Banks (DMBs) and two (2) new rural banks in 2006, the cedi redenomination in 2007 that pegged ¢10,000 to GH¢1, the adoption of the E-zwich card (a biometric smart card) in 2008 for electronic payments, BoG's implementation of the GH¢ 60 million as minimum capital requirement of banks in 2009 and the

fixing of a capital base of GH¢120 million for new entrants in the banking industry in 2013. However domestic banks had up to December 2012 to meet this GH¢ 60 million requirement**.** As of December 2015, there were 29 DMBs, 62 Non-Bank Financial Institutions(NBFIs), 139 Rural and Community Banks (RCBs) and 546 Microfinance Institutions (MFIs) as well as three (3) credit reference bureaux (XDS Data Ghana, Hudson Price Data Solutions, and Dan & Bradstreet) operating in Ghana. The DMBs comprises 12 Ghanaian and 17 foreign-controlled banks.

2.3 Regulatory Reforms

To provide guidelines for banks and to ensure they operate within the legal framework, the Banking Law 1989 (PNDCL 225) was passed. In 2002, the BoG embarked on the development of legislative instruments on a new banking act to replace the existing Banking Law 1989 (PNDCL 225) aimed at enhancing the regulatory structure of the Ghanaian banking system to cope with developments in the global banking industry. Following the promulgation of the Banking Act 2004 (Act 673), the Banking Law 1989 (PNDCL 225) was repealed. Banking regulation in Ghana was further enhanced when in 2007 three important Acts were enacted. They include the Banking (Amendment) Act 2007 (Act 738), the Credit Reporting Act 2007 (Act 726), and the Anti-Money Laundering Act 2007 (Act 749). The Banking (Amendment) Act 2007 (Act 738) introduced three types of banking licenses, namely: the General Banking license, and Class I and Class II Banking licenses. The General Banking license was to regulate universal and off-shore banking. That is, it allowed both Class I and Class II banking businesses in Ghana. Barclays Bank of Ghana Limited was issued the first General Banking license on August 28, 2007 that made it launch the first offshore banking in Ghana in that year.

With a Class I Banking license, currently referred to as Universal Banking license, a bank undertakes only domestic banking business. Class II Banking license on the other hand permits a bank to carry out banking business or investment banking with non-residents and other banks with the same Class II banking licenses in currencies other than the local currency (the cedi). In the advent of the Class II banking license, foreign banks can now establish branches in Ghana to undertake Class II banking business. The enactment of the Credit Reporting Act 2007 (Act 726) brought about the setting up of credit reference bureaux in Ghana. XDS Data Limited, the first credit reference bureau, was issued a provisional license in 2008. XDS Data Limited was to provide credible information on prospective borrowers and reduce information asymmetry that is associated with lending that has contributed to the growing number of non-performing loans.

To provide for the criminalization of money laundering and the establishment of a Financial Intelligence Centre, the Anti-Money Laundering Act 2007 (Act 749) was also enacted. The FI Centre aids in identifying and monitoring money-laundering activities and provides the necessary information to investigating authorities. In 2008, the Ghanaian Parliament passed the Borrowers and Lenders Act, Act 773 to provide the legal framework for credit, improve disclosure, and prohibit certain practices in the credit market. This further strengthened banks' lending activities and reduced information asymmetry that hitherto characterized bank lending.

2.4 Financial Performance

2.4.1 Profitability

The Ghanaian banking sector experienced an impressive growth in terms of earnings and total assets from 2006 to 2015. The DMBs remained profitable over the ten years. However, in 2015, with the exception of net interest margin (NIM), the other indicators – return on assets (ROA)

and return on equity (ROE) – witnessed a significant decline in growth. The decline in profitability was as a result of high non-performing loans which led to an increased provision for bad debts, high cost of loans and the high cost of operations resulting from the shortfalls in energy supply. Table 2.1 and fig 2.1 exhibit the growth in profitability of the banking industry of Ghana.

Table 2.1 Banking Sector Profitability Indicators from 2006 to 2015

YEAR	ROA	ROE	NIM
2006	4.8	27.4	11.2
2007	3.7	25.8	9.7
2008	3.2	23.7	10.1
2009	2.8	17.5	10.8
2010	3.8	20.4	12.4
2011	3.9	19.7	10.2
2012	4.9	25.8	10.9
2013	6.2	30.9	12.6
2014	6.6	33.1	13.4
2015	4.6	22.2	13.8

Source: *Bank of Ghana data, 2006 – 2015*

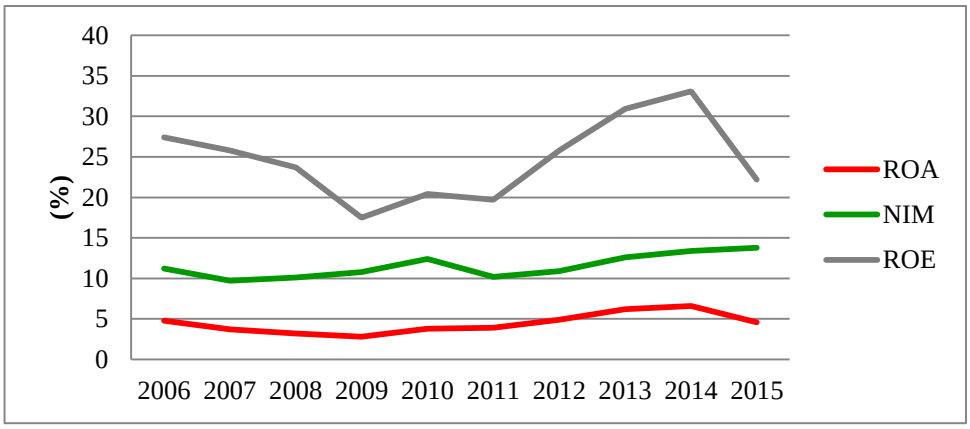

Figure 2.1: Profitability of the Banking Industry

Source: *Author's compilation*

2.4.2 Solvency

Banks in Ghana have remained stable and sound over the 10-year period under review. This has been projected by the solvency indicator; Capital Adequacy Ratio (CAR) in Table 2.2. The industry capital adequacy ratios continuously exceeded the 10% minimum requirement specified in S.23 (1) of the Banking Act 2004 (Act 673). This implies that the banks were able to comply with the law and thus remained well capitalized. Table 2.2 and Fig 2.2 exhibit the industry solvency levels.

Table 2.2 Solvency Indicators of the Ghanaian Banking Industry from 2006 to 2015

YEAR	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CAR (%)	15.8	14.8	13.8	18.2	19.1	17.4	18.6	18.5	17.9	17.8

Source: *Bank of Ghana data, 2006 – 2015*

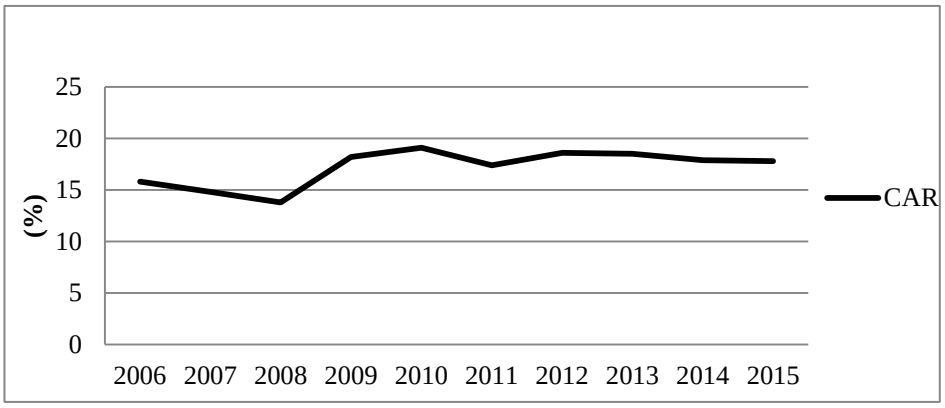

Figure 2.2: Solvency of the Banking Industry

Source: *Author's compilation*

2.4.3 Liquidity

The banking industry was generally liquid as banks met the primary reserve requirement of 9.0% in all the years except in 2009 when all but one bank met the requirement. The industry average fell short of the 9.0% requirement as 8.2% was recorded. The Cash Reserve Ratio was reviewed upwards to 11% in April 2014 but later reduced to 10% in November same year but the DMBs still met the requirement as they achieved 10.6% and 10.4% in 2014 and 2015 respectively. The cash ratio is the ratio of cash to deposit of banks. Table 2.3 and fig 2.3 project the liquidity status of the banking industry from 2006 to 2015.

Table 2.3 Liquidity of the Ghanaian Banking Industry (2006-2015)

YEAR	Domestic Primary Reserves (%)	Foreign Primary Reserves (%)
2006	9.1	12.4
2007	10	20.3
2008	9.0	19.5
2009	8.2	22.1
2010	9.6	13.0
2011	10.6	12.3
2012	9.1	-
2013	9.7	-
2014	10.6	-
2015	10.4	-

Source: *Bank of Ghana data, 2006 – 2015*

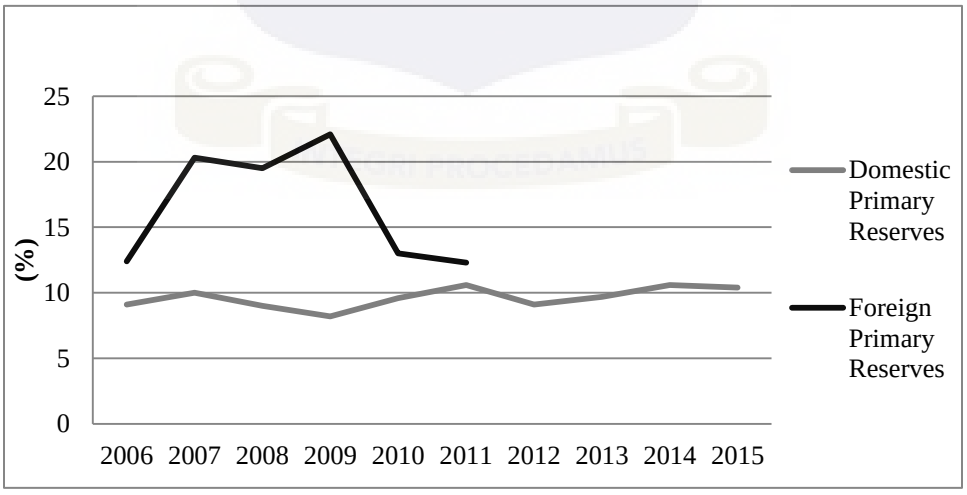

Figure 2.3: Liquidity of the Banking Industry

Source: *Author's compilation*

2.5 Macroeconomic Indicators of Ghana

Ghana's economic performance has trickled down effects on the operations of financial institutions. For instance, during economic booms, banks' lending increases with high net margins and reduces non-performing loans. From Table 2.4, it can be seen that the Ghanaian economy performed relatively well over the 10 years with the exception of 2014 and 2015 where growth declined. This was attributed to high cost of business operations resulting from the intensive energy crises at that time. However, it was still one of the highest in West Africa and exceeded growth in the global economy (PwC & GAB, 2015). Figures from the Ghana Statistical Service in 2016 indicate that the services sector grew well continuously and remained a major contributor to Ghana's GDP. Its share in GDP increased from 51.9% in 2014 to 54.4% in 2015. From the World Bank figures in the appended table, it can be observed that inflation remained a nuisance over the years but declined a little decline in 2011and 2012. It however worsened in 2015. The upsurge in inflation was said to have reflected the sharp depreciation of the Cedi and the effects of utility and fuel price adjustments (PwC & GAB, 2016).

Table 2.4 GDP Growth and Inflation rates of the World, Sub-Sahara Africa and Ghana from 2006 to 2015

	WORLD		SS AFRICA		GHANA	
YEAR	GDPg (%)	INFL (%)	GDPg (%)	INFL (%)	GDPg (%)	INFL (%)
2006	4.38	4.49	7.05	6.70	6.40	10.92
2007	4.32	5.34	7.07	7.08	4.35	10.73
2008	1.84	8.95	5.39	10.39	9.15	16.52
2009	-1.70	3.04	2.85	7.13	4.85	19.25
2010	4.37	3.55	5.39	4.39	7.90	10.71
2011	3.10	5.00	4.32	5.66	14.05	8.73
2012	2.45	3.85	3.72	6.47	9.29	9.16
2013	2.48	2.70	4.76	4.63	7.31	11.61
2014	2.69	2.66	4.59	4.39	3.99	15.49
2015	2.63	1.44	3.01	3.80	3.92	17.15

Source: The World Development Indicators / World Bank (WDI 2017)

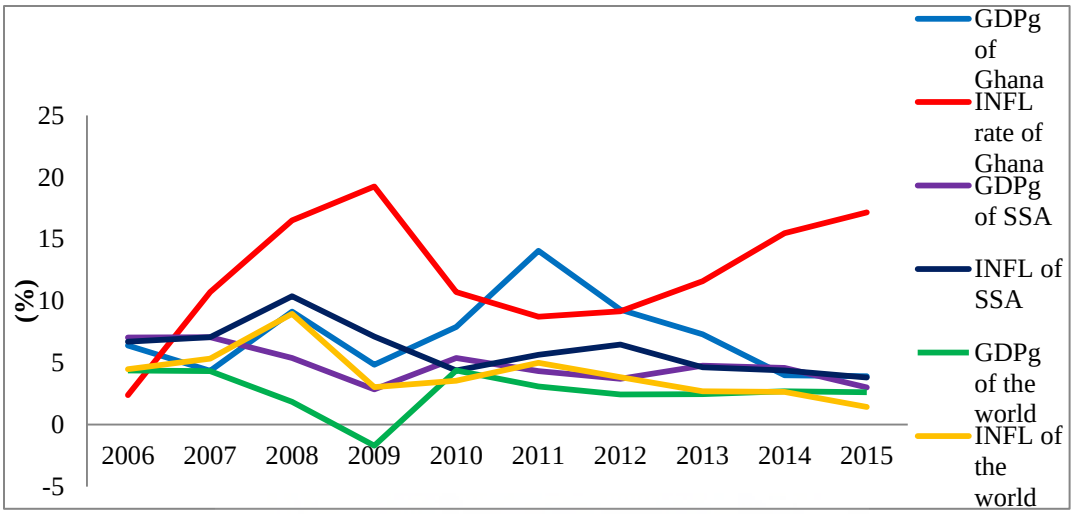

Figure 2.4: GDP Growth and Inflation rates

Source: *Author's compilation*

2.6 Conclusion

This chapter looked at the background of the Ghanaian banking industry and centred discussion on changes that characterized the industry over the years. The changes ranged from regulation, through financial performance and technology, to risk management. The chapter also considered two macroeconomic indicators of the world, Sub-Sahara Africa and Ghana.

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

This chapter reviews the relevant literature on bank capital adequacy and liquidity transformation. It looks at the measures of capital adequacy and liquidity transformation, theories of the bank liquidity creation and capital nexus, as well as the empirical review of literature.

3.2 Theoretical Review

3.2.1 The Concept of Capital Adequacy and Bank Safety

There are varied views on the role of capital adequacy in the banking industry. Some researchers have indicated that capital adequacy enables banks to absorb shocks on their balance sheets (Barrios & Blanco, 2013) while others see it as a buffer against deposit withdrawals. Mekonnen (2015) hints that capital adequacy promotes efficiency and stability of the financial system and protects depositors. Similarly, it is argued in Masood & Ansari (2016) that banks' survival rests in the ability to maintain sufficient capital to act as buffer during a liquidity crunch. Chowdhury (2015), on the other hand, finds no significant evidence of sufficient equity capital serving as buffer and shock absorber in the UAE banking industry. Therefore meeting the requirement of keeping high bank capital does not necessarily mean that better capitalised banks are well-positioned to withstand the unfavourable impact of financial crisis. Thus holding large capital does not guarantee banks' survival during crisis.

Other researchers believe that the generally known reasons for the capital adequacy requirements are not entirely beneficial. Ensuring safety and soundness has been one of the reasons for the imposition of higher capital requirements on banks by regulators. But the findings of Berger and Bouwman (2009) suggest that even though the regulators may be able to realize this purpose, the benefit of the action may bring about a decline in small banks' liquidity creation and an increase in same for large banks. This implies that the small banks' ability to generate and retain profits to boost their capital base is at stake. Similarly, Blum (1999) indicates that in some cases, regulations that seek to increase capital may reduce bank profits and increase risks. The reality is that banks generate most of their revenue through financial intermediation which includes liquidity transformation and part of this revenue may be retained as reserves to supplement capital.

Goddard, Molyneux and Wilson (2004) also argue that a high capital adequacy ratio may be an indication of a bank operating over-cautiously and does not take advantage of prospective profitable activities within its environment. In this regard, a bank becomes risk averse as it tries to eschew any risk associated with productive ventures thereby missing the avenues for growth.

3.2.2 Measures of Bank Solvency

Bank solvency or capital adequacy is measured in different ways. For example, equity to total assets ratio (Novokmet & Marinović, 2016), shareholder equity to risk-weighted assets (Polat & Al-khalaf, 2014), and eligible capital to total risk-weighted assets proposed in the Basel III accord (BIS 2010; Masood & Ansari, 2016). Among the known measures of bank solvency, the Basel III proposed measure is said to provide more protection for banks than the rest, following the 2007/2008 financial crises. The eligible capital comprises Tier 1 capital and Tier 2 capital

while the total risk-weighted assets is composed of credit RWAs, market RWAs, and operational RWAs.

The tier 1 capital is made up of equity capital, permanent preference shares (irredeemable non cumulative preferred stock), loan loss reserves, and disclosed reserves. Tier 2 capital, on the other hand, has the following elements: subordinated term debt, hybrid capital, revaluation reserves and undisclosed reserves. The former measures banks' ability to absorb losses while in operation. That is why the 'core capital' ratio, as it is commonly known, seems to be providing more protection for depositors than the 'secondary' or Tier 2 capital. Banks usually cater for losses with earnings first, and beyond earnings, the reserves in Tier 1 capital. This means that depositors are not affected at this stage as their deposits remain intact. The Tier 2 capital on the other hand, absorbs losses only when the bank is winding up. In the event of losses extending beyond Tier 1 capital, the bank has to wind up. In that case, Tier 2 capital comes in to mop excess losses.

The Tier 2 capital is temporary in nature relative to Tier 1 and contains more debt than Tier 1 capital. Demirguc-Kunt, Detragiache and Merrouche (2010) found that Tier 1 capital is significant to market participants as they concentrate more on the constituent of capital that is available to absorb losses while the bank is still in operation. Tier 1 capital has to represent at least 50% of the total eligible capital (BIS, 2006). It is observed to be the only element of banks' capital base that is common to the banking systems of all countries in the world (BIS, 2006).

In order to specify how much risk-covering capital banks require in sustaining their operations in difficult times, bank regulators express the capital base as a percentage of the total risk-weighted assets. The risk weighting of assets varies according to each asset's default prospect and the likely associated losses in the event of default. For instance, an unsecured commercial loan is

considered riskier than a mortgage secured with the property. Thus, the former attracts a higher multiplier than the latter.

If capital adequacy ratio is high, it means the banks are capable of absorbing losses resulting from their operations. The reverse is the case where the ratio is low. The benchmark for determining whether the ratio is low or high is the minimum capital adequacy ratios set by the central banks of every country as a policy requirement. Countries, such as Ghana, which have subscribed to the Basel Accords, set the ratio at 10%. The 10% implies that a bank can lose up to 10% of its assets without becoming insolvent. As indicated earlier, bank losses are catered for with earnings. However, where there are larger unexpected losses beyond earnings, they are absorbed with capital (Olalekan & Adeyinka, 2013). This implies that losses from bank operations affect capital in two ways. One is where banks make large advances out of capital and they go bad. The other is where normal earnings are insufficient to take care of large losses. To cushion themselves against the losses, banks sometimes maintain more capital than what regulation imposes on them so that they can be more resilient during crises if they cannot avoid the crises in the first place. They also do so to avoid the high transaction cost of raising new equity on short notice (Berger, DeYoung, Flannery, Lee & Öztekin, 2008).

3.2.3 Measuring Bank Liquidity Transformation

Generally, the current and acid-test ratios are being used to measure liquidity. The current ratio (used in Novokmet and Marinović 2016) shows the relationship between short term assets (current assets) and short term liabilities (current liabilities). Bank of Ghana measures liquidity of commercial banks in Ghana using the liquid assets to total assets ratio, liquid assets to total deposit ratio, and liquid assets to short-term borrowings ratio. Examples of liquid assets include cash, equity investments, investments in associated and subsidiary companies, investments in

government and non-government securities. The Cash ratio (ratio of cash to total deposits or assets) is also used to measure bank liquidity level. The shortcoming of the above liquidity measures are that they do not take into account, off-balance sheet items of banks. Banks sometimes undertake off-balance sheet activities such as issuing letters of credit, making loan commitments and guarantees, and other contingencies in large volumes which have far-reaching consequences on their liquidity positions.

The Basel Committee on Banking Supervision (BCBS) in December 2010, proposed two new standardized measures of bank liquidity following the 2007/2008 global financial crises. These are liquidity coverage ratio (LCR) and net stable funding ratio (NSFR). The LCR is the threshold for short-term liquidity. It measures the resilience of banks within a thirty-day period should there be crises. It is the ratio of stock of high-quality liquid assets to total net cash outflows over the next 30 calendar days. The ratio should be greater than or equal to 100%.

The NSFR, on the other hand, measures banks' long-term resilience. It is the ratio of available stable funding to the amount of required stable funding. The ratio must be greater than 100% (King 2010). The limitation of the LCR is that it cannot be computed directly because it requires details of the bank's anticipated cash outflows for a month. The data on this are scarce.

All the liquidity ratios discussed above are short of quantifying bank liquidity transformation. The first liquidity transformation/creation measure was developed by Deep and Schaefer (2004). They indicated that the determination of the degree to which banks' liquid assets differ from liquid liabilities is a prerequisite for measuring liquidity transformation. Based on this analogy, they measured banks' liquidity transformation as the net liquid liability expressed as a fraction of total assets.

Subsequently, Berger and Bouwman (2009) came up with what they call a more comprehensive measure of liquidity creation or transformation which they used to determine the amount of liquidity created by U.S banks in eleven years. Berger and Bouwman (2009) developed four liquidity creation measures by first grouping banks' activities into liquid, semi-liquid and illiquid. Next, they assigned weights of 0.5 to illiquid assets and liquid liabilities, 0 to semi liquid assets and liabilities and -0.5 to liquid assets and illiquid liabilities and summed them up. The weighting was done on the basis of the Liquidity Creation Theory. The theory indicates that banks create liquidity on balance sheet when they use liquid liabilities to finance illiquid assets. The theory further explains that total liquidity is created when illiquid assets such as long term loans are financed with liquid liabilities and total liquidity is destroyed when liquid assets such as government securities are converted into illiquid liabilities such as equity. Based on this, they assigned positive weights to items which facilitate liquidity transformation (liquid liabilities and illiquid assets), and since these items play an equal role in liquidity transformation, they were assigned equal weights of +1/2. Also, since illiquid liabilities and liquid assets do not add up to liquidity transformation, they were assigned negative but equal weights of -1/2. They then came up with the four measures namely 'cat fat', 'mat fat', 'cat nonfat', and 'mat nonfat' which are based on category, maturity, category with off balance sheet activities, and maturity with off balance sheet activities, respectively. In literature, the Berger and Bouwman liquidity creation measures have become the most known and used measures of liquidity transformation.

3.2.4 Relationship between Liquidity Transformation and Bank Solvency

The role of banks as risk transformers explains their motive for keeping capital. In recent times, theories have shown that banks' ability to transform liquidity influences their capital base. The known theories provide contradictory predictions on the liquidity transformation and capital

nexus. The following are the two main schools of thought on the link between liquidity transformation and bank capital.

3.2.4.1 'Risk Absorption' Hypothesis

This is a collection of theories relating to banks' risk transformation function. The theories predict an enhancement in the level of bank capital, resulting from liquidity transformation. Two strands of the literature support this prediction. One is composed of studies which argue that bank capital increases banks' ability to bear risk since capital absorbs risk (e.g. Von Thadden, 2004; Repullo, 2004; Coval & Thakor, 2000; Bhattacharya & Thakor, 1993). The other argues that banks are exposed to risk through liquidity transformation (e.g. Allen & Gale, 2004; Allen & Santomero, 1998). Blending the two arguments generates the prediction that liquidity transformation compels banks to maintain higher levels of capital so as to absorb liquidity risk. The risk 'absorption hypothesis' predicts a positive association between liquidity transformation and bank solvency. The more liquidity banks transform, the greater their chance of incurring severe losses in relation to the disposal of illiquid assets to meet the liquidity needs of depositors. Customer funds get stuck in illiquid assets when banks grant long term loans and make long term investments with deposits. As indicated in chapter one, this results in liquidity mismatch and liquidity risk. In such instances, banks guard against customer apathy and loss of public confidence in the banking system, by resorting to fire selling of illiquid assets to raise funds to repay depositors. They usually do so if cash reserves are not enough to repay customers. When bank assets are fire sold, bank value declines thereby prompting an upward adjustment of capital to avoid insolvency. It is a standard knowledge that substantial portion of bank assets are financed by equity. Thus, an upward adjustment of capital implies restoring bank value.

3.2.4.2 'Financial Fragility-Crowding Out' Hypothesis

The second group of theories is referred to as the '*financial fragility-crowding out*' hypothesis (Diamond & Rajan, 2000; 2001). These theories predict an inverse relationship between liquidity transformation and the bank capital ratio. Diamond and Rajan (2000; 2001) created a scenario where a bank intermediates to channel funds from investors (surplus units) to an entrepreneur (deficit unit). However, the entrepreneur may not make an effort to secure funds from the bank or the bank may not make an effort to raise funds from the investors. But the contractual relationship between depositors and the bank will restrain the bank from not securing funds to on-lend to the entrepreneur because depositors will surely make funds available to the bank even if it does not go for them. This would increase the bank's liquidity transformation (or creation) potential, and hence increase liquidity transformation. This is because capital remains the same or even declines since the bank does not make an effort to secure more investments but deposits continuously increase. It is also assumed that the entrepreneur (borrower) borrows long on a regular basis. Further, unlike depositors, bank shareholders are not at liberty to provide funds to the bank at their chosen time. That is, depositors have more flexibility in providing funds to the bank than shareholders. In this situation, deposits are said to have 'crowded-out' capital, thereby compelling banks to perpetually fund long-term loans and investments with deposits. Besides, equity constitutes the largest proportion of banks' capital; yet it has an indefinite term to maturity which makes it an illiquid liability. Therefore, banks will not transform liquidity if they finance long-term loans and investments with capital. But they will if they do so with deposits since they are liquid liabilities and they do because deposits outgrow capital under the financial fragility crowding-out hypothesis.

Holistically, the more liquidity banks transform, the more they rely on deposits and the less motivated they become in securing external funding such as equity capital. This, with time, reduces the banks' capital base and solvency.

3.3 Empirical Review of Relevant Literature

Empirical studies on liquidity transformation are quite scanty (Horváth, Seidler & Weill 2012) and the available ones have given little attention to the bank capital and liquidity transformation nexus (Pana, Park, and Query 2010; Deep and Schafer 2004; Fidrmuc, Fungáčová and Weill 2015; Nikbakht, Nezhad & Azhdar 2016; Chatterjee 2015). Some of the studies concentrate on the theories of liquidity transformation but ignore the role of bank capital. Those that include capital in their estimations fail to accentuate the link between the two; rather they highlight other issues. It must be emphasized that the empirical literature on the effect of liquidity transformation on capital adequacy is somewhat rare. Thus, the empirical literature reviewed in this study does not exclusively deal with this effect; rather it considers liquidity transformation holistically.

3.3.1 The extent to which Banks Transform Liquidity

Some studies have estimated liquidity transformation and determined factors influencing it. However, those studies were carried out in industries other than banking. For example, Choi, Park and Ho (2013) investigated liquidity creation in the property liability (P/L) insurance industry in the U.S. for ten years (1998-2007) using accounting Data of the P/L insurers in the U.S. market. They employed the Berger and Bouwman's liquidity transformation measures to determine the total liquidity transformed by the P/L insurers. Further, they used those measures in a regression analysis to determine factors relevant to insurers' liquidity transformation. They

revealed that the P/L insurers were more of liquidity destroyers than creators. The liquidity destruction was estimated to have ranged from $618 billion to $872 billion representing an increase from 47% to 58% of the insurers' total assets. Much of the liquidity destruction was accounted for by large insurers. This, they explained, resulted from the fact that they held a substantially large amount of equity exceeding 45% of total assets as against the banks' 10%. They observed that the destruction of liquidity varied over time and across insurers.

Similarly, Choi, Park and Ho (2016) measured liquidity transformation among U.S. life insurers from 1999 to 2008. They constructed liquidity transformation measures similar to those in Berger and Bouwman (2009) by grouping the liabilities and assets of the insurers into illiquid, semi-liquid and liquid and assigning them weights. They applied the constructed measures to the available data and observed that an amount of $2.1trillion worth of liquidity was de-created in 2008 which represented 43% of the insurers' total assets.

Deep and Schaefer (2004) used quarterly data from the "Call Reports" filed by all federally regulated United States commercial banks in investigating liquidity transformation among US banks. They developed and applied the first ever liquidity transformation measure; (the liquidity transformation (*LT*) gap) on a sample of 200 large banks in the US. They indicated that the banking industry created liquidity of up to 20% of its total assets. This, they concluded, was not enough.

Hackethal, Rauch, Steffen and Tyrell (2010) measured liquidity transformed by German savings banks from 1997 to 2006 and identified the influential factors of liquidity transformation. They applied the "BB-Measures of Berger and Bouwman (2009) and the "Liquidity Transformation" (*LT*) Gap of Deep and Schaefer (2004). They analyzed data on 457 German savings banks and

observed that liquidity transformed by the banks worsened from €120.7b to €182.2b (51% change) during the study period. The use of the 'BB-measure' is commendable since it comprehensively deals with all activities of the banks that aid in liquidity transformation. However, the study has not indicated categorically which of the four 'BB-measures' has/have been used. It is relevant to specify the measures because out of the four measures Berger and Bouwman constructed, they applied only two and explained the limitations of the others.

In analyzing liquidity transformation in the Lithuanian Banking System from 2004 to 2008, Lakštutienė and Krušinskas (2010) adopted the Berger and Bouwman (2009) and Deep and Schaefer (2004) liquidity transformation measures to estimate liquidity transformed by the banking industry. They realized that the banks, in the last year of the study (2008), transformed Lt31,138,373, Lt25,647,520, Lt23,048,993 and Lt17,558,140 liquidity when the Berger and Bouwman's 'Cat fat', 'Cat nonfat', 'mat fat' and 'mat nonfat' measures were used, respectively. The study spanned for five years and this may not be long enough to reveal the real magnitude of liquidity transformed by the banks. A replica of this study with an extended period beyond five years could give more insights into the long-term liquidity transformation activities of the banks as it is in the current study.

Bai, Krishnamurthy, Weymuller (2015) implemented the Liquidity Mismatch Index (LMI), which they used to determine disparity between funding liquidity of liabilities and market liquidity of assets. They constructed the measure for 2882 BHCs between 2002 and 2014 and investigated the patterns of banks' liquidity risk and liquidity over time and across banks. They observed that the combined liquidity of the banking sector prior to the crisis worsened from +$5trillion to -$3 trillion (in 2008) and then reversed to the pre-crisis level (in 2009). They also

showed how the LMI measure could be used to conduct a liquidity stress test. They further indicated that when the stress test is used as a macro-prudential tool, it can unveil the banking sector liquidity needs. The study only determined the movement of the banks' liquidity and liquidity risk. However, it did not indicate if the banks actually transformed liquidity.

Berger and Bouwman (2009) used eleven-year data from US banks and constructed four liquidity creation measures, namely: 'cat fat', 'cat nonfat', 'mat fat' and 'mat nonfat'. Applying these measures, they found that liquidity creation increased annually and was above US$2.8 trillion in the last year of their study (2003). They observed that most of the liquidity was transformed by large banks, retail banks, recently merged banks, and multibank holding company members. The comprehensive nature of measures used in estimating the amount of liquidity transformed by the sampled banks adds reliability to the results.

3.3.2 The Empirical Relationship between Liquidity Transformation and Bank Capital

The available empirical literature on liquidity in most cases assesses matters associated with liquidity transformation but ignores its relationship with bank capital and solvency (Berger and Bouwman, 2009). For example, Gatev and Strahan (2006) provides evidence that in the event of commercial paper spreads widening and liquidity drying up in an economy, banks witness more inflows of deposit which give them an upper hand in hedging liquidity risk. Thus, liquidity shock or market distress aids banks in providing more loans that customers draw under commitments.

In exploiting the 1998 Russian default as an inverse liquidity shock to international banks and analyzing its transfer to another country (Peru), Schnabl (2012) found that after the shock, international banks decreased lending on bank-to-bank basis to banks in Peru and the latter also decreased lending to one another. The findings indicate that international banks transfer liquidity

shocks among countries and that adverse liquidity shocks decrease lending among banks in those countries.

Kashyap, Rajan, and Stein (2002) assert that banks' deposit taking and lending could represent one of their traditional roles, namely: liquidity provision on demand, since they mostly lend through commitments. They used their model to prove the existence of synergy between bank lending and deposit-taking to the extent of both demanding that banks keep more liquid assets. In line with Kashyap, Rajan, and Stein (2002), Pennacchi (2006) confirm that synergies exist between deposit taking and loan commitments, but argue that those synergies could not exist before the FDIC deposit insurance was created. The study presents a model to prove that banks would be incentivized to take excess market risk, when insurance premiums are set to be ''actuarially fair,''

Gatev, Schuermann and Strahan (2009) have noted that with the help of transaction deposits, banks are able to hedge liquidity risk from unused loan commitments. They have argued that for banks with fewer transaction deposits, unused loan commitments are increased by bank stock-return volatility. According to them, the hedge becomes stronger in times of liquidity constraints when risk-averse investors push more funds to their banks.

Khwaja and Mian (2008) assess the effect of liquidity shocks by exploiting changes in liquidity across banks which were invoked by unexpected nuclear tests in Pakistan. They found that when a firm borrows from different banks, its loan from a bank that experiences a percentage decrease in liquidity falls by 0.6%. They also observed that as banks transfer liquidity shocks to firms, large firms especially those with active political and business ties offset their losses by contracting additional loans from the credit market. Small firms without this capability experience a heavy fall in borrowing and financial distress.

Holmström and Tirole (1998) investigated liquidity provision by the private and public sectors. They found that there are liquidity premiums which only emerge when there is a shortage of liquidity instruments. They also found a negative link between liquidity shocks and the prices of real estates which are held for liquidity purposes. This, according to them, is because assets will be sold off when liquidity is needed and bought when liquidity is to be stored.

Aspachs, Nier, Tiesset (2005) applied quarterly data from the P&L and statement of financial position of fifty seven banks in the UK in their study of the relationship among banking regulation, liquidity and the macro economy. They studied both idiosyncratic factors and county-level indicators of liquidity buffers of banks. They found that banks hold lower liquidity buffers when the prospective support from the central bank during liquidity shortages is greater. They also found that UK banks appear to pursue a counter-cyclical liquidity policy, with liquidity lower in upturns.

Other studies consider the relationship between bank liquidity transformation and variables other than capital. For instance, Deep and Schaefer (2004) investigated liquidity transformation among the 200 largest banks in the U.S. They found that Deposit insurance is less effective in promoting liquidity transformation since insured deposits usually replace uninsured liabilities instead of expanding the deposit base or loans. They again observed that it is credit risk that suppresses liquidity transformation and not deposit insurance. The limitation of the study is that it excludes off balance sheet items from the computation of liquidity transformation. However, there are instances where banks' undertake significant off balance sheet liquidity transformation. Thus, the banks' full liquidity transformation activities are not covered by the study.

Fidrmuc et al. (2015) empirically investigated the relationship between the growth of the Russian economy and bank liquidity transformation. They employed a dataset from banks in Russia. The

study spanned for nine years (2004 to 2012). They followed the methodology of Berger and Bouwman (2009) to determine liquidity transformation among the banks. They constructed and applied 'cat fat' and 'mat fat' measures and in line with Deep and Schaefer (2004), they did not consider off balance sheet items. They also performed GMM and fixed effects estimations in examining the relationship. Their results suggest that bank liquidity transformation fosters economic growth.

Chatterjee (2015) investigated the association between liquidity creation of banks and the liquidity of the asset market. The study covered the 1st quarter of 1984 to the 4th quarter of 2010. In the study, asset market liquidity is proxied by the liquidity of the Treasury bond market and that of the stock market. Their finding suggests that the liquidity of the asset market and credit spreads influence large banks' liquidity creation and total liquidity creation by banks. In addition, it was found that liquidity of the Treasury bond exhibits greater influence on liquidity created on balance sheet while the liquidity of the stock market is in a better position to determine liquidity created off balance sheet. Finally, they showed that the monetary policy has a greater influence on small banks' liquidity creation than on that of large banks.

Alman and Oehler (2012) considered how liquidity transformation is affected by the institutional and specific financial system characteristics of Islamic banks. The study spanned from 2000 to 2007. They used data of banks in Brunei, Turkey, Southeast Asia, Egypt, and the Gulf Cooperation Countries. They set an interest-based control group which operated in a similar manner as those of the Western industrial countries. The results indicate that Islamic banks' liquidity transformation is highly inversely explained by interbank demand and bank risk taking as compared to banks in the Western industrial countries.

Again, Hackethal, Rauch, Steffe and Tyrell (2010) employed a multivariate dynamic panel regression framework which differentiated between prospective macro and bank level determinants of liquidity. They measured the effects of the removal of state guarantees from banking in the public sector on liquidity transformation. Their result shows that monetary policy tightening strongly and negatively determines bank liquidity transformation. It was also found that liquidity transformation was not explained by any bank level variables.

Berger and Bouwman (2010) studied the influence of monetary policy on the aggregate liquidity creation in the banking industry of the United States from 1984 to 2008. They assessed the nature of the impact during financial crises in normal periods on the basis of bank size. They found that the tightening of monetary policy decreases liquidity creation among small banks in the U.S. though the effect is not strong during financial crises. They again noticed that liquidity transformation is higher in pre-financial crisis period than it is in the period of financial crisis.

Berger, Bouwman, Kick, and Schaeck (2010) exploited data on universal banks in Germany from 1999 to 2008. They found that interventions by regulators and capital injections decrease liquidity transformation. They observed that the chance of a fall in liquidity transformation increased up to 50% following these actions. They also indicated that as liquidity transformation market share of banks decreases over 5 years subsequent to these regulators' interventions, so do they make banks safer by decreasing their risk exposure at such times.

In assessing the association between bank crisis and liquidity creation, Berger and Bouwman (2008) found an appreciable build-up of an extraordinary liquidity transformation crisis. They argue that there is a difference between bank and market-related crises because abnormal positive liquidity transformation precedes bank crises, but market crises on the other hand are

generally preceded by abnormal negative liquidity transformation. They also found that off-balance sheet guarantees increase faster than on-balance sheet assets during banking crises.

Berger, Bouwman, Kick, and Schaeck (2011) claim that, in times of bank distress authorities in the banking industry mostly engage in regulatory interventions and provide banks with capital support to reduce their risk taking. These interventions, they claimed, inadvertently reduce banks' liquidity creation which has the tendency of affecting the entire economy. Their study spanned from 1999 to 2009 and, with a unique dataset, they tested their hypothesis on how bank liquidity transformation and risk taking are affected by capital support and regulatory interventions. They found that both actions lead to a statistically significant decrease in liquidity transformation and risk taking in the short run and long run. Their findings indicate that while the effects of capital support are only economically significant in the long run, the effects of regulatory interventions are economically significant in both the short run and the long run.

Altunbas, Gambacorta and Marqués (2007) assert that the functioning of credit markets has been modified by the dramatic increase in securitization since securitization has reduced financial intermediaries' liquidity transformation function. They used a large sample of European banks in their analysis and found that securitization shields the supply of loans by banks from the effects of monetary policy. It also enhances the banks' ability to grant new loans. This, however, depends on business cycles.

Berger and Sedunov (2017) used a sample of annual state level observations from 1984 to 2010 in their study of the relationship between bank liquidity creation and real economic growth. They found that when liquidity is transformed by small banks, liquidity transformation per capita is statistically significantly positively associated with economic growth per capita.

Again, though some literature on bank lending behavior includes capital ratios, they concentrate on issues other than liquidity transformation. For example, using quarterly data from Italian banks from 1992 to 2001, Gambacorta and Mistrulli (2004) investigated the presence of cross-sectional variations in how bank lending responds to GDP and monetary policy shocks because of differences in capitalization of banks. They found that the level of bank capital influences the effect GDP shocks and monetary policy have on bank lending.

Holod and Peek (2007) investigated fluctuations in monetary policy which constituted exogenous changes in the financing problems facing banks. They found that when monetary policy is tightened, publicly traded banks with lower degree of information asymmetry are better in getting rid of market frictions that are information-based, as compared to those that are not publicly traded.

Vodová (2011) investigated the influential factors of the liquidity of commercial banks in the Czech Republic from 2001 to 2009. The study used panel data regression analysis to identify factors that influence bank liquidity. The results suggest that there is a positive association between bank liquidity and capital adequacy, share of non-performing loans and interest rates on loans and on interbank transaction.

Nikbakht et al. (2016) studied the influence of aggregate bank capital on the liquidity of banks listed in Tehran Stock Exchange from 2010 to 2014 using a statistic sample of 18 commercial banks which were selected by systematic elimination. They used linear regression and correlation to investigate the research hypotheses. They found that liquidity of the banks listed in Tehran Stock Exchange has been positively and meaningfully affected by bank capital.

Novokmet & Marinović (2016) studied solvency and liquidity level tradeoff in the Croatian Banking industry, focusing on 32 banks from 2002 to 2010. Applying dynamic panel data

analysis on two specified models, they found a positive bi-directional relationship between bank liquidity and solvency. They emphasized the role of bank size in liquidity and capital management and observed that bigger banks minimized regulatory costs by avoiding the concurrent rise in bank liquidity and solvency. They argue that smaller banks do the direct opposite which results in sub-optimization of their fund allocations.

Studies that closely assess the link between liquidity transformation and bank capital depict reverse causality and not a specific case of liquidity transformation causing bank capital as it is in the current study. For instance, Lei and Song (2013) used the yearly bank data of China from 1988 to 2009. Their sample comprised 4 state commercial banks, 113 domestic banks, and 18 foreign banks (FB). They investigated the link between the structure of bank capital and liquidity transformation in the Chinese banking industry. They tested the risk absorption and financial fragility crowding out hypotheses among banks in China. Their findings suggest an inverse association between liquidity transformation and bank capital which they attributed to the financial fragility crowding out hypothesis. On the contrary, they found the association to be weaker among foreign banks in China. This, they claimed, is explained by the risk absorption theory.

Fungáčová et al. (2010) examined how deposit insurance affects the relationship between liquidity creation and bank capital. They studied three alternative liquidity creation measures similar to those constructed by Berger and Bouwman (2009) and applied them on large Russian banks. In consonance with the findings of Deep and Schaefer (2004), they found deposit insurance to have had a little influence on the liquidity transformation and bank capital nexus in the Russian Banking industry. They inferred from the findings that adequately capitalized banks tend to create or transform less liquidity. This, they claim, is in line with the 'financial fragility

crowding-out' hypothesis. They indicate that, as a matter of policy, bank capital requirements implemented by emerging countries to aid financial stability have the tendency of limiting liquidity transformation.

Choi, et al. (2013) investigated liquidity creation in the property liability (P/L) insurance industry in the U.S. for ten years (1998-2007), using accounting Data of the P/L insurers in the U.S. market. They applied the White's heteroscedastic-consistent estimation on a sample of 17,176 insurers who met their regression requirements to test the theories of liquidity transformation. They found that the insurers' capital is inversely related to liquidity transformation. This, they claime, satisfies the 'financial fragility crowding-out' hypothesis.

Similarly, Choi et al. (2016) measured the amount of liquidity transformed by the U.S. life insurance industry for ten years (1999 to 2008) and tested the 'financial fragility-crowding out' and 'risk absorption' hypotheses for the purpose of identifying the influence of capital on liquidity transformation in the life insurance industry of the U.S. The degree of insurers' liquidity transformation was used in their model to test the two hypotheses. Their finding indicates an inverse link between the property insurers' capital and their liquidity creation which supports the 'financial fragility-crowding out' hypothesis.

In examining how liquidity transformation, regulatory capital, and bank profitability interrelate in the banking industry of U.S., Tran, Lin and Nguyen (2016) compiled and used an unbalanced quarterly panel data of all U.S. banks from 1996 to 2013. They found that liquidity creation and regulatory capital have a positive effect on each other especially among small banks. According to them, that is an indication that an increase in capital requirements does not lead to a decrease in liquidity transformation among small banks.

Pana et al. (2010) investigated how liquidity transformation is affected by mergers among banks in the U.S. They used data on 189 mergers that took place among banks from 1997 to 2004. Their findings show that bank mergers have a direct influence on bank liquidity creation. As opposed to Deep and Schaefer (2004), their findings suggest that banks with deposit insurance transform more liquidity than those without it. They also found that variations in liquidity transformation are explained by the level of bank equity.

One study that comprehensively looked at the liquidity transformation and bank capital nexus is Berger and Bouwman (2009). They used eleven-year data from US banks and constructed four measures of liquidity creation. Their findings indicate a significantly positive relationship between liquidity transformation and capital of large banks and this is in conformity with the 'risk absorption' hypothesis which predicts that an increase in liquidity transformation calls for the upgrade of bank capital. On the contrary, they found a statistically significantly negative link between liquidity transformation and bank capital among small banks. This, according to them, is in line with the 'financial fragility-crowding out' hypothesis. This implies that bank size matters in liquidity transformation and in bank capital issues. However, they did not find the relationship to be significant among medium size banks. The implication is that the two effects neutralise each other when medium size banks are involved. The findings are quite explicable but the study was undertaken in a developed country, which raises the fundamental question of what the outcome would be if the study was replicated in the developing world.

Another study that critically considers the relationship between liquidity transformation and bank capital is Horváth, Seidler and Weill (2012). Using exhaustive data from Czech Banks, they investigated the association between liquidity creation and capital among banks in the Czech

Republic. Their study spanned from 2000 to 2010. They found that liquidity transformation increased until the beginning of the financial crisis that engulfed the euro zone from 2009 to 2011. They observed that liquidity transformation inversely affects bank capital. The findings, according to them, imply that an increase in liquidity transformation could result in a decrease in bank solvency. Their study, similar to that of Berger and Bouwman (2009), dealt with key issues on the bank liquidity creation and capital nexus but it did not estimate the volume of liquidity transformed by the sampled banks. Knowing the extent of liquidity transformation in the banking industry helps answer the question on whether determining the influence of it on other variables is necessary. However, this was not considered in their study.

3.4 Conclusion

Though theoretically liquidity transformation has existed for a while, there is paucity of empirical literature on this concept. The scarcity of literature is even more serious when liquidity transformation is being linked up with bank solvency or capital adequacy. The chapter has reviewed the literature on capital adequacy and bank safety, measures of bank solvency, and measures of bank liquidity transformation. It has considered two key theories of liquidity or transformation and bank capital or bank solvency: the 'risk absorption' hypothesis and the 'financial fragility-crowding out' hypothesis. While the former predicts a positive relationship between liquidity transformation and bank capital, the latter predicts an inverse relationship between the two. Studies which empirically support the current study have also been reviewed in this chapter.

CHAPTER 4

METHODOLOGY

4.1 Introduction

This chapter discusses the methods adopted in achieving the objectives of the study specified in the earliest chapter. It presents the research design, population, data source, sample size, and the econometric models employed for the analysis of data to determine the effect of liquidity transformation on the solvency of banks in Ghana.

4.2 Research Design

Secondary data are used in the study; hence, a quantitative approach is adopted. This approach is to enable a deeper assessment of the relationship between the variable of interest and the control variables on one hand and the explained variable on the other. The secondary data were extracted from annual reports of the various banks of concern, published reports of the Ghana Banking Survey conducted jointly by the Ghana Association of Bankers (GAB) and the PricewaterhouseCoopers (PwC) Ghana (an international auditing firm) over the years, and the annual reports and bulletins of the Central Bank of Ghana. The Macro indicators, GDP growth and inflation rates used in this study were sourced from the World Bank database (The World Development Indicators). The materials from which data were extracted were sourced from the websites of the above mentioned institutions. Data on six bank level variables – capital adequacy, return on average assets, return on average equity, bank size, credit risk, and the liquidity transformation gap – were considered aside from the macro variables.

4.3 Sample Size, Population and Sampling Criterion

A sample of 20 out of the 29, banks which operated in Ghana during the study period, was considered. This represents almost 70 percent of banks in Ghana as of December 2015. Banks which had data on at least three out of the five bank-specific explanatory variables were selected. The study spans a period of ten years (from 2006 to 2015). The choice of a ten-year period for the study was informed by the fact that longer durations give a better insight into the relationship between the explained and explanatory variables. However, some of the banks which had data on all the variables were relatively young in the Ghanaian banking industry, given the duration of the study; hence, the selection of banks which operated in the country for three or more years. Also not included in the sample, are Non-Bank Financial Institutions since banks overshadow other financial institutions in liquidity creation in the Ghanaian economy and to a very large extent, most of these institutions are part of the banks' liquidity creation process. The non-bank financial institutions include but are not limited to savings and loans companies, microfinance institutions, mortgage companies, insurance companies and the Stock Exchange.

4.4 Data

An unbalanced panel dataset is used in this study because in certain years, some, though not many, of the sampled banks did not report all the relevant variables. In their study 'what explains household non-performing loans?', Rinaldi and Sanchis-Arellano (2006) claim that the unbalanced panel data give the benefit of having more observations at a time and that the outcomes are less dependent on a particular time. Also the unbalanced panel takes away survivor bias, in that it allows firms (banks) to enter and leave the industry during the study period; thus, data are not truncated. In the words of Brooks (2008), panel data in general have the dimensions

of both time series and cross-sections and offer a number of advantages. First, they address a broader range of issues and allow for the tackling of more complex problems. Second, they provide the user the opportunity to examine long-term changes in variables and their relationships (this is not impossible to do using pure time-series data but it is much easier with panel data). Finally, with panel data, a proper structuring of the specified model can eliminate the influence of certain omitted variable biases in regression results. Overall, with the unbalanced panel, the absence of data for some of the variables at certain times will not affect the results of this study.

The study generates summary statistics of variables used in the model to help the researcher examine the data for potential outliers. The statistics include the maximum and minimum points as well as standard deviations and means of both the effect and causal variables adopted in the research. A correlation matrix, specifically Pairwise correlation, is also employed in this research to evaluate the association that might exist among the regressors. The relationship between a pair of regressors or explanatory variables may vary from high correlation to no correlation. Thus, the focus here is on highly correlated pair of regressors. Highly correlated pair of regressors is said to have multicollinearity. The implication of multicollinearity is that the effect of one independent variable can easily be predicted linearly from the other with a high degree of accuracy which may affect the reliability of the model. In case of multicollinearity, one regressor has to be dropped as both predict the same thing and serve the same purpose. The yardstick for dropping one of the variables that have multicollinearity is the value of the correlation coefficient. If the correlation coefficient is above 0.5, then one of the variables must be dropped. However, Hair, Black, Babin, and Anderson (2010) place the figure at 0.90 and above.

4.5 Liquidity Creation / Transformation Measures

To meet the first objective of the study, two of the liquidity creation measures developed by Berger and Bouwman (2009) are employed to estimate the amount of liquidity the banks transformed during the study period. In line with Berger and Bouwman (2009), this study groups banks' activities into liquid, semi-liquid and illiquid and assigns weights of 0.5 to illiquid assets and liquid liabilities, 0 to semi liquid assets and liabilities and -0.5 to liquid assets and illiquid liabilities and sums them to construct the four measures indicated in chapter three. The study however, applies only the 'cat fat' and 'cat nonfat' measures to estimate liquidity transformed by the observed banks with and without off balance sheet items respectively. This is because, what is important in liquidity transformation as far as assets are concerned is the cost, ease, and time banks require to obtain liquid funds from their assets (e.g. loans), Berger and Bouwman (2009). According to them, banks' ability to securitize loans is closer to liquidity transformation than time. For instance, it may be relatively easier to securitize a 20-year residential mortgage though it is a long-term loan. Using the two measures, total liquidity transformed or created by the banks is estimated as:

Liquidity created (GH¢) = Σ [0.5*(Illiquid assets + Liquid liabilities) + 0*(Semi liquid assets + Semi liquid liabilities) – 0.5*(Liquid assets + Illiquid liabilities)] ... ... (1)

Classification of Bank Activities into Liquid, Semi liquid and Illiquid

On the bases of cost, ease, and the time it takes customers to retrieve their funds from banks, Berger and Bouwman (2009) grouped liabilities of banks into illiquid, semi liquid and liquid. In the same vein they categorized bank assets into illiquid, semi liquid and liquid based on the cost, ease, and time it takes banks to secure funds to honour the demands of customers.

Classification of Bank Liabilities

Berger and Bouwman (2009) categorized funds such as current and savings account balances as liquid liabilities since bank customers do not have to incur any cost in having quick access to them. Also, time deposit account balances and similar funds which customers have to undergo minor difficulties or incur minor costs to obtain were classified by Berger and Bouwman as semi liquid liabilities. They further classified long duration liabilities including subordinated term debt (one of the components of tier 2 capital) which are difficult to access easily as illiquid. Bank equity is also counted among the illiquid liabilities, though in the capital markets it is considered liquid because it can be traded with ease. Bank liquidity is what is considered here not capital market liquidity.

Classification of Bank Assets

As regards bank assets, Berger and Bouwman (2009) considered bank marketable securities, cash, and similar assets which can be used to solve liquidity problems devoid of major costs, as liquid. Assets that are relatively easier to sell or securitize and self-liquidating items such as short-term loans maturing within a year are considered semi liquid. Long term loans are illiquid. Also considered illiquid assets are commercial loans, banks' investments in unconsolidated subsidiaries, and similar assets since they cannot be easily converted into cash without attracting losses. Table 4.1 presents the various classes of bank assets and liabilities.

Table 4.1 Classification of Bank Assets and Liabilities based on Liquidity

Illiquid Assets	Liquid Liabilities	Semi liquid Assets	Semi liquid Liabilities	Liquid Assets	Illiquid liabilities
-Commercial real estate loans -Fixed assets -Agric loans -Investment in property -Intangible assets -Other assets -Commercial and industrial loans	-Short term borrowing -Repurchase agreements -Trading liabilities -Reserves for loan impairment -Savings deposits -Current deposits	-Loans and advances to banks -Loans to the state -Residential loans -Other earning assets	-Other borrowed funds -Deposits from other financial institutions -Time deposits	-Government securities -Cash and cash equivalent from other banks -Other securities -Statutory reserves	-Other liabilities -Subordinated debt -Long term funding -Senior debt maturing after year -Deferred tax liabilities -Equity

Source: *Author's classification based on Berger and Bouwman (2009) and Deep and Schaefer (2004)*

To meet the second objective, the study uses a modified form of the Deep and Schaefer (2004) liquidity transformation (LT) gap as a proxy for liquidity transformation in the specified econometric models to ascertain whether liquidity transformation influences bank solvency. The modified Deep and Schaefer (2004) LTG is the ratio of liquidity gap (liquid liabilities-liquid assets) to illiquid assets. This is quite explicable as it relates net liquid liabilities or the liquidity gap (as it is known in Deep and Schaefer) directly with the illiquid assets the liabilities finance thereby meeting the generic definition of liquidity transformation. Liquidity is said to be transformed when liquid liabilities are used to finance illiquid assets. With the modified LTG it can be easily determined how much of the banks' liquid liabilities are used to finance a unit of illiquid assets. For instance, an LTG value of 0.3 would mean for every cedi (GH₵1) of illiquid

assets such as long term loans and investments, the bank spends Thirty Pesewas (GH¢0.30) of liquid liabilities such as customer deposits and short term borrowed funds. Based on this, the bank can easily tell the magnitude of its liquidity risks since higher values of LTG imply higher liquidity risk. That is the more liquidity banks transform, the higher the liquidity risk they are exposed to. The original LTG relates the liquidity gap to total assets which comprise liquid and illiquid assets after providing for liquid assets earlier. This ratio seems to contradict the generic definition of liquidity transformation. Also, it excludes off-balance items because of their contingent nature. The problem here is that there are times banks undertake more off-balance sheet liquidity activities than on-balance sheet. This study therefore includes off-balance sheet items in the computation of liquidity transformed by the sampled banks.

4.6 Specification of Model

The study specifies and estimates two (2) dynamic panel regression models. Model 1 contains the modified liquidity transformation gap (LTG1) where off balance sheet activities are omitted from the computation of liquidity transformation. Model 2 looks at the effect of liquidity transformation (LTG2) on capital adequacy where off balance sheet activities are factored into the bank liquidity transformation process. Model 2 is similar to model 1; the only difference being the addition of the off-balance sheet items. Some of the determinants of bank solvency are incorporated in the models as control variables. They include return on average assets (ROAA), return on average equity (ROAE), bank size (SIZE), and credit risk (CRSK) as bank level variables. To control for bank external environmental influences, Gross Domestic Product (GDP) and Inflation (INFL) are also included in the models. The variables were sourced from the data of the various institutions stated earlier. Since an in-country study is undertaken, the specified models are such that the bank level regressors vary with time and among individual banks while

the macroeconomic indicators – GDP and INFL – only vary with time since they generally affect all the banks in the country in the same way.

To ascertain the long-term impact of the explanatory variable of interest (Liquidity Transformation) on Capital Adequacy, the author specifies the first order lag; AR (1) for the proxy of liquidity transformation (LTG) and runs the autoregressive model for each bank, *i*. A reasonable number of lags are necessary to determine how fast banks' actions payoff (Fiordelisi & Molyneux, 2010). In line with Horvath, Seidler and Weill (2012), Novokmet and Marinovic (2016), Athanasoglou, Brissimis and Delis (2008) and Fiordelisi and Molyneux (2010), the study specifies and estimates the following autoregressive models specifying first order lag:

$$CAR_{it} = \delta CAR_{i,t-1} + \pi LTG1_{i,t-1} + \beta_1 ROAA_{it} + \beta_2 ROAE_{it} + \beta_3 SIZE_{it} + \beta_4 CRSK_{it} + \beta_5 GDPg_t + \beta_6 INFL_t + \mu_{it} \quad \ldots\ldots (2)$$

$$CAR_{it} = \delta CAR_{i,t-1} + \pi LTG2_{i,t-1} + \beta_1 ROAA_{it} + \beta_2 ROAE_{it} + \beta_3 SIZE_{it} + \beta_4 CRSK_{it} + \beta_5 GDPg_t + \beta_6 INFL_t + \mu_{it} \quad \ldots\ldots (3)$$

$$i = 1,\ldots\ldots,20 \quad t = 1,\ldots\ldots,10$$

Where μ_{it} is the error term that includes unobserved bank specific effects (λ_i), time specific effects (v_t) and idiosyncratic error (ε_{it})

$$=> \qquad \mu_{it} = \lambda_i + v_t + \varepsilon_{it}$$

μ_{it} captures all bank-specific and time-specific variables which were omitted from the model or could not be observed or computed because of unavailability of data.

4.6.1. Definition of variables

CAR = (Tier 1 capital +Tier 2 capital) to total Risk Weighted Assets Ratio

LTG1 = (Liquid Liabilities-Liquid Asset) to Illiquid Assets Ratio

LTG2 = [(Liquid Liabilities-Liquid Asset) to Illiquid Assets Ratio] and OBS Items

ROAA = Net Profit after tax to Average Assets Ratio

ROAE = Net Profit after Tax to Average Equity Ratio

SIZE = log of Total Assets

CRSK = Loan Loss Provision to Gross Loans Ratio

GDPg = Annual rate of growth of Gross Domestic Product

INFL = Annual Inflation rate

4.6.2 Justification of Variables

Capital Adequacy Ratio (CAR)

The explained variable, CAR, measures bank solvency. Banks are more likely to fail if they have lower capital adequacy, and a reduction in capital in relation to assets signals an impending financial distress (Mayes & Stremmel, 2012). Higher CAR means the bank is more solvent, stable and sound. The ratio indicates that the bank can lose up to a specified percentage of its assets without becoming bankrupt. There is always a threshold for bank capital adequacy. Below this threshold, the bank is said to be under-capitalised and susceptible to insolvency. Minimum capital adequacy ratio promotes efficiency and stability of the financial system by reducing the probability of bank insolvency (Bateni, Vakilifard & Asghari, 2014). The threshold varies across nations. In Ghana, it is 10% and it is strictly enforced by the Central Bank of Ghana under S.23

(1&2) of the Banking Act 2004 (Act 673). The 10% is a common requirement for bank regulators who conform to the Basel Accord. Basel Committee on Banking Supervision (BCBS) measures bank capital adequacy as a ratio of eligible capital to total risk-weighted assets of the bank. The eligible capital comprises tier 1 capital and tier 2 capital (BCBS 2006). This study adopts the Basel III proposed measure of capital adequacy. However, the sampled banks have already computed the capital adequacy ratios based on the Basel II and III accords and the ratios are therefore adopted from their annual reports and incorporated into the models for estimation. The choice of the above measure is informed by the fact that it was enhanced to absorb more shocks when the BCBS, in the aftermath of the 2007/2008 global financial crises, found the previous measure of capital adequacy in the Basel II not to be resilient to crises. The BCBS attributed the global financial crisis to deficiencies in the Basel II. The Basel II seemed not to have contained specific rules on the debt banks could hold. It also ignored systemic risk and concentrated on bank level risks. In other words, this chosen measure (the Basel III proposed measure of capital adequacy) adjusts for systemic risk.

Independent Variables

Liquidity Transformation Gap (LTG)

A negative LTG implies that the bank's liquid assets exceed its liquid liabilities. This makes the bank more of a liquidity consumer than provider (Deep & Schaefer, 2004) and it is said to have de-created liquidity (Choi et al. 2016). By Deep and Schaefer's assertion, banks only create or transform liquidity when their liquid liabilities exceed their liquid assets. From the literature, the relationship between the liquidity transformation gap and CAR is expected to be either positive or negative. Horváth, Seidler and Weill (2012) found that increased liquidity transformation results in lower levels of capital. This is because since liquidity is transformed mainly out of

deposits, an increased liquidity transformation implies that customer deposits have increased and thus banks do not make efforts to seek more capital externally. In this situation capital dwindles overtime. This indicates a negative relationship between liquidity transformation and bank capital. Theoretically, the financial fragility crowding out hypothesis supports this negative relationship. Tran, Lin and Nguyen (2016), on the other hand, found that liquidity creation/transformation is positively related to bank capital. This finding, they claim, is consistent with the risk absorption hypothesis which assumes that bank capital absorbs risks and has to be increased proportionately if liquidity transformation increases because liquidity transformation increases banks' liquidity risk. Until tested and found, the relationship is hypothesized to be either positive or negative.

Control Variables

Other variables are included in the model to control for profitability, loan losses, size and the influences of the macro-economy, specifically, economic growth and price instability on bank solvency.

Return on Average Assets (ROAA)

The ROAA and ROAE as proxies for profitability are included in the model because a substantial part of banks' revenue is generated through financial intermediation of which the liquidity transformation process is part. The ROAA measures the bank's profitability in terms of earning capability of its assets. It is the ratio of net income (net profit after tax) to average assets. Average assets are the sum of assets at the beginning and at the end of a financial year divided by two. ROAA shows the ability of the management of a bank to make profits with the assets of the bank and indicates how effectively those assets have been managed in generating revenue for

the bank. Since the assets are used to make the bank's profit, it is imperative that the bank measures, on average, how much of the net profit after tax is earned by each asset. If it is positive, it means the bank is in good standing in terms of profitability and that its assets are efficient. Banks' current profits could have a positive influence on their capital if they choose to boost capital through retained earnings rather than issuing new equity. In the presence of information asymmetry, the issuing of new equity may signal a declining bank value (Rime, 2001). On the contrary, Mili, Sahut, and Trimeche (2014) found return on assets to have no effect on the CAR of foreign banks' subsidiaries in developing and developed countries.

Abusharba, Triyuwono, Ismail and Rahman (2013) also found that return on assets has a significant relationship with CAR. They explain that as earned profits increase, Islamic banks may have higher incentive to protect their owners' capital since they can increase their reserves through retained earnings. The positive relationship is in line with the pecking order theory of capital structure which indicates that firms prefer internal to external finance and depend more on retained earnings to fund their upcoming projects. This positive relationship was also found in Shaddady and Moore (2015), Ayanda, Christopher, and Mudashiru (2013), Noman, Chowdhury, Jahan, Kabir, and Pervin (2015), Goddard, Molyneux and Wilson (2004), and Gropp and Heider (2010). Based on these findings, ROAA is expected to have a positive relationship with CAR.

Return on Average Equity (ROAE)

ROAE is another proxy for bank profitability. It is the ratio of net income (net profit after tax) to average equity. Average equity is the sum of shareholders' funds at the beginning and at the end of a financial year divided by two. ROAE shows how much of the net profit after tax is made by the investment of ordinary shareholders of the bank. To the equity holders, it is the true measure

of bank profitability. If it is positive, it implies that the bank is actually making good use of its equity and creating value for shareholders. Dietrich and Wanzenried (2010) have indicated that banks with lower leverage and higher equity normally report higher ROAA but lower ROAE implying an inverse relationship between ROAE and CAR. In line with this, Bokhari, Ali, and Sultan (2013) found a significant and negative relationship between return on equity (ROE) and capital adequacy ratio while in Mili et al. (2014), ROE was found to have no effect on the CAR of foreign banks' subsidiaries in developing and developed countries. On the contrary,

Bateni,Vakilifard and Asghari (2014) found that ROE has a positive influence on bank capital adequacy. The signaling theory of firms' capital structure underscores the positive relationship between ROAE and bank capital. Increasing ROAE could send a positive signal to investors about the earning capability of the bank and hence attract more investments from external investors. This would improve the bank's capital and enhance its stability. Going by this deduction, ROAE is expected to have a positive relationship with CAR.

Bank Size (SIZE)

Bank size is measured using the number of employees, the natural log of total assets (e.g. Rime, 2001; Chiaramonte & Casu, 2016; Nachane, Narain, Ghosh & Sahoo 2000), or the log of total sales (Margaritis & Psillaki, 2010). The log of total assets is employed in this study because assets seem to be relatively broad and stable over time compared to the other resources of banks. The total assets of banks, for financial accounting purposes, are stated in currency denomination. However, ratios are used in ascertaining the relationship between the regressors and the regressand; therefore, it would be difficult to include a currency denominated variable in the model. Taking the log of the currency denominated total assets is also necessary in minimizing outliers. Size is important in determining bank solvency because of the 'too-big-to-fail' axiom in

banking. The 'too-big-to-fail hypothesis' indicates that large banks are more sound and safer in terms of risk absorption than small banks. For this reason, large banks do not face pressure to raise capital as it is in the case of small banks (Ariff, Ahmad & Skully, 2009; Akhter & Daly, 2009). Thus, large banks keep lower capital ratios than small banks. This implies an inverse relationship between the size of a bank and its capital base. Masood and Ansari (2016), on the other hand, found bank size to have no significant effect on the bank capital base. This, according to them, is because all banks had to maintain the minimum capital requirements regardless of their sizes. However, according to the franchise value theory, higher earnings lead to greater diversification and more investment opportunities which lower the cost of capital thereby incentivizing large banks to raise more equity capital to avoid taking extraordinary risks such as increasing their debt levels. In line with this, studies such as Mekonnen (2015) and Polat and Al-khalaf (2014) found a positive relationship between capital adequacy and bank size. In this study, size is expected to have a positive relationship with capital adequacy because, generally, large banks have the capability to withstand shocks on their capital and absorb losses from their operations. Thus, the bigger the bank is, the better its solvency and survival are.

Credit Risk (CRSK)

It is the ratio of loan loss provision to Gross Loans. Credit risk is included in the model to control for default on the part of borrowers. Dahl and Shrieves (1990), as in Barrios and Blanco (2003), have indicated that the higher the credit risk attributable to bank advances, the greater the bank capital ratio, if the bank is to avoid bankruptcy. The bankruptcy theory asserts that banks hold large equity capital relative to debt in situations where the costs of financial distress or bankruptcy and the processing cost of acquiring new capital from the public are huge (Berger, 1995). According to Barrios and Blanco (2003) credit risk and the probability of bankruptcy are

positively correlated. They found a significant positive link between credit risk and bank capital. This implies that since banks, like other businesses, rationally avoid bankruptcy and its associated costs, they would normally adjust their capital base in direct response to changes in credit risk. It is along these lines that in this study, a positive effect of credit risk on capital adequacy is expected.

Gross Domestic Product (GDPg)

Gross Domestic Product growth rate (GDPg) is a measure of economic growth. GDPg is the annual rate of change in the total output of all economic activities of a country. This variable is included in the model to control for the effect of economic growth on bank capital adequacy. That is the influence of economic booms and depressions that may call for adjustments of bank solvency levels. Economic growth is not necessarily a good omen because banks may be inundated with demands from customers for loans without a corresponding increase in deposits. Such situations propel the banks from being liquidity providers to being liquidity consumers (Deep and Schaefer, 2004). This widens the bank liquidity mismatch and increases liquidity risk. Bokhari, Ali and Sultan (2013), Aktas, Acikalin, Bakin, and Celik (2015) have noted that in periods of high economic growth, the perceived risk level is low. Thus, banks maintain low capital adequacy ratios so as to invest more in other financial sectors. This implies a negative relationship between economic growth and capital adequacy. Other studies such as Schaeck and Čihák (2007) and Mili et al. (2014) have found GDP growth to have a positive relationship with capital adequacy ratios of banks. On the basis of the above findings, GDP is expected to have either a positive or negative sign.

Inflation (INFL)

Inflation (INFL) is added to the model to show how bank stability is threatened or strengthened by an increase in money supply without a corresponding increase in output. Inflationary periods are characterized by limited supply of products and availability of funds coupled with an increase in the credit creation function of banks with a resultant increase in bank capitalization. In support of this, Ogere et al. (2013) and Schaeck and Čihák (2007) found a positive association between inflation and bank capital.

Studies which support the positive relationship between inflation and capital adequacy argue that the value of bank capital declines during inflationary periods. Thus, to remain stable, banks have to consistently upgrade their capital base. This means higher inflation calls for a higher capital base. However, Williams (2011) has argued that inflation is negatively related to capital adequacy since capital gets eroded during inflationary periods. Ochei (2013) and Aktas, Acikalin, Bakin, and Celik (2015) have both shown that inflation and bank capital are negatively correlated. The negative relationship between inflation and bank capital reflects in how inflation inhibits maturity transformation role by increasing risks associated with this function of banks (Demirgüç-Kunt, & Detragiache, 1998). With the maturity transformation, the bank borrows short and lends long. In this study, inflation is expected to have a negative sign. This is because inflation is exogenous to the operations of all banks in the country and this takes away their control of it. Therefore, the banks will adjust capital for inflation in order to remain stable. But this comes at a cost – the cost of raising new equity or accessing and servicing a debt or even the cost of boosting performance in order to persuade existing shareholders to increase their investment in the bank. These costs subtract from the benefit of upgrading the capital base and will invariably reflect negatively in the banks' capital base.

Table 4.2 Expected Impact of Explanatory Variables on Capital Adequacy

VARIABLE	MEASURE	EXPECTED SIGN
CAR	(Tier1 Capital +Tier 2 Capital) to total Risk Weighted Assets	
LTG1	Ratio of liquidity gap to Illiquid Assets	+/-
LTG2	Ratio of liquidity gap to Illiquid Assets and Off-Balance Sheet Items	+/-
GDPGR_LTG	Product of GDPGR and LTG (interaction term)	+/-
ROAA	Ratio of net profit after tax to Average Assets	+
ROAE	Ratio of net profit after tax to Average Shareholder Fund	+
SIZE	Log of total assets	+
CRSK	Loan Loss Provision to Gross Loans ratio	-
GDPg	Annual rate of growth of Gross Domestic Product	+/-
INFL	Annual inflation rate	-

4.7 Model Estimation Technique

System generalized method of moments (GMM) is employed to estimate the models. The system GMM estimator is a modified version of the traditional or consistent GMM developed by Arellano and Bond (1991). Generally, the GMM estimators are preferred for many reasons. For instance, they naturally provide for constructing tests which account for sampling and estimation errors. In addition, the dynamic panel GMM automatically corrects for heteroskedasticity, serial correlation, and endogeneity issues associated with panel data (Blundell & Bond, 1998).

When estimating linear dynamic panel-data models such as models 1 and 2 above, the inclusion of the lagged dependent variable results in a correlation between the said variables and the error term; the reason being that lagged dependant variables have unobserved panel-level effects – random or fixed – which are similar or the same as those in the original static panel models. This makes the standard estimators unreliable and inconsistent when used to estimate such models. Again, in Arellano and Honoré (2001) it is demonstrated that panel data estimators such as least squares dummy variables (LSDV) and the traditional model estimators including instrumental variable estimators and ordinary least squares (OLS), might insufficiently handle inconsistent estimates.

Thus, the conventional estimators become biased. Arellano and Bond (1991) developed the traditional GMM estimator which seemed to be more consistent in this case. With the traditional GMM estimator, Arellano and Bond (1991) employed the lagged values of all endogenous as well as dependent variables as instrumental variables. One limitation of the Arellano and Bond GMM is that it becomes weak where the autoregressive parameters are too large. Again, contrary to the Arellano and Bond's (1991) use of the lagged values of endogenous and dependent variables as instruments, Arellano and Bover (1995) explain that the GMM estimator becomes

ineffective where short-time period panels are considered and instruments employed are not strong enough to predict changes in the endogenous variables.

Advancing on the work of Arellano and Bover (1995), Blundell and Bond (1998) criticized the use of lagged values of the dependent variable as instruments and as a result came (GDP)up with the system GMM that utilizes additional moment conditions. It uses the levels equation (example equations (1) and (2) above) to obtain a system of two equations: one differenced (the transformed equation), the other in levels (the original equation). By adding the differenced equation, more instruments can be obtained. Therefore, the variables in levels in the second equation are instrumented with their own first differences. This can dramatically improve efficiency (Roodman, 2006). The system GMM requires that panel-level effects be uncorrelated with the first difference of the first observation of the dependent variable. The estimator is designed to handle datasets that have few time periods and many panels. One of the assumptions of the system GMM is that there is no autocorrelation among the error terms. This is in line with the assumption that disturbance terms in Classical Linear Regression Models should be linearly independent of one another i.e. cov (u_i, u_j) = 0 (Brooks, 2008). One advantage the system GMM estimator has over the difference GMM estimator is that it caters for instances where the autoregressive parameter is large and the number of time series is less than the number of observations.

The reasons for the adoption of system GMM as a model evaluation technique in place of OLS, fixed Effects, and Random Effects models for this study stems from the fact that the System GMM has a property that takes care of autocorrelation by using the past levels of the first differenced lagged dependent variable as instruments. Again, the data have more cross-sectional units (20 banks) than time periods (10 years). With such data, the system GMM is preferred

since it works well with panel data that have more cross-sectional units than time periods. More so, given the nature of the equations, an endogeneity problem may emerge. This is where the causal variables correlate with the error term. Endogeneity also arises where there is simultaneity of causality that is where both the dependent and independent variables cause and are caused by each other concurrently. In such situations the idiosyncratic errors are likely to correlate with the explanatory variable, since such an explanatory variable has the potential of being an explained variable in the same model.

The correlation between the error terms and the dependent variable is normal but the correlation between them and the independent variables signals endogeneity. From the literature, the variable of interest – liquidity transformation – is likely to be endogenous. That is there is the likelihood of reverse causality between LTG and CAR. The system GMM predetermines the endogenous variables thereby making them and the error term uncorrelated. It does this by combining the lagged levels of endogenous causal variables and exogenous variables. This makes it the preferred estimator for the specified models.

To ensure the reliability of the model evaluation technique (the system GMM), three tests were run: the Hansen/Sargan test of overidentifying restrictions, the Arellano-Bond test for zero autocorrelation, and the Wald χ^2 test.

4.8 Conclusion

This chapter has presented the methodology adopted in the study. It is composed of the population, data source, sampling technique, sample size, data collection, data processing, specification of model for data analysis, and model estimation techniques. Panel data on commercial banks from various data sources were used to realize the study objectives of

estimating the amount of liquidity transformed by banks in Ghana and the effect of this on bank solvency.

CHAPTER 5

EMPIRICAL RESULTS AND DISCUSSION

5.1 Introduction

This chapter presents a descriptive statistics on the variables under consideration, a correlation matrix and results of the diagnostic tests conducted. It also presents the regression results with detailed explanation, and the evaluation of the study objectives relative to the findings.

5.2 Descriptive Statistics

The values of the dependent variable, CAR ranged from 8.2% to 280% with an average of 23.94%. In 2008 one of the state banks failed to meet the minimum capital adequacy requirement of 10% and reported only 8.2% which happened to be the lowest in the banking industry for a decade. Similarly, in 2007 a new entrant in the industry, specifically a foreign-owned bank, joined the industry with a huge capital base with limited risk-weighted assets since they did not grant many loans in the first year of operation. That was what accounted for the 280% maximum CAR. However, on average, the sampled banks recorded an impressive capital adequacy ratio of 23.94% as against the policy requirement of 10%, meaning solvency level among the banks was high.

On average, the banks transformed 21.53% liquidity, which means that net liquid liabilities such as customer deposits, accounted for GH₵21.53 of every GH₵100 worth of illiquid assets such as long term loans and investments of the banks.

As regards profitability, the banks did not do much especially when it came to return on average assets as the average bank in the industry reported a loss of 0.6% and a profit of 16.12% for return on average assets and return on average equity respectively. The banks grew well with size, increasing from 5.61 to 12.89. The average bank had 8.67. The implication is that, in terms of assets, banks in Ghana improved significantly over the period. The worry, however, is that the asset portfolio of the banks may be habouring many non-performing or substandard loans looking at the increase in credit risk from 0.3% to 41%, though the average credit risk of 10.7% is not bad.

From Appendix I it can be seen that the output of the economy on average grew by 7.12%. The economy of Ghana underwent serious challenges during the study period. While some were home grown challenges, others were foreign. The challenges ranged from domestic energy crises and depreciation of the Cedi to global financial crisis. Since these challenges did not suppress the growth of the economy, one may describe the economy as being resilient during the study period. The average inflation rate for the period is 13%. By this it can be inferred that relatively, there was a persistent rise in the general price levels of goods and services. This might have induced frequent withdrawals by bank customers and compelled banks to increase their reserves thereby increasing their capital adequacy ratios.

5.3 Correlation Matrix

A correlation matrix testing for multicollinearity among the explanatory variables is shown in Appendix II. As indicated in the previous chapter, multicollinearity may result in unreliable estimates. From Appendix II, it can be seen that with the exception of GDP and INFL, no other pairs of variables are highly correlated. GDP and INFL are slightly highly correlated with a correlation coefficient of -0.57 0 as against the benchmark of 0.5. Hair et al. (2010) indicates

that, generally, when the correlation coefficient of a pair of variables is 0.90 or greater, it is a sign of high collinearity. Going by this, it can be said that there is no multicollinearity among the independent variables used in this study.

Another school of thought has it that the correlation matrix may be deficient where more than two explanatory variables in one model are highly correlated. The absence of high bivariate correlations does not mean lack of collinearity since correlation matrix may not reveal collinear relationships among more than two variables (Mason & Perreault, 1991). A more reliable alternative to the correlation matrix is the variance inflation factor (VIF). A maximum variance inflation factor greater than 10 is thought to signal a harmful multicollinearity (Marquardt 1970) as stated in Mason and Perreault (1991). The mean VIF1, VIF2 and VIF3 results in Appendices III, VI, and V indicate the absence of severity of multicollinearity. The average means recorded for VIF1, VIF2 and VIF3 are 1.78, 1.79, and 3.11 respectively as against the maximum mean VIF of 10. Holistically, it can be concluded that the model estimates are not affected by the presence of the highly correlated variables; GDP and INFL.

5.4 Estimation of Liquidity Transformed by the Observed Banks

In meeting the first objective, the study adopted the Berger and Bouwman (2009) measures of liquidity creation. In all, the banks in ten years received a total of approximately GH¢143.5bn as deposits and granted loans of GH¢99.6bn. They transformed approximately GH¢54.3bn and GH¢67.1bn liquidity without and with off-balance sheet items, respectively (Refer to appendices XIII and XIV). These represented 38% and 45% of deposits, respectively (see appendix XV). This indicates that the sampled banks actually engaged in more liquidity transformation than expected, given the risky nature of liquidity transformation and the fluidity of customer deposits. The banks' financing of illiquid assets such as long-term loans and investments with 38% and 45

% of total deposits might have increased the industry's liquidity risk substantially. Relatively, the banks' liquidity transformation was enhanced when off balance sheet activities were incorporated in this function. However, in Deep and Schaefer (2004), off balance sheet items were ignored because of their contingent nature.

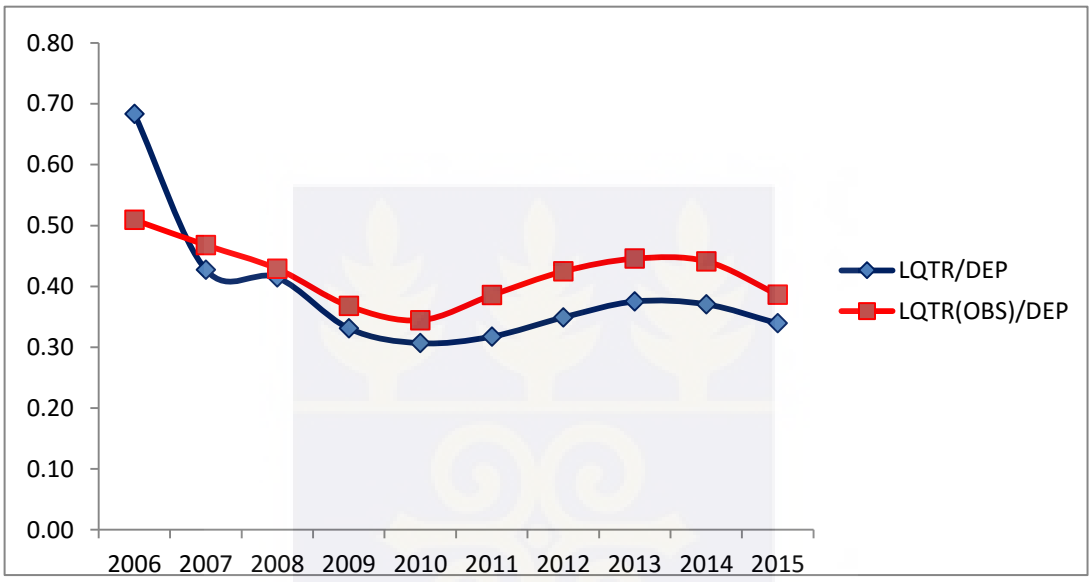

Figure 5.1: Liquidity Transformed with and without Off Balance Sheet Items to Total Deposits ratio

Source: *Author's compilation*

Figure 5.1 presents the ratios of liquidity transformed with and without off balance sheet items to total deposits: LQTR/DEP and LQTR (OBS)/DEP respectively. Deposits constitute a substantial portion of banks' liquid liabilities and usually account for a significant amount of loans granted. From the graph, it can be observed that liquidity transformed with and without off balance sheet items drop continuously, though not at the same pace, from 2006 till 2010 when it began to rise. The growth reached its peak in 2013 and then began to fall again, though marginally. This

probably resulted from the banks' craving to meet the minimum capital requirements of GH¢ 7million, GH¢ 60million, and GH¢ 120million, set by the Regulator during the study period. The banks might have exercised circumspection in their liquidity transformation activities so as to safeguard solvency. The banks might have responded by reducing liquidity transformation in an attempt to reduce liquidity risk that threatens bank solvency. It is a double-edged 'sword'. Banks that wish to increase liquidity transformation activities at such times may find other ways of increasing the capital base in order to absorb liquidity risk. Alternatively, they could reduce liquidity transformation so as to reduce liquidity risk and safeguard solvency.

5.5 The Regression Results and Analysis

The results of the estimated models 1 and 2 are shown in Appendices VI and VII, respectively. The liquidity transformation gap in model 1 excludes off-balance sheet activities of the sampled banks, while the one in model 2 includes them. Such activities include guarantees and loan commitments. The results show the coefficients and standard errors of the variables under consideration. It can be observed that the lagged dependent variable and the variable of interest, together with four control variables (bank size, credit risks, Gross Domestic Product and inflation) in estimation 1, have significant effects on bank solvency.

The lagged value of Capital Adequacy Ratio ($CAR_{i,t-1}$) is positive and statistically significant at 1% in both estimations (models 1 and 2). This implies that there is a certain persistency of solvency among the sampled banks whereby an increase in solvency in one period increases the solvency of the subsequent period. However, the estimated parameter is lower when the off-balance sheet items are included in the banks' liquidity transformation than before. This implies that the speed of adjustment of the banks' solvency profile in the former case is higher than it is

in the latter. The persistency of solvency among the banks could clearly be attributed to their compliance with the minimum capital requirements set for them by the BoG at different times within the study period as indicated earlier. This finding is in line with Novokmet (2015).

In both instances of Liquidity transformation with and without off-balance sheet items, liquidity transformation is found to have a statistically significant and positive relationship with bank solvency. This suggests that liquidity transformation leads to improvements in bank solvency. Banks do upgrade their capital base in response to increasing liquidity transformation in order to enhance their risk absorption and avoid depletion of the capital. This is because banks are exposed to risk through liquidity creation (Allen & Gale, 2004; Allen & Santomero, 1998) and bank capital increases banks' ability to bear risk since capital absorbs risk (Von Thadden, 2004; Repullo, 2004; Coval & Thakor, 2000; Bhattacharya & Thakor, 1993). The finding is in line with the 'risk absorption' hypothesis (discussed earlier). Also, liquidity transformation exposes banks to liquidity risk and they usually counteract this risk by maintaining more reserves to cater for liquidity shortages. Increased reserves strengthen tier 1 capital and improves solvency. This is in conformity with the literature on bank solvency and liquidity (e.g. Al-Khouri 2012; Tran, Lin & Nguyen 2016; Novokmet & Marinovic 2016). It however contradicts the 'financial fragility-crowding out' hypothesis. The risk-reward tradeoff hypothesis also supports the finding. Though financing of long term loans and investments with short term funds is highly risky, it is indisputably one of the most profitable activities of banks. This is as a result of the risk-reward trade off where high risk bank lending compensates banks with higher returns which in turn help the banks strengthen their reserves and remain solvent.

The profitability measures: return on average assets and return on average equity are found to have no significant effect on capital adequacy though a statistically significant and positive relationship was expected. This suggests that profitability does not drive solvency of banks in Ghana. The competitive nature of the banking industry in Ghana makes other sources of capital funding, such as medium-term borrowed funds, more reliable and attractive to banks than retained earnings. This disconnects profitability from solvency as per this finding. The finding is in line with Mili et al. (2014) where ROA and ROE were found to have no effect on the CAR of foreign banks' subsidiaries in developing and developed countries. It is also consistent with the results of Shingjergji and Hyseni (2015) which indicate that ROA and ROE had no effect on the solvency of the banking system of Albania during the period of their study. It, however, contradicts the results of Rime (2001) where a significant and positive effect of profitability on the capital of Swiss banks was found.

As expected, bank size has positive coefficients and is significant at 1% in models 1 and 2. This is consistent with the findings in Mekonnen, (2015) and Polat and Al-khalaf (2014). This suggests that as the observed banks' total assets increase, so their capital adequacy ratios. The reality is that banks, like other business entities, finance assets with capital and other liabilities. Thus, the growth in assets of banks reflects in the solvency level barring the dominance of non-performing loans among the assets. This is in line with the literature (e.g. Chiaramonte and Casu, 2013). The finding is consistent with the franchise value theory which predicts a positive association between a bank's size and its capital. However, it does not support the 'too-big-to-fail' hypothesis which predicts low capital ratios for large banks. It is also inconsistent with the findings in Ariff, Ahmad and Skully (2009), Akhter and Daly (2009), Masood and Ansari (2016).

In both models, credit risk appears to be a positive and statistically significant determinant of capital adequacy as expected. This is consistent with the findings in Barrios and Blanco (2003). The finding is also highlighted by the bankruptcy theory which predicts a direct association between credit risk and bank capital. The implication is that when banks expect an increase in credit risk, they may increase their capital base in order to avoid insolvency resulting from loan default since high credit risk militates against bank stability. Increasing credit risk is a product of increasing non-performing loans relative to gross loans. Increasing non-performing loans increases the asset portfolio of the banks dominated by substandard loans. In such situations, the banks are likely to report low capital adequacy ratios if measures are not taken to increase the eligible capital proportionately. Stressing this, Shrieues and Dahl (1990) indicates that the value of expected bankruptcy costs is an increasing function of the probability of bankruptcy and hence, banks would normally decrease or increase their capital base should their asset portfolio risk decrease or increase. Solvency is proxied by the capital adequacy ratio in this study in line with the BCBS accords.

Economic growth is found to have a statistically significantly negative effect on capital adequacy and it is significant at 5% and 10% in estimations 1 and 2, respectively. The implication is that as an economy is doing well, banks may not worry so much about insolvency since the perceived risk levels are low. They will therefore maintain low capital adequacy ratios and increase their investments in other financial sectors in order to profit from the economic booms and disinvest when the economy slows down. This is in line with Bokhari et al. (2013) and Aktas et al. (2015), where a negative relationship was found between economic growth and bank capital. On the contrary, Schaeck and Čihák (2007) and Mili et al. (2014) found GDP growth to be positively related to bank capital adequacy.

Finally, inflation is also shown to have had a statistically significant adverse effect on bank solvency, suggesting that as inflation soars, so bank capital gets eroded. High inflationary periods are characterized by price instability and declining purchasing power and these reduce the value of bank capital over time. Also, the costs of adjusting capital upwards, including the cost of boosting performance to persuade shareholders to increase their investments in the bank as indicated earlier, deter banks from raising more capital during high inflationary periods. Therefore, the banks are compelled to maintain low capital ratios during high inflationary periods. This is in line with the findings in Shaddady and Moore (2015), Williams (2011), Ochei (2013), Aktas, Acikalin, Bakin, and Celik (2015) and Demirgüç-Kunt, & Detragiache (1998). Contrasting the current finding, Ogere et al. (2013) and Schaeck and Čihák (2007) found a positive association between inflation and bank capital.

5.6 Robustness

Three robustness tests were undertaken to validate the findings. The first test involved estimation of the two models using fixed effects after eliminating outliers from regression (see Appendices VIII and IX). In the second test, the log of bank capital was used as a dependent variable in place of capital adequacy ratio in the two models (see Appendices X and XI). In the final robustness test, the original measure of liquidity transformation pioneered by Deep and Schaefer (2004) was used as a proxy in Model 1 to evaluate the effect of liquidity transformation on bank capital adequacy using the system GMM estimator. In this test, only Model 1 is evaluated because Model 2 contains OBS items which Deep and Schaefer excluded from the liquidity transformation measure, citing their contingent nature as the reason. Model 1 does not contain OBS items. Thus, it is prudent to use it for the test. The results of the second robustness test are shown in Appendix XII. The results of the first robustness test indicate a negative and

statistically significant relationship between liquidity transformation and bank solvency in models 1 and 2. This is similar to the results of the original estimation, though a positive relationship was found in the original results. As regards the profitability measures, ROAA is statistically insignificant in models 1 and 2. ROAE on the other hand, is insignificant in model 1 but significant at 10% in model 2. The rest of the variables are insignificant. Similar to the first robustness test, the results of the second and third robustness tests show that the variable of interest – liquidity transformation gap – has a statistically significant negative relationship with bank solvency. This implies that all the three alternate estimations are robust to the original specification.

The models and the data have to be compatible if consistent and reliable results are to be obtained. If the data and the models are not compatible, the results could be inconsistent, and by logical extension, wrong conclusions and recommendations could be drawn and made out of them. To ascertain the compatibility, three tests were conducted: the Hansen / Sargan test, the Arellano-Bond test, and Wald test (see Appendices VI and VII).

The Hansen / Sargan test of over-identifying restrictions checks if the instruments used in the estimation correlate with the idiosyncratic errors. In estimations 1 and 2, the p-values of the Hansen / Sargan test are 0.938 / 0.999 and 0.964 / 0.605, respectively. All these values are above the 5% threshold. This confirms the validity of the instruments used and that the over-identifying restrictions are valid.

The p-values of the Arellano-Bond test for Zero Autocorrelation in the first and second orders are 0.063 and 0.168 respectively for estimation 1, and 0.070 and 0.716 respectively for

estimation 2. Again, since these values are greater than 5% it can be concluded that there was no serial correlation in the first and second orders in the two estimations.

Further, the probability value of the Wald χ^2 is 0.000 in both estimations implying that at least one of the causal variables in the estimations explains changes in the effect variable (see Appendices VI and VII).

5.7 Conclusion

The chapter has exhibited the empirical results of the study. It looked at the descriptive statistics such as the mean, standard deviation, the minimum, as well as maximum values of the variables under consideration. It also showed the correlation among the variables, the results of the model estimation tests, the regression results and analysis, and the robustness tests to confirmed consistency of the regression results.

CHAPTER 6

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter presents a summary of the findings on the influence of liquidity transformation on bank capital adequacy. The conclusion of the study as well as recommendations made for future research is captured in this chapter. The summary gives a recap of the study, highlighting key issues discussed in the research**.** The conclusion presents inferences drawn from the empirical results. Based on the conclusion, recommendations are made for further studies and for application by the regulator, practitioners and players in the banking fraternity.

6.2 Summary of Findings

The study determined the extent to which banks in Ghana transform liquidity and assessed the influence of liquidity transformation on capital adequacy of 20 commercial banks in Ghana from 2006 to 2015. The variables used include liquidity transformation gap, return on average assets, return on average equity, size, credit risk, gross domestic product, and inflation. The study used dynamic panel models to ascertain whether liquidity transformed with or without off-balance sheet items influences bank solvency. To evaluate the panel models, system Generalised Method of Momements estimator was used as opposed to the ordinary least squares estimator or other traditional model estimation techniques in order to obtain reliable results.

The study revealed that the sampled banks actually engaged in more liquidity transformation than expected, given the risky nature of liquidity transformation and the fluidity of customer deposits. The ratios of liquidity transformed to deposits (see Appendix XV) are indications that

the banks' liquidity transformation rate is high and this makes the banks susceptible to liquidity risk. The study further revealed that liquidity transformation had a statistically significant positive effect on capital adequacy. This suggests that liquidity transformation with or without OBS items is positively associated with improvements in bank solvency. The more liquidity banks transform, the greater their exposure to liquidity risk and the more they should upgrade their capital base to absorb the risk. Consistently upgrading of capital improves banks' solvency.

The previous value of the dependent variable (lagged CAR) is also found to be statistically significantly and positively associated with bank capital adequacy, implying a persistency of solvency among banks in Ghana. However, the speed of adjustment of the bank solvency profile is lower when off-balance sheet items are included in the computation of liquidity transformation than it is when they are excluded from the computation. The finding signifies a 'built-on' effect of capital adequacy since a change in bank capital adequacy in one period induces a similar change in the subsequent period.

With regard to the control variables, the profitability indicators are found to be insignificant, which suggests that they do not drive the solvency of banks in Ghana. Size, credit risk, economic growth and inflation are all significant in explaining the bank solvency.

6.3 Conclusions

Using the Berger and Bouwman (2009) preferred liquidity creation measures, the 'cat fat' and 'cat nonfat' to determine the extent to which banks in Ghana transform liquidity, there is an indication that the banks engage in significant liquidity transformation and this increases their exposure to liquidity risk, given the fluid nature of customer deposits. Also, using the Systems GMM estimator to establish if liquidity transformation has an influence on bank solvency in

Ghana, it is evident that liquidity transformation with or without OBS items drives bank solvency in Ghana. Thus, liquidity transformation actually matters in handling bank capital adequacy issues and it helps in improving bank stability. Again, it has been demonstrated in the study that solvency is persistent and has a 'built-on' effect in the banking industry of Ghana, in that one period's solvency directly influences the solvency of another subsequent to it.

From the study, it is also evident that profitability does not explain bank solvency in Ghana. However, bank size and credit risk do since they appear to have a significant and positive effect on capital adequacy. Further, it has been proven from the study that at any point in time, bank solvency improves when the macroeconomic indicators, GDP and inflation, decline. This implies that they have some explanatory and predictive power on bank solvency.

6.4 Recommendations

The following are recommendations made based on the findings and conclusions of the study.

Since liquidity transformation is positively associated with improvements in bank solvency, it is recommended that banks adjust their capital levels proportionately whenever liquidity transformation rises. This would help them avert liquidity risk and consistently build on their existing capital base, thereby improving solvency levels.

Also, for banks to know the movements of liquidity transformation, that is, to be able to tell whether liquidity transformation has increased or decreased at a particular time (so as to adjust the capital base), bank management should adopt the main measures of liquidity transformation used in this study. These measures – 'cat fat' and 'cat nonfat' – would comprehensively quantify the banks' liquidity transformation activities and aid the banks in capital management. Again, since the banks appear to have transformed significant amounts of liquidity, it is suggested that

the Central Bank of Ghana applies the said measures in addition to its traditional measures of liquidity to determine the levels of liquidity transformation among banks. This will enhance its regulations on liquidity and solvency of the banks.

Further, banks should anticipate working comfortably with low capital ratios in good times of economic growth. Based on this, it is suggested that the banks increase their investments in other sectors, especially on short-term basis during economic booms. This will help strengthen their liquidity positions and cushion them against solvency risk when the economy slows down.

Further studies could consider the influence of liquidity transformation on the solvency and stability of NBFIs such as Savings and Loans companies, microfinance institutions, mortgage companies, and insurance companies. Also this study could be replicated with an extended period beyond ten years. Similarly, a similitude of the current study in an extended environment such as a continent would broaden the horizon of knowledge and understanding of the concepts of liquidity transformation and bank solvency and stability.

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APPENDICES

APPENDIX I

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
CAR	138	0.2394	0.2949	0.0820	2.8010
CAP	168	7.9817	0.5239	6.5464	8.9450
LTG1	168	0.2153	6.8189	-48.3200	71.2500
LTG2	168	0.0404	1.6023	-12.4910	1.2180
LTGds	168	0.1337	0.2194	-0.8872	0.6127
ROAA	175	-0.0060	0.4052	-5.3100	0.2510
ROAE	175	0.1612	0.2716	-2.3200	0.5000
SIZE	176	8.6676	0.9807	5.6100	12.8900
CRSK	136	0.1070	0.0826	0.0030	0.4100
GDPg	10	0.0712	0.0302	0.0390	0.1400
INFL	10	0.1301	0.0352	0.0870	0.1920

Capital Adequacy (CAR) is measured as the ratio of eligible capital to total risk-weighted assets. CAP is the log of bank capital. Liquidity Transformation is proxied by the Liquidity Transformation Gap (LTG). LTGds is measured as the ratio of liquidity gap to total assets. LTG1 is measured as the ratio of liquidity gap to illiquid assets excluding off balance sheet items. LTG2 is measured as LTG1 plus off balance sheet items. ROAA and ROAE are proxies of profitability. They are measured as the ratio of net profit after tax to average assets and average shareholder funds respectively. Bank size is proxied by SIZE measured as the natural log of total assets. Credit risk (CRSK) is measured as the ratio of loan loss provisions to gross loans. Economic growth is proxied by GDPg measured using the annual rate of growth in total output of all economic activities. INFL, proxy for inflation, is measured using the Consumer Price Index.

Source: *Author's Computation*

APPENDIX II

Pairwise Correlation Matrix

	CAR	CAP	LTG1	LTG2	LTGds	ROAA	ROAE	SIZE	CRSK	GDPg	INFL
CAR	1.0										
CAP	-0.270***	1.0									
LTG1	-0.430***	0.079	1.0								
LTG2	-0.601***	0.100	0.346***	1.0							
LTGds	0.008	0.002	0.0001	0.410***	1.0						
ROAA	-0.068	0.018	-0.008	-0.020	0.021	1.0					
ROAE	-0.157*	0.480***	-0.001	0.069	0.012	0.122	1.0				
SIZE	-0.204**	0.247***	0.072	0.170**	0.073	-0.015	0.223***	1.0			
CRSK	0.095	0.331***	0.096	-0.157*	-0.085	-0.081	-0.128	-0.103	1.0		
GDPg	0.063	-0.095	-0.070	-0.113	-0.006	-0.053	-0.017	-0.024	-0.044	1.0	
NFL	-0.117	0.119	0.126	0.119	-0.032	-0.074	-0.001	-0.020	0.010	-0.570***	1.0

Capital Adequacy (CAR) is measured as the ratio of eligible capital to total risk-weighted assets. CAP is the log of bank capital. Liquidity Transformation is proxied by the Liquidity Transformation Gap (LTG). LTGds is measured as the ratio of liquidity gap to total assets. LTG1 is measured as the ratio of liquidity gap to illiquid assets excluding off balance sheet items. LTG2 is measured as LTG1 plus off balance sheet items. ROAA and ROAE are proxies of profitability. They are measured as the ratio of net profit after tax to average assets and average shareholder funds respectively. Bank size is proxied by SIZE measured as the natural log of total assets. Credit risk (CRSK) is measured as the ratio of loan loss provisions to gross loans. Economic growth is proxied by GDPg measured using the annual rate of growth in total output of all economic activities. INFL, proxy for inflation, is measured using the Consumer Price Index. The symbols *, **, *** represent significance level of 10%, 5%, and 1% respectively.

Source: *Author's computation*

APPENDIX II I

Variable	VIF	1/VIF
ROAE	2.48	0.403673
ROAA	2.29	0.436043
GDPg	2.22	0.450234
INFL	2.21	0.451963
SIZE	1.15	0.866710
CRSK	1.06	0.945294
LTG1	1.03	0.971132
Mean VIF	1.78	

APPENDIX IV

Variable	VIF	1/VIF
ROAE	2.50	0.399952
ROAA	2.30	0.434226
GDPg	2.24	0.445790
INFL	2.21	0.453187
SIZE	1.16	0.865333
CRSK	1.07	0.936395
LTG2	1.06	0.943020
Mean VIF	1.79	

APPENDIX V

Variable	VIF	1/VIF
ROAE	6.88	0.145322
ROAA	6.84	0.146130
GDPg	2.37	0.422609
INFL	2.33	0.429643
SIZE	1.18	0.846922
CRSK	1.13	0.885758
LTGds	1.06	0.942847
Mean VIF	3.11	

APPENDIX V I

Table 5.3: The Effect of Liquidity Transformation (without OBS Items) on Bank Capital Adequacy

MODEL 1				
VARIABLES	**Coef.**	**Std. Err.**	**z**	**p-value**
CAR_{t-1}	0.8276***	0.0659	12.57	0.000
$LTG1_{t-1}$	0.0330***	0.0055	5.97	0.000
ROAA	-0.2687	0.4372	-0.61	0.539
ROAE	-0.1029	0.1010	-1.02	0.308
SIZE	0.0159***	0.0054	2.91	0.004
CRSK	0.3337***	0.0821	4.06	0.000
GDPg	-0.3726**	0.1811	-2.06	0.040
INFL	-0.6865***	0.1935	-3.55	0.000

Test	**p-value**		
AB Test AR (1)	0.063	Number of observations:	103
AB Test AR (2)	0.168	Number of instruments:	29
Sargan Test	0.999		
Hansen Test	0.938		
Wald χ^2	0.000		

The dependent variable, Capital Adequacy (CAR) is measured as the ratio of eligible capital to total risk-weighted assets. CAR_{t-1} is the first lag of the dependent variable. Liquidity Transformation is proxied by the Liquidity Transformation Gap (LTG). $LTG1_{t-1}$ is the first lag of LTG measured as the ratio of liquidity gap to illiquid assets excluding off balance sheet items. ROAA and ROAE are proxies of profitability. They are measured as the ratio of net profit after tax to average assets and average shareholder funds respectively. Bank size is proxied by SIZE measured as the natural log of total assets. Credit risk (CRSK) is measured as the ratio of loan loss provisions to non-performing loans. Economic growth is proxied by GDgP measured using the annual rate of growth in total output of all economic activities. INFL, proxy for inflation is measured using the Consumer Price Index. The symbols *, **, *** represent significance level of 10%, 5%, and 1% respectively.

Source: *Author's computation*

APPENDIX VI I

Table 5.4: The Effect of Liquidity Transformation (with OBS Items) on Bank Capital Adequacy

MODEL 2				
VARIABLES	**Coef.**	**Std. Err.**	**z**	**p-values**
CAR_{t-1}	0.3357***	0.0296	11.35	0.000
$LTG2_{t-1}$	0.0336***	0.0081	4.13	0.000
ROAA	-0.2083	0.1882	-1.11	0.268
ROAE	0.0796	0.0608	1.31	0.190
SIZE	0.0166***	0.0035	4.70	0.000
CRSK	0.1150*	0.1013	1.14	0.056
GDPg	-0.1960*	0.1183	-1.66	0.098
INFL	-0.3864***	0.1472	-2.63	0.009

Test	**p-value**		
AB Test AR (1):	0.070	Number of observations:	103
AB Test AR (2)	0.716	Number of instruments:	29
Sargan Test	0.605		
Hansen Test	0.964		
Wald χ^2	0.000		

The dependent variable, Capital Adequacy (CAR) is measured as the ratio of eligible capital to total risk-weighted assets. CAR_{t-1} is the first lag of the dependent variable. Liquidity Transformation is proxied by the Liquidity Transformation Gap (LTG). $LTG2_{t-1}$ is the first lag of LTG measured as the ratio of liquidity gap to illiquid assets including off balance sheet items. ROAA and ROAE are proxies of profitability. They are measured as the ratio of net profit after tax to average assets and average shareholder funds respectively. Bank size is proxied by SIZE measured as the natural log of total assets. Credit risk (CRSK) is measured as the ratio of loan loss provisions to non-performing loans. Economic growth is proxied by GDPg measured using the annual rate of growth in total output of all economic activities. INFL, proxy for inflation is measured using the Consumer Price Index. The symbols *, **, *** represent significance at 10%, 5%, and 1% respectively.

Source: *Author's computation*

Robustness Tests

APPENDIX VIII

The Effect of Liquidity Transformation (without OBS Items) on Bank Capital Adequacy- Fixed Effect Model

MODEL 1

VARIABLES

CAR	Coef.	Std. Err.	t	p-value
LTG1	-0.0505**	0.0206	-2.46	0.016
ROAA	0.9288	0.6360	1.46	0.147
ROAE	-0.1511	0.0965	-1.57	0.121
SIZE	0.0065	0.0191	0.34	0.732
CRSK	-0.1287	0.1300	-0.99	0.325
GDPg	-0.1775	0.3856	-0.46	0.646
INFL	-0.4194	0.2661	-1.58	0.118
Constant	0.2249	0.1740	1.29	0.199
Observations	121		Wald chai2 (7)	28.30
R-squared	0.1284		chai2 (p-value)	0.000

Liquidity Transformation is proxied by the Liquidity Transformation Gap (LTG1) and measured as the ratio of liquidity gap to illiquid assets excluding off balance sheet items. ROAA and ROAE are proxies of profitability. They are measured as the ratio of net profit after tax to average assets and average shareholder funds respectively. Bank size is proxied by SIZE measured as the natural log of total assets. Credit risk (CRSK) is measured as the ratio of loan loss provisions to non-performing loans. Economic growth is proxied by GDPg measured using the annual rate of growth in total output of all economic activities. INFL, proxy for inflation is measured using the Consumer Price Index. The symbols *, **, *** represent significance level of 10%, 5%, and 1% respectively.

Source: *Author's computation*

APPENDIX IX

The Effect of Liquidity Transformation (with OBS Items) on Bank Capital Adequacy- Fixed Effects Model

MODEL 2

VARIABLES

CAR	Coef.	Std. Err.	t	p-values
LTG2	-0.0702**	0.0308	-2.28	0.025
ROAA	1.0199	0.6390	1.60	0.114
ROAE	-0.1735*	0.0976	-1.78	0.079
SIZE	0.0037	0.0189	0.20	0.846
CRSK	-0.0795	0.1278	-0.62	0.535
GDPg	-0.1271	0.3894	-0.33	0.745
INFL	-0.4350	0.2670	-1.63	0.107
Constant	0.2485	0.1733	1.43	0.155
Observations	121	Wald chai2 (7)	27.91	
R-squared	0.1210	chai2 (p-value)	0.000	

Liquidity Transformation is proxied by the Liquidity Transformation Gap (LTG2) and measured as the ratio of liquidity gap to illiquid assets including off balance sheet items. ROAA and ROAE are proxies of profitability. They are measured as the ratio of net profit after tax to average assets and average shareholder funds respectively. Bank size is proxied by SIZE measured as the natural log of total assets. Credit risk (CRSK) is measured as the ratio of loan loss provisions to non-performing loans. Economic growth is proxied by GDPg measured using the annual rate of growth in total output of all economic activities. INFL, proxy for inflation is measured using the Consumer Price Index. The symbols *, **, *** represent significance at 10%, 5%, and 1% respectively.

Source: *Author's computation*

APPENDIX X

The Effect of Liquidity Transformation (without OBS Items) on Bank Capital Adequacy (Using the log of Bank Capital as a dependent variable)

MODEL 1

VARIABLES	Coef.	Std. Err.	z	p-values
CAP_{t-1}	0.9251***	0.0656	14.11	0.000
$LTG1_{t-1}$	-0.0157*	0.0093	-1.69	0.091
ROAA	-0.7628***	0.2788	-2.74	0.006
ROAE	0.2121***	0.0583	3.64	0.000
SIZE	0.1027*	0.0594	1.73	0.084
CRSK	-0.5478***	0.1068	-5.13	0.000
GDPg	-0.4221	0.2906	-1.45	0.146
INFL	-0.5747**	0.2417	-2.38	0.017

Test	p-value		
AB Test AR (1)	0.003	Number of observations	124
AB Test AR (2)	0.415	Number of instruments	30
Sargan Test	0.996		
Hansen Test	1.000		
Wald χ^2	0.000		

The dependent variable, Bank Capital (CAP) is measured as the log of banks' total equity. CAP_{t-1} is the first lag of the dependent variable. Liquidity Transformation is proxied by the Liquidity Transformation Gap (LTG). $LTG1_{t-1}$ is the first lag of LTG measured as the ratio of liquidity gap to illiquid assets excluding off balance sheet items. ROAA and ROAE are proxies of profitability. They are measured as the ratio of net profit after tax to average assets and average shareholder funds respectively. Bank size is proxied by SIZE measured as the natural log of total assets. Credit risk (CRSK) is measured as the ratio of loan loss provisions to non-performing loans. Economic growth is proxied by GDPg measured using the annual rate of growth in total output of all economic activities. INFL, proxy for inflation, is measured using the Consumer Price Index. The symbols *, **, *** represent significance at 10%, 5%, and 1% respectively.

Source: *Author's computation*

APPENDIX XI

The Effect of Liquidity Transformation (with OBS items) on Bank Capital Adequacy (Using the log of Bank Capital as a dependent variable)

MODEL 2

VARIABLES	Coef.	Std. Err.	z	p-value
CAP_{t-1}	0.9392***	0.0881	10.66	0.000
$LTG2_{t-1}$	-0.0574***	0.0191	-3.00	0.003
ROAA	-0.2459	0.6035	-0.41	0.684
ROAE	0.1828**	0.0879	2.08	0.038
SIZE	0.0951	0.0799	1.19	0.234
CRSK	-0.5072**	0.2114	-2.40	0.016
GDPg	-0.7052*	0.4115	-1.71	0.087
INFL	-0.7519**	0.3243	-2.32	0.020

Test	p-value		
AB Test AR (1)	0.001	Number of observations:	124
AB Test AR (2)	0.523	Number of instruments:	30
Sargan Test	0.417		
Hansen Test	0.994		
Wald χ^2	0.000		

The dependent variable, Bank Capital (CAP) is measured as the log of banks' total equity. CAP_{t-1} is the first lag of the dependent variable. Liquidity Transformation is proxied by the Liquidity Transformation Gap (LTG). $LTG2_{t-1}$ is the first lag of LTG measured as the ratio of liquidity gap to illiquid assets and off balance sheet items. ROAA and ROAE are proxies of profitability. They are measured as the ratio of net profit after tax to average assets and average shareholder funds respectively. Bank size is proxied by SIZE measured as the natural log of total assets. Credit risk (CRSK) is measured as the ratio of loan loss provisions to non-performing loans. Economic growth is proxied by GDPg measured using the annual rate of growth in total output of all economic activities. INFL, proxy for inflation, is measured using the Consumer Price Index. The symbols *, **, *** represent significance at 10%, 5%, and 1% respectively.

Source*: Author's computation*

APPENDIX XII

The Effect of Liquidity Transformation (without OBS Items) on Bank Capital Adequacy using the *Deep and Schaefer LTG*

MODEL 1

VARIABLES	Coef.	Std. Err.	z	p-value
CAR_{t-1}	0.4260***	0.0548	7.78	0.000
$LTGds_{t-1}$	0.1672**	0.0729	2.29	0.022
ROAA	0.7837***	0.2177	3.60	0.000
ROAE	0.0404	0.0656	0.62	0.538
SIZE	0.0107*	0.0064	1.66	0.096
CRSK	0.2054***	0.0728	2.82	0.005
GDPg	0.0930	0.1001	0.93	0.353
INFL	-0.5444**	0.2374	-2.29	0.022

Test	p-value		
AB Test AR (1)	0.158	Number of observations:	88
AB Test AR (2)	0.416	Number of instruments:	31
Sargan Test	0.416		
Hansen Test	0.996		
Wald χ^2	0.000		

The dependent variable, Capital Adequacy (CAR) is measured as the ratio of eligible capital to total risk-weighted assets. CAR_{t-1} is the first lag of the dependent variable. Liquidity Transformation is proxied by the Liquidity Transformation Gap (LTGds). $LTGds_{t-1}$ is the first lag of LTGds measured as the ratio of liquidity gap to total assets excluding off balance sheet items. ROAA and ROAE are proxies of profitability. They are measured as the ratio of net profit after tax to average assets and average shareholder funds respectively. Bank size is proxied by SIZE measured as the natural log of total assets. Credit risk (CRSK) is measured as the ratio of loan loss provisions to non-performing loans. Economic growth is proxied by GDPg measured using the annual rate of growth in total output of all economic activities. INFL, proxy for inflation, is measured using the Consumer Price Index. The symbols *, **, *** represent significance at 10%, 5%, and 1% respectively.

Source: *Author's computation*

APPENDIX XIII

YEAR	LOANS AND ADVANCES (GH¢)	DEPOSITS (GH¢)
2006	3,061,289,814.00	2,709,251,186.00
2007	3,110,528,475.00	4,157,787,010.00
2008	4,512,662,225.00	5,489,530,919.00
2009	4,891,186,463.00	7,347,728,721.00
2010	4,990,457,449.00	9,549,062,042.00
2011	7,407,790,996.00	13,317,060,372.00
2012	11,031,910,450.00	16,895,230,808.00
2013	14,968,439,357.00	20,954,570,096.00
2014	20,947,629,321.00	28,120,637,993.00
2015	24,490,170,654.00	34,971,714,898.00
TOTAL	**97,951,856,604.00**	**143,512,574,045.00**

APPENDIX XIV

YEAR	LIQUIDITY TRANSFORMED (NO OBS) GH¢	LIQUIDITY TRANSFORMED WITH OBS GH¢
2006	1,851,695,822.00	1,379,600,926.00
2007	1,777,112,762.00	1,944,985,829.50
2008	2,275,161,631.50	2,353,798,378.00
2009	2,432,158,637.50	2,701,593,950.50
2010	2,929,061,818.50	3,287,866,909.50
2011	4,228,443,537.00	5,135,194,782.00
2012	5,897,109,549.50	7,173,499,284.00
2013	7,861,752,998.00	9,336,933,804.00
2014	10,419,761,063.00	12,404,617,925.00
2015	11,863,295,662.50	13,515,326,722.00
TOTAL	**54,264,242,016.50**	**65,104,650,860.50**

APPENDIX XV

	LIQUIDITY DEPOSIT	TRANSFORMED TO RATIO	
YEAR	WITHOUT OBS	WITH OBS	LOANS / DEPOSIT RATIO
2006	0.68	0.51	1.13
2007	0.43	0.47	0.75
2008	0.41	0.43	0.82
2009	0.33	0.37	0.67
2010	0.31	0.34	0.52
2011	0.32	0.39	0.56
2012	0.35	0.42	0.65
2013	0.38	0.45	0.71
2014	0.37	0.44	0.74
2015	0.34	0.39	0.70
GRAND RATIO	**0.38**	**0.45**	**0.68**