

**BANK PORTFOLIO ALLOCATION: EVIDENCE FROM
SIERRA LEONE**

BY

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DECLARATION

This is to certify that this thesis is the result of a research undertaken by Baimba Augustine Bockarie towards the award of a Master of Philosophy degree in the Department of Economics, University of Ghana.

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ABSTRACT

Bank portfolio allocation is an important determinant of the efficacy of monetary policy through the bank lending channel of monetary policy transmission mechanism. This study generally investigates the factors that influence banks' portfolio allocation in Sierra Leone. Specifically, the study looks into the effects of risk premium, leverage ratio, and credit risk on banks' earning asset portfolio allocation in Sierra Leone between 2002 and 2011.

Using annual bank level data on an unbalanced panel of thirteen commercial banks for the study period, and employing time and bank specific fixed effects model for estimation, it is confirmed that risk premium, the share of non-performing loans in the banks' loan portfolio, tier 1 capital ratio (leverage ratio), and local currency deposit levels positively and significantly affect the share of loan supply to the private sector in banks' earning assets. On the other hand the loan-deposit ratios (or advance-deposit ratio) and bank size has significant negative effects on the share of loans in banks' earning assets. The study also finds bank type (state, private domestic, and foreign) and the growth rate of real Gross Domestic Product - a control variable for economic activities and hence, loan demand - to be important determinants of the share of loans in banks' earning assets.

Based on these results, the study makes a number of recommendations including the following:

- Action should be taken to increase risk premium to banks, for example, through exercising stronger fiscal discipline so as to bring down the yield on government securities.

- The Central Bank of Sierra Leone should play a parental role in strengthening the depth of the Interbank Market operations as a secondary market. This will have the effect of increasing access of banks to short term liquidity. The availability of more funding sources other than client deposits reduces the risk of adverse deposits shocks.
- Banks should be encouraged to have capital in excess of the minimum paid up capital (Capital buffers) so as have more room to absorb the inherent risk in the business of banking.



DEDICATION

This work is dedicated to my daughters (Ayisha and Anisah Bockarie) and my parents (Mrs Jinnah-Watta Bockarie and Mr Mohamed Bockarie).



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ABBREVIATIONS AND ACRONYMS

ADR	–Advances to Deposits Ratio
BSL	–The Central Bank of Sierra Leone
CAMELS	–Capital Adequacy, Management quality, Earnings, Liquidity and Sensitivity to Market Risk
CAR	– Capital Asset Ratio
ECB	– European Central Bank
GTB	– Guarantee Trust Bank (SL) Ltd.
IDR	– Investments to local currency deposits ratio
LDR	– Loans to local currency deposit ratio. The same meaning as ADR
LM	– Lagrangian Multiplier
Ltd.	– Limited Liability Company
NPL	– Non-performing loans
RCB	– Rokel Commercial Bank (SL) Ltd.
ROE	– Return on Equity
SCB	–Standard Chartered Bank (SL) Ltd.
SL	– Sierra Leone
SLCB	–Sierra Leone Commercial Bank Ltd.
SME	– Small to Medium Scale Enterprises
UBA	– United Bank for Africa (SL) Ltd.
UK	– United Kingdom
USA	– United States of America. Same as U.S.
UTB	– Union Trust Bank (SL) Ltd.
VAR	– Value at Risk

CHAPTER ONE

BACKGROUND OF THE STUDY

1.1 Introduction

The financial sector of any economy plays a critical role in the growth and development of that country, dependent on the quality, quantity and efficiency of the services the financial institutions provide on aggregate. Banks are noted for the mobilisation, allocation and investment of much of a society's savings. Their performance has tremendous implications for capital allocation, firms' growth, industrial expansion and sustainable economic growth. Firms make heavy use of bank borrowings as a form of short-term financing. Therefore, bank credit allocation can have significant practical consequences for the economy, and is a significant determinant of economic growth (Papaioannou, 2007). King and Levine (1993) studied a panel of 77 countries and found that the degrees to which financial intermediaries allocate credit to the private sector as against the government affect growth in those countries. Moreover, determining how the allocation of credit responds to shocks to the banking system may help us to better understand the channels by which the credit view of monetary policy works, and determine the relative impact of such policies across different sectors of the economy.

According to Acosta and Loza (2005), the capital allocation path seems to be closely dependent on a well-developed financial sector, the credit market and on the perspective of fiscal sustainability. Their paper suggests that poor operation of the financial credit system happens to be an integral impediment to economic growth.

In developing countries, the importance of the traditional role of financial institutions in savings mobilization and the supply of credit for productive investment to enhance economic growth cannot be overstated. It is however true that the supply of credit to the private sector continues to be very low in most sub-Saharan African economies (World Bank, 2010). This is further compounded by the stringent credit policies and procedures followed by deposit money banks in their credit allocation processes, especially following the global financial turmoil of 2007. The risks involved in credit allocation (client credit risk, liquidity risk and market risk) are further contributing factors.

Rodriguez (1992) points out that the Central Bank of Argentina had behaved as the “borrower of first resort”, where commercial banks reallocated their investment portfolio from the private sector to government bonds in the periods of high inflation. In times of financial distress, banks are hesitant to investing in risky assets. Sawada (2008) indicates that in Japan, bank managers hesitated to invest in stocks because they were considered to be too risky to invest in. The point is that when banks are faced with liquidity issues, bank treasurers at first try to discern whether the negative deposit shock is temporary or a permanent one. Temporary shocks are usually met by banks borrowing from the interbank market, borrowing from corporations and non-bank financial institutions, through the central bank standing REPO facility or outright rediscounting of the institutions’ government securities - mostly with remaining maturity of less than ninety-one (91) days. A more permanent deposit shock that leads to liquidity problems are normally met by liquidation of the banks’ existing loans and advances¹ or not allowing

¹Loans and advances are taken to mean commercial banks’ claims on the private sector. It excludes interbank and intra group loans and advances and credit allocated to government institutions.

the rollover of maturing commercial and institutional, retail and personal loans. The process of a bank reducing its stock of loans in order to fund negative deposit shocks is the costliest way of acquiring reserves; it has negative impact on client relationship.

Banks are in the business of taking calculated risk to make money. Bank risk management entails some level of portfolio diversification. How diversified the portfolio becomes is dependent on the risk return trade off and the risk appetite of the concerned bank. The proportion of the individual assets in a bank's portfolio measures its level of diversification. In general, given the characteristics of the broad asset market in which commercial banks operate, the two investment opportunities available to them include that of risky assets and risk free investments. It is worth noting that the characteristics of the individual assets in the risky portfolio are diverse. Our concern therefore is the fraction of the investment budget that is allocated to the risky portfolio and that which is allocated to the riskless portfolio.

The base rate of return for any investment portfolio is the riskless rate of return. The risky portfolio is expected to earn a risk premium, given that investors are risk averse, and that they are unwilling to take any risky position without a positive risk premium. Managing an investment portfolio is a strategy that attempts to balance risk versus reward by adjusting the percentage of each asset in an investment portfolio according to the investor's risk tolerance, goals and investment time frame. Portfolio allocation is based on the principle that different assets perform differently in different markets and under different economic conditions. For a better diversified portfolio, the portfolio assets must

necessarily and sufficiently have varying risk characteristics and thus, should not move together.

The influx of banks into the Sierra Leonean economy has been a subject of public discussions. The general concern is that given the relatively small size of the Sierra Leone Financial Market, there are too many banks to contend with. Whilst the Bank of Sierra Leone (2009) reinforces this concern, the IMF (2010) suggests that the low level of intermediation in Sierra Leone may be indicative of limited competition in the banking sector. But from available data, the increased number of banks-mostly of foreign origin and ownership has intensified competition in the system. Market shares are being lost by the three big players², interest margins are becoming thinner and foreign exchange rate spreads are being eroded. However, client deposits continue to increase and the well managed banks continue to be highly profitable. Additionally, despite the expansion in the Sierra Leone banking industry, there is still a dearth of bank credit to the private sector. A strict line could therefore be drawn between bank credit availability and accessibility in this market, as the banks' balance sheets show high liquidity of the banks.

Dehesa et al. (2007) opine that banks are more willing to extend credit to the private sector if: it is easy to obtain collateral; there is timely information on borrowers' economic conditions through some institution; and there is an efficient exchange of information which helps banks in their credit assessment decisions. Thus, the availability

²They include Standard Chartered Bank (SL) Ltd, Rokel Commercial Bank (SL) Ltd. and Sierra Leone Commercial Bank Ltd.

of information and the ability to return the credit during periods of distress are crucial aspects that affect banks' credit allocation between the private and public sectors.

Competition in the financial sector matters for a number of reasons. As in other industries, the degree of competition in the financial sector can matter for the efficiency of the production of financial services, the quality of financial products, and the degree of innovation in the sector, including the introduction of value added products in the market. Specific to the financial sector is the link between competition and stability, long recognized in theoretical and empirical research and, most importantly, in the actual conduct of prudential policy toward banks (Vives, 2001). It has also been shown, theoretically as well as empirically, that the degree of competition in the financial sector can matter for the access of firms and households to financial services and external financing, in turn affecting overall economic growth, although not all relationships are clear. However, excessive competition can create instability in the banking sector and have a negative impact on some customers, especially those at risk of being financially excluded. Limited competition on the other hand, leads to inefficiency and the exercise of market power.

To date, thirteen banking institutions exist in the country, being licensed by the Central Bank of Sierra Leone to carry out the business of commercial banking. The financial market in Sierra Leone is highly dominated by the banking sector, controlling seventy-five per cent (75%) of the total financial sector assets (Bank of Sierra Leone, 2009). The market is however very shallow, with not much active interbank market. Greuning and

Bratanovic (2009) clearly put it that in an underdeveloped financial market where liquidity of financial instruments depends exclusively on their maturities rather than on the ability to sell them, banks tend to hold a relatively high volume of liquid assets.

The average total assets of the Sierra Leone banking system is thirty-eight million United States Dollars (USD38M), while the three largest players account for about half of the market share. This proportion had witnessed a persistent drop from the level of ninety per cent (90%) in 1999 to eighty-eight per cent (88%) in 2004 and eighty-six per cent (86%) recorded in 2005, owing to the influx of foreign banks (Bank of Sierra Leone, 2009). The system happens to be sound with average capital in excess of average total assets by seventeen per cent (17%). However, the issue of non-performing loans continues to be problematic – sixteen per cent (16%) of total loans (Bank of Sierra Leone, 2010). According to Bathalomew (2005), the present day Sierra Leone Commercial (SL) Ltd. came into being in 1973 as a result of the problem of huge non-performing loans on the books of Intra-Bank (SL) Ltd., with only three years of operation in the market. The market is also characterised by the absence of any credit information agency and no client or bank is noted to be internationally rated. Banks in the industry only rely on their individual internal credit risk assessments in their process of loan allocation. The banks accept deposits in both local currency and three foreign currencies³. They are however forbidden by the Central Bank regulations to extend credit denominated in foreign currencies in the domestic market (Banking Act of 2000). The implication is that a whole of the banks' lending portfolio is in a single currency, except for offshore placements which form a minute fraction of the total interest earning assets.

³The Great British Pound – GBP, the United States Dollars – USD and the Euro – EUR.

According to the World Bank (2010), the risk premium in the Sierra Leone financial market averaged 4.59% between 2000 and 2008. Average market bank lending rate to the private sector for the same period was 23.65%, average Ninety-one (91) day Treasury Bills interest rate was 17.84% whilst average deposit rate was 9.44% for the same period.

1.2 Statement of the Research Problem

Sierra Leone continues to be characterised by an underdeveloped financial market which constrains financial resource allocation in an efficient manner and hence, holding economic growth backward (World Bank, 2010). Understandably, given the difficult conditions in the Sierra Leonean financial market, the banking sector has fallen short of its traditional role of credit allocation to private sector in order to boost growth and development. Thus the banking system's support to the private sector through credit allocation remains weak. From 1984 to 1987 for example, the Domestic Money Banks' claims on the private sector as a percentage of their claims on government were only 63.78%, 32.81%, 66.58% and 74.62% respectively (IMF, 2009). Between 2001 and 2009, the same figure averaged at 56%, with 2007, 2008 and 2009 individually recording 61%, 66% and 86% respectively. Between 2000 and 2007, the banks' non-performing loans as a percentage of gross loans averaged 22.11% (World Bank, 2010).

The lack of interest by commercial banks in providing loans and advances in the country is not due to liquidity considerations as this sector is seemingly liquid based on the fact that their total deposits nearly double their loan portfolio (Bank of Sierra Leone, 2010). Rather than lending to the perceived risky sector (the private sector), they prefer to invest

in government securities such as treasury bills and treasury bearer bonds which earn varying returns and which are also riskless. The banks' holdings of riskless assets (government securities) form a huge proportion of their total financial assets (47.5%) (Bank of Sierra Leone, 2010). Access to finance outside the capital city - Freetown, by small and medium scale enterprises and the agricultural sector continues to be grossly inadequate.

The unwillingness of banks to lend to the private sector can be caused by several reasons, among which are the increased capital adequacy requirements imposed by banking regulators; impaired debt-servicing capacity by clients, especially small-to-medium enterprises (SMEs), and risks of a further decline in collateral value. These make the interest rate on loans not to serve as the main determinant of bank credit approval. Non-performing loans (NPLs) have been viewed to constitute one of the most important factors causing reluctance for banks to provide credit to the private sector. In a high NPL condition, banks increasingly tend to carry out internal consolidation to improve the asset quality rather than allotting credit. Unavailability of credit to finance firms' working capitals and investments might trigger the second round business failure which in turn exacerbates the quality of bank loans, resulting in an endless vicious cycle of credit crunch. Krueger and Tornell (1999) attribute the credit crunch in Mexico after the 1995 crisis partially to the bad loans. They point out that banks were burdened with credits of negative real value, thereby reducing the capacity of the banks in providing fresh fund for new projects.

One of the preconditions for achieving the strategic priorities of the Second Poverty Reduction Strategy Paper (PRSP II) is growing the private sector through increased access to investible funds. This cannot be accomplished with the banks' failure to adequately direct the much needed credit to the private sector. This study therefore constitutes an attempt to further the theoretical understanding of, and empirically investigate the behaviour of commercial banks in Sierra Leone with respect to their earning asset portfolio allocation, focusing on the supply side of the story relating to the inherent risks.

1.3 Research Objectives

The main objective of this study is to investigate the factors that influence bank portfolio allocation, vis-à-vis the share of loans in banks' interest earning assets.

The specific objectives include:

1. Investigation of the effect of risk premium on the share of loans in banks' interest earning asset.
2. Examination of the effect of a bank's leverage ratio on its earning asset portfolio allocation
3. Examination of the effect of credit risk on banks' earning asset portfolio allocation.

1.4 Research Hypotheses

The main null hypothesis that is tested is that the level of risk premium influences the banks' share of loans in their total interest earning assets. The following specific hypotheses are also tested:

1. That a bank's leverage ratio affects its asset portfolio composition
2. That the level of a bank's credit risk affects its asset portfolio composition

1.5 Significance of the Study

This study investigates the determining factors of commercial banks' portfolio allocation of financial assets. Commercial banks' portfolio behaviour is an important determining factor for the size and direction of the aggregate economic quantities of bank credit and the monetary stock. Findings of the study will not only add to the body of existing knowledge on the subject matter by investigating the case for Sierra Leone, but will also be very useful to policy makers in their effort to stimulate banks' allocation of their assets to the private sector to enhance private sector growth and development.

The current state of banking supervision in Sierra Leone is rudimentary. One certainly does not see any attempt to explicitly organise the approach to assessing the soundness and management of a financial firm in light of risks and risk management (Johnson, 2011). Accordingly, findings from this study will help the monetary authorities to improve the efficacy of monetary policy and banking supervision. From a micro perspective, the results of this study will disclose the behaviour of banks in the credit market over the periods considered.

Additionally, Sierra Leone's banking sector presents a unique opportunity to study bank loan supply in relation to bank specific features in the context of post war financial reconstruction. This is because conflict exacerbates many of the informational limitations of a country's banking system that can act as impediments to bank risk taking activities. Post war structural modifications such as rapid foreign bank entry provide an added incentive to explore the subject matter of bank portfolio allocation. Furthermore, instead of using aggregated data, the study uses bank level data from individual banks' balance sheets and income statements. Also, instead of studying individual banks in isolation, the behaviour of the banks is studied in a panel.

A couple of works have been done on the financial sector in Sierra Leone: - Bathalomew (2005; 2009); Kargbo and Adamu (2009); and Kargbo (2010) among others. Almost all the existing literature on finance to the private sector had focused on the demand side. No empirical work has been sighted on the subject matter of Bank Portfolio Allocation in Sierra Leone – a supply side analysis. This provides an explanation for carrying out such a work. The work would look into the risk factors that determine a bank's loan supply.

1.6 Organisation of the Study

The rest of the work is organised as follows:

Chapter Two focuses on a review of theoretical and empirical literature in the area of Bank Portfolio Allocation. Sections in this chapter are devoted to some selected banking risk measurements and analyses. Chapter Three is committed to a review of the Sierra Leone commercial banking system, focusing on past and present structural and functional

scenarios; evolution of the system and market shares. Chapter Four considers the methodology of the study, which encompasses data type and sources, econometric model specification, diagnostic tests and estimation techniques. Chapter Five of the work presents an analysis of the empirical results. Chapter Six contains the conclusion of the work, policy recommendations, limitations of the study and areas for further research.

CHAPTER TWO

OVERVIEW OF THE COMMERCIAL BANKING SYSTEM

2.1 Introduction

The Sierra Leone commercial banking industry has undergone a number of transformations including mergers and acquisitions. This chapter illuminates the evolution of commercial banking activities in Sierra Leone. Presentations are also made of the banks' assets and liabilities structure, analysis of the industry balance sheet, market shares of the banks in terms of local currency deposits, loans and advances, investments and profitability as measured by the banks' return on equity. Analyses of the banks' non-performing loans as a percentage of gross loans and advances as well as their equity capital-asset ratios (Leverage ratios) are also presented here.

2.2 Evolution of the Commercial Banks in Sierra Leone

Commercial banking in Sierra Leone started as branch banking by large United Kingdom (UK) commercial banks, well integrated within the framework of the UK financial system through interlocking directorship and the use of both the UK money and capital markets. Only two commercial banks had existed in Sierra Leone at independence; the British Bank of West Africa (1894) which later became Standard Chartered Bank (SL) Ltd. in 1971, and Barclays Bank (DCO) (1916). Three years post-independence, Intra Bank (SL) Ltd., a Lebanese owned entity, commenced the business of banking in the country, although its operation was halted in 1970, following financial difficulties (huge non-performing loans) of its parent company. The bank was acquired by the Government

of Sierra Leone and renamed as Sierra Leone Commercial Bank Ltd. in 1973 with a 100% government stake. In the late 1970s and early 1980s, three other banks emerged to cater for the financial needs of the banking population. Bank of Credit and Commerce International (BCCI) Overseas (1979), International Bank for Trade and Industry (IBTI) (1982), and Meridian BIAO (1990) were on the list.

Economic difficulties especially in the second half of the 1980s significantly hampered productivity which culminated into an unhealthy business environment. Additionally, business failure had devastating consequences on commercial banks' loan portfolios. The quality of banking services became watered down with portfolio contamination becoming very conspicuous. A good number of the existing banks were concealing their losses. The practice of using "good money" (new loans) to finance "bad money" (doubtful loans or contaminated portfolio) to avoid providing for bad and doubtful debts had become a common thing. This practice is otherwise known as *ever-greening*. The resultant effect was a gradual disintermediation and severe liquidity problems in the early 1990s when the market witnessed the exit of IBTI and BCCI. The closure of BCCI in 1991 was however highly connected with problems of the parent company which affected their local assets holdings. In 1995, Meridian BIAO was taken over by Union Trust Bank (SL) Ltd., owing to associated management problems and issues to deal with its parent entity. In 1998, First International Bank (SL) Ltd., an affiliate of FIB Group with headquarters in The Gambia, was incorporated in Sierra Leone but started business only in 2002. In 1999, Barclays Bank (SL) Ltd. sold a majority of its shares to the Government of Sierra Leone because of security concerns at the height of the rebel war. The bank was renamed

as Rokel Commercial Bank (SL) Ltd. In 2002, through the acquisition of 90% of shareholdings, Guaranty Trust Bank (SL) Ltd. (GTB) took over First Merchant of Sierra Leone (established in 1999), after the bank had faced massive liquidity problems. GTB was incorporated in Sierra Leone in 2001. The other players in the market opened to business as follows: International Commercial Bank (SL) Ltd. (2004), Ecobank (SL) Ltd. (2006), Access Bank (SL) Ltd. and Procredit⁴ Bank (SL) Ltd. (2007), United Bank For Africa (SL) Ltd. (2008), Skye Bank (SL) Ltd. (2008), Zenith Bank (SL) Ltd. (2008) and Bank PHB (SL) Ltd. (2009).

2.3 Branch Networks

Extensive branching can be perceived as a sign of increased competition, and can be used as a unique selling point in marketing campaigns. In 2005, there were only seven commercial banks operating in the market (three local and four foreign banks) with a branch network of 31. Out of the 31 branches, the three local banks accounted for 68%. By 2010, the number of commercial banks had increased to thirteen (13) (three local and ten foreign), with a branch network of 80 (local banks accounting for 39% of it). As at December 2011, additional six branches were opened, making a total of 86 branches (local banks accounting for 40% of it). Out of the 86 branches country wide, First International Bank maintains 16, followed by Sierra Leone Commercial Bank (13 branches) and then Rokel Commercial Bank (12 branches). Table 2.1 illustrates the banks' ownership structure and branch network from 2008 to 2011.

⁴Procredit Bank was acquired by Ecobank (SL) Ltd in 2010.

Table 2.1 Banks' Ownership Structure and Branch Networks.

BANK	Ownership Structure	No. of Branches in 2008	No. of Branches in 2009	No. of Branches in 2010	No. of Branches as at Dec. 2011
Rokel Commercial Bank	51% Govt. of SL, 40% Public & 9% Staff	11	11	11	12
Sierra Leone Commercial Bank	100% Government of Sierra Leone	9	11	12	13
Standard Chartered Bank	81% SCB Holdings, 18% Public & 1% Directors	3	3	3	3
Union Trust Bank	100% Private Individuals	7	7	8	9
Guaranty Trust Bank	100% GTB PLC (Nigeria)	4	7	7	10
First International Bank	87% FIB Group (The Gambia), 12% Individuals and 1% FIBank (The Gambia)	7	14	18	16
International Commercial Bank	100% Malaysian	2	2	2	2
Ecobank	100% Ecobank Transnational	6	7	7	7
Access Bank	85% Access Bank PLC & 15% Senator Polycarp Nwite (Nigeria)	2	3	4	4
United Bank for Africa	100% UBA PLC (Nigeria)	1	3	3	3
Skye Bank	100% Skye PLC (Nigeria)	1	1	1	1
Zenith Bank	100% Zenith Bank PLC (Nigeria)	1	1	3	4
Bank PHB	100% Bank PHB PLC (Nigeria)	-	1	1	2
Grand Total		57	75	80	86

Source: Bank of Sierra Leone.

2.4 Analysis of the Industry Balance Sheets

The industry balance sheet is presented as an aggregate of the individual banks' balance sheets for the periods considered (2002, 2006, 2010 and 2011). The balance sheet is split (by convention) into the assets and liabilities sides. Distinction is made here between on and off balance sheet items⁵. The off balance sheet items are presented under the heading of "contingent liabilities", since there are no derivatives available in the market. On the asset side, the items included are cash, loans to banks and discount houses, investments (Government Securities), loans to customers, fixed assets and other assets. On the liabilities side, the items include deposits from banks and discount houses, deposits from customers, capital and reserves and other liabilities. The net mismatch figure (otherwise known as Swapped Funds) is the amount of foreign currency that is used to fund local currency assets⁶. It is therefore computed as Total Assets less Total Liabilities.

By tradition, all liability items are recorded as debits (negatives). From Table 2.2, all the balance sheet items grew over the periods considered, except deposits from banks and discount houses, which recorded a 76% decrease between 2010 and 2011. The values for loans to banks and discount houses and deposits from banks and discount houses do not cancel out because of the actions of the discount houses and the central bank in the market. They can be net takers or lenders in the market. The positive net mismatch values for all the periods under consideration indicate that the banks extensively utilised their foreign currency books to fund growth in their local currency asset portfolios, since the banks are by regulation not allowed to lend in foreign currency in the domestic market.

⁵ Off balance sheet items generally include derivatives and contingencies.

⁶ This holds when the value is positive. A negative value indicates the amount of local currency liabilities used to fund foreign currency assets.

Table 2.2 Industry Balance Sheet as at 31st. December each year.

	2002	2006	2010	2011
Assets				
Cash	21,696,158	42,183,411	168,846,421	182,399,178
Loans to Financial Institutions	14,126,368	21,387,681	35,944,252	44,493,393
Investments	130,266,205	237,333,433	466,883,912	549,301,193
Loans to Customers	58,644,559	201,275,320	874,704,758	1,072,303,947
Fixed assets	38,755,227	80,845,212	184,477,137	198,724,857
Other assets	26,284,533	41,145,210	91,674,254	95,330,004
Total Assets	289,773,050	624,170,267	1,822,530,734	2,142,552,572
Liabilities				
Deposits From Financial Institutions	0	(3,851,901)	(71,999,702)	(17,486,578)
Deposits From Customers	(174,322,932)	(407,620,203)	(1,089,699,599)	(1,315,870,573)
Capital and reserves	(70,516,954)	(145,378,045)	(394,015,296)	(440,442,571)
Other Liabilities	(38,409,542)	(44,923,955)	(115,213,411)	(222,270,291)
Total Liabilities	(283,249,428)	(601,774,104)	(1,670,928,008)	(1,996,070,013)
Net Mismatch	6,523,622	22,396,163	151,602,726	146,482,559
CONTINGENT LIABS.				
<i>Confirmed Documentary Letters of Credits</i>	(4,772,105)	(23,027,852)	(38,296,967)	(66,448,428)
<i>Acceptances, Endorsement & Guarantees</i>	(43,685,188)	(53,490,154)	(202,161,547)	(180,665,027)
	(48,457,293)	(76,518,006)	(240,458,514)	(247,113,455)

Source: Bank of Sierra Leone

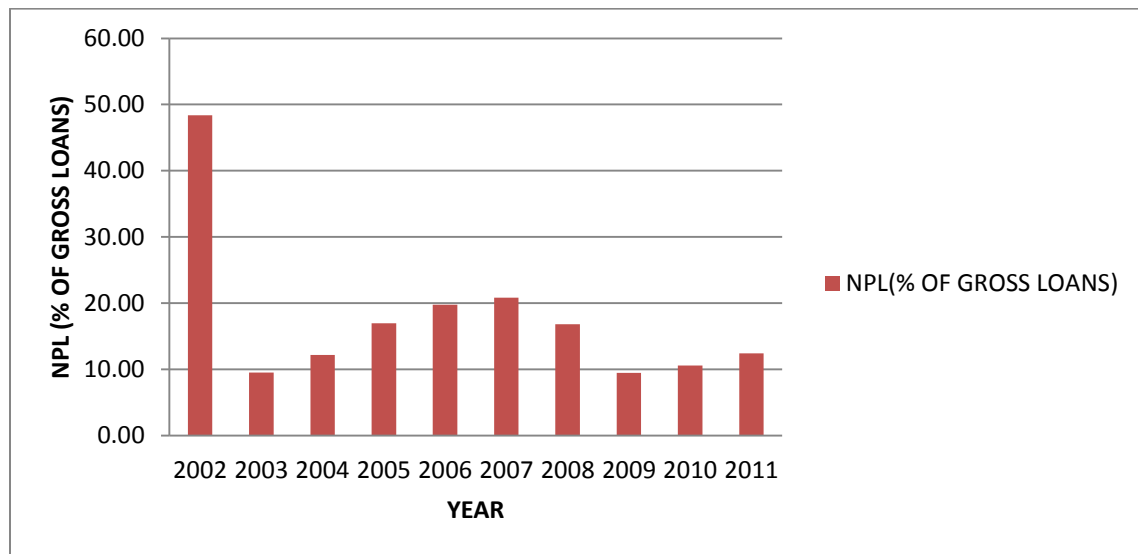
For 2010 and 2011 respectively, 8% and 7% of total local currency assets are seen to have been funded from the foreign currency book. Whilst loans to customers grew at 22.6% from 2010 to 2011, local currency deposits from customers grew at 20.8% for the

same period, indicative of the fact that lending started at a much lower base than local currency deposits mobilisation.

2.4 Market Trend

From the available data for the period 2002 through 2011, it is evident that the issue of non-performing loans was a huge problem in 2002, when it stood at 48% of gross loans and advances. The value drastically fell to a level of 9.5% at the industry level in 2003, but gradually soared to a peak of 21% in 2007. It is again on the increase (12% in 2011) from a level of 9% in 2009 as illustrated in Figure 2.1.

Figure 2.1 Non-Performing Loans (% of Gross Loans and Advances) at the market level.



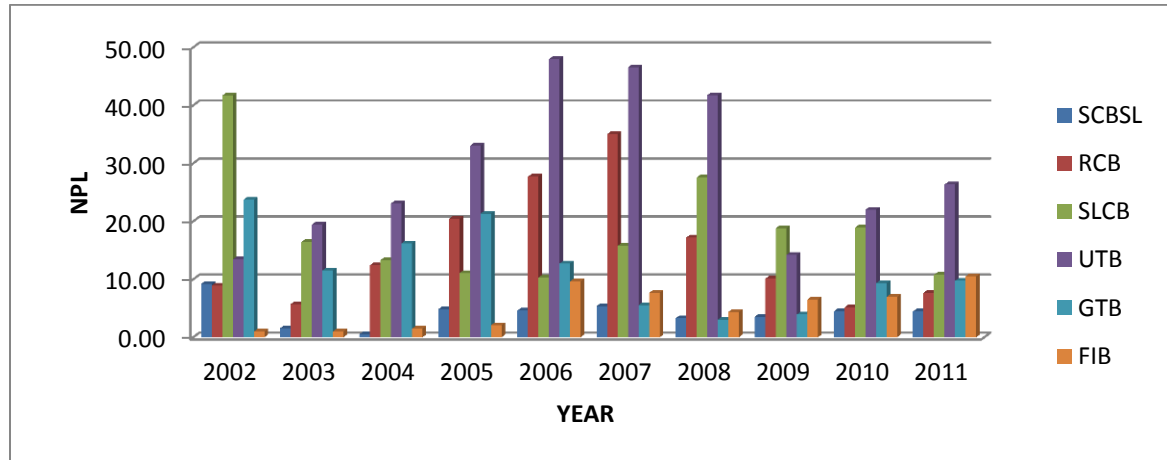
Source: Author's computation using data from BSL.

At the bank level as shown in Figure 2.2, SLCB is seen to have had the worst loan portfolio given the quality of loans (among the six banks analysed⁷) in 2002 with 42% of

⁷ The choice of the banks analysed in this chapter is based on the banks that have been existing since 2002.

its loan portfolio being bad or doubtful. This position was however overtaken by UTB whose worst was recorded in 2004 (48%) and continues to be the bank with the poorest quality of loan portfolio, except for 2009 when it once again gave way to SLCB.

Figure 2.2 Non-Performing Loans (% of Gross Loans and Advances) at Bank Level.

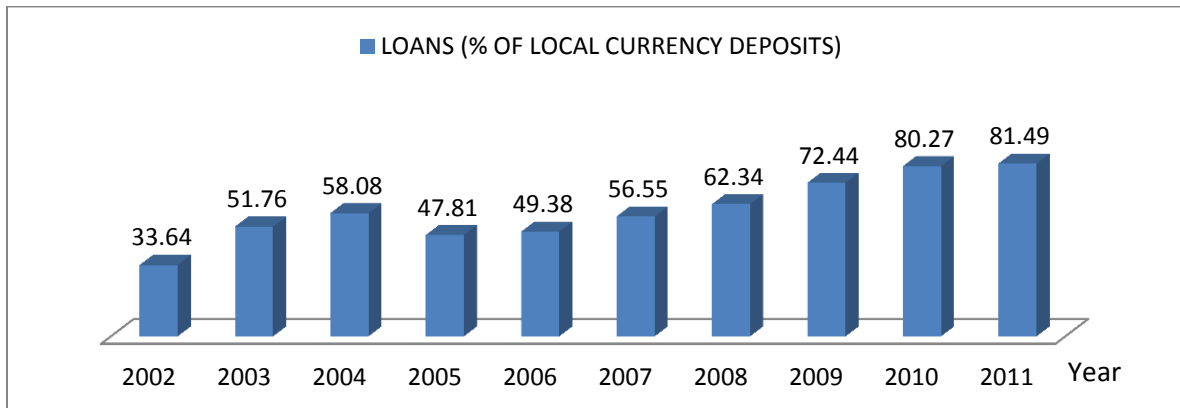


Source: Author's computation using data from BSL.

At the industry level as depicted by Figure 2.3, the ratio of loans to local currency deposits (LDR or ADR⁸) saw a consistent increase after a drop from 58% in 2004 to 48% in 2005. As at 31st.December 2011, the market ADR value was recorded at 81%, the highest ever on records in the market.

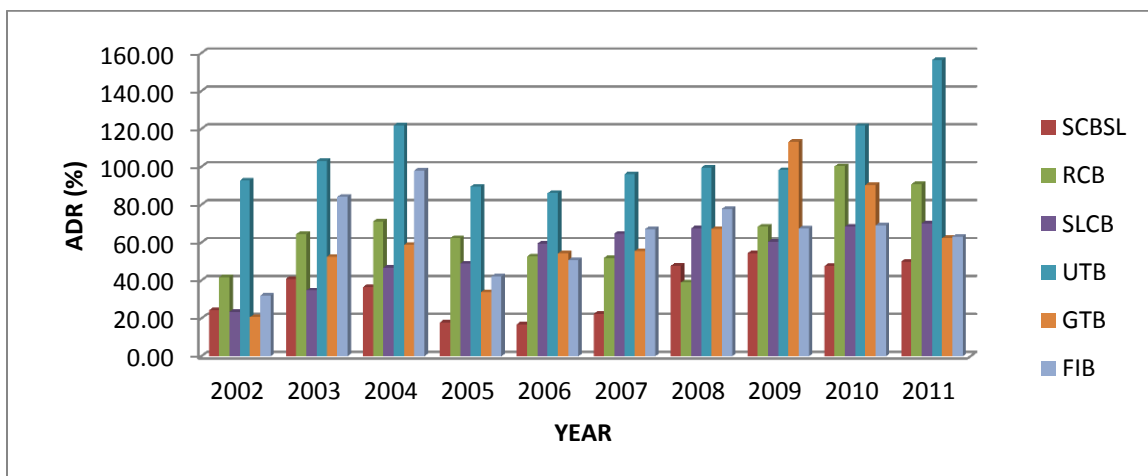
ADR reflects how much of commercial assets are funded by commercial deposits. It is however worthy distinguishing it from the Natural ADR, which measures the capacity of a bank to lend from its core deposit taking business and capital base, after correcting for statutory requirements and fixed assets.

⁸ Advances to Deposits ratio

Figure 2.3 Industry Loans and Advances (% of Local Currency Deposits).

Source: Author's computation using data from BSL.

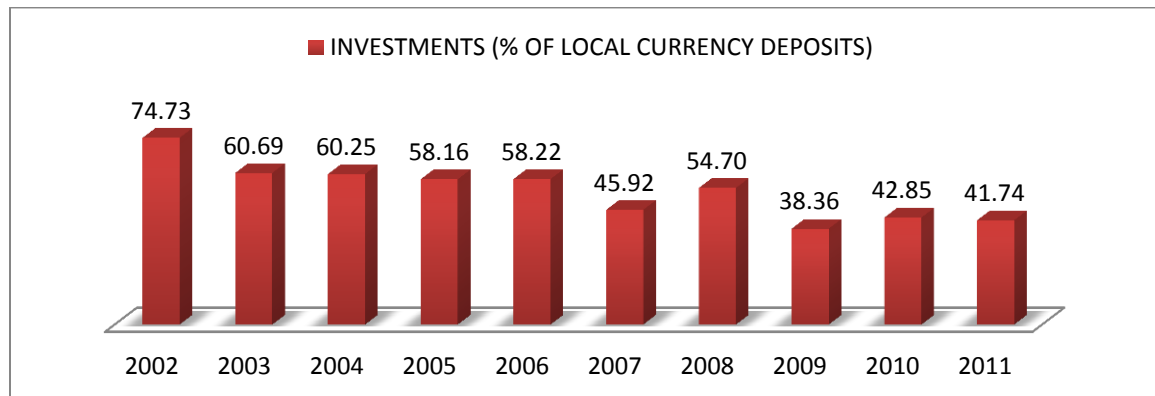
At the individual bank level, Figure 2.4 illustrates that except for 2009 when GTB overtook UTB, UTB recorded the highest ADR value, exceeding 100% in 2003, 2004, 2010 and 2011; no doubt the bank's leading role in NPL. In 2011 for example, the bank's ADR value was 156%. The implication is that the bank (UTB) has been funding its loan portfolio from a union of three sources; the capital base or net worth, foreign currency deposit liabilities and the interbank market.

Figure 2.4 Bank Loans and Advances (% of Local Currency Deposits).

Source: Author's Computation using data from BSL.

On the other hand, investments as a percentage of local currency deposits at the market level fell from a level of 75% in 2002 to 42% in 2011 as Figure 2.5 shows.

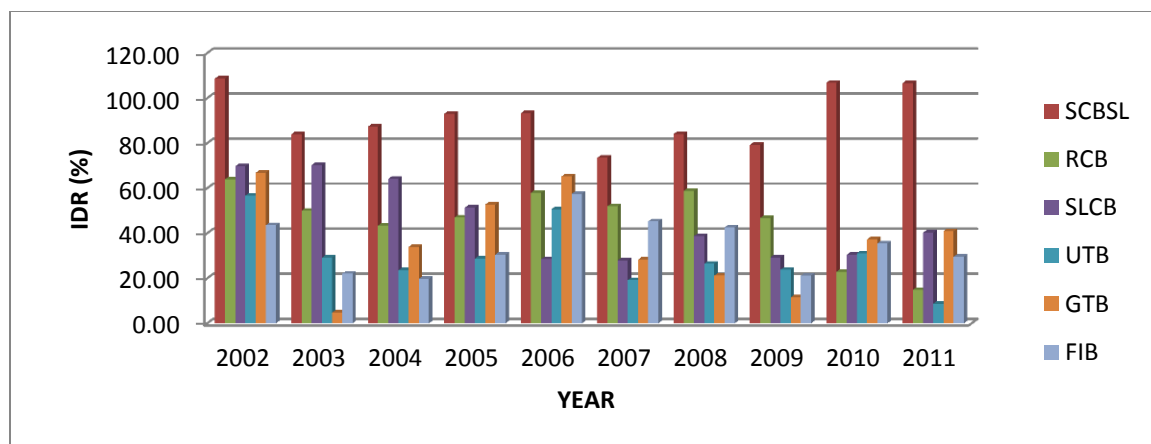
Figure 2.5 Investments (% of Local Currency Deposits) at the Market Level.



Source: Author's computation using data from BSL.

Bank wise, whilst SCBSL recorded the lowest values for ADR, it showed the highest values for IDR for all the years under consideration as shown in Figure 2.6. A possible explanation for this is that loans to customers take up much capital in terms of capital adequacy because of their risk classification, whilst investments in government securities attract zero per cent capital requirement by regulation.

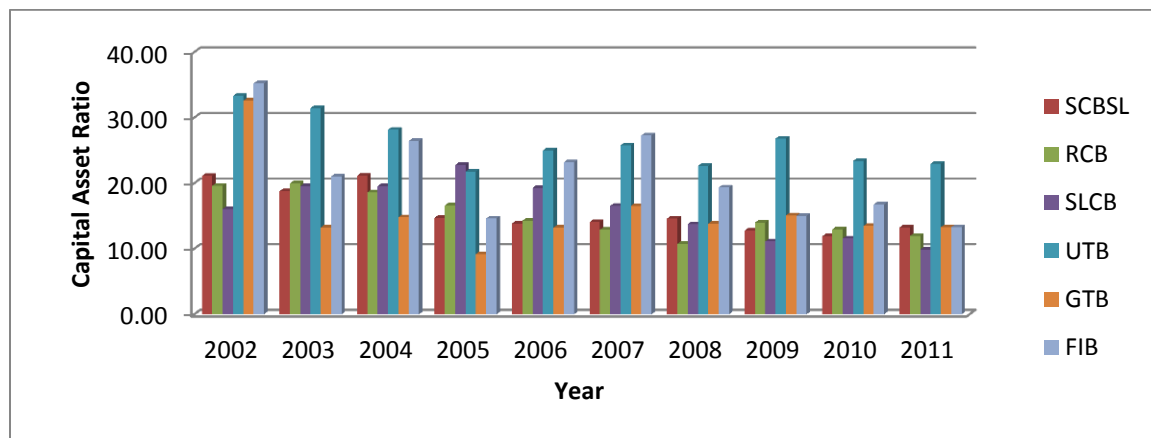
Figure 2.6 Investments (% of Local Currency Deposits) at the bank level.



Source: Author's computation using data from BSL.

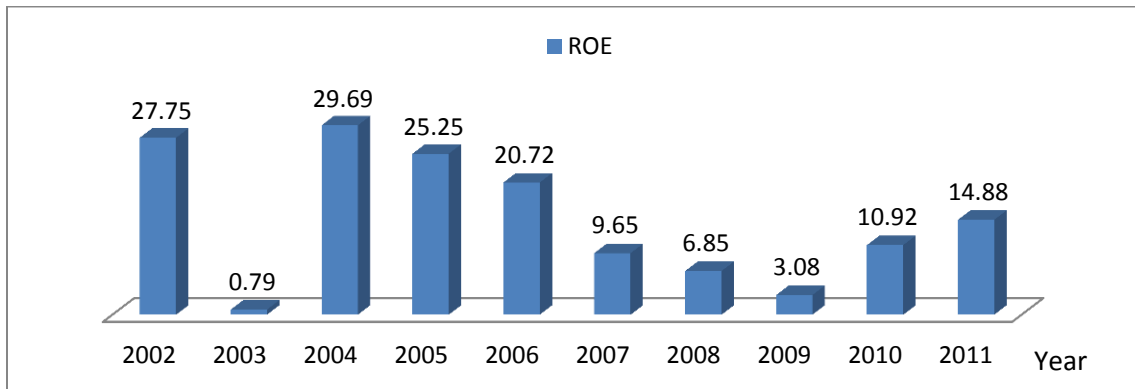
Figure 2.7 puts UTB on the lead side, from 2008 to 2011, in terms of the ratio of equity capital to total assets (also known as the bank's leverage ratio) which is taken here as a proxy for capital adequacy. This would explain why UTB has higher value for ADR. Also, given that UTB is the only private and locally owned operating commercial bank in the market, and considering the trend, one is likely to think that the privately owned banks are more capitalised than the state owned banks.

Figure 2.7 Tier 1 Capital to Asset Ratio at the Bank Level.



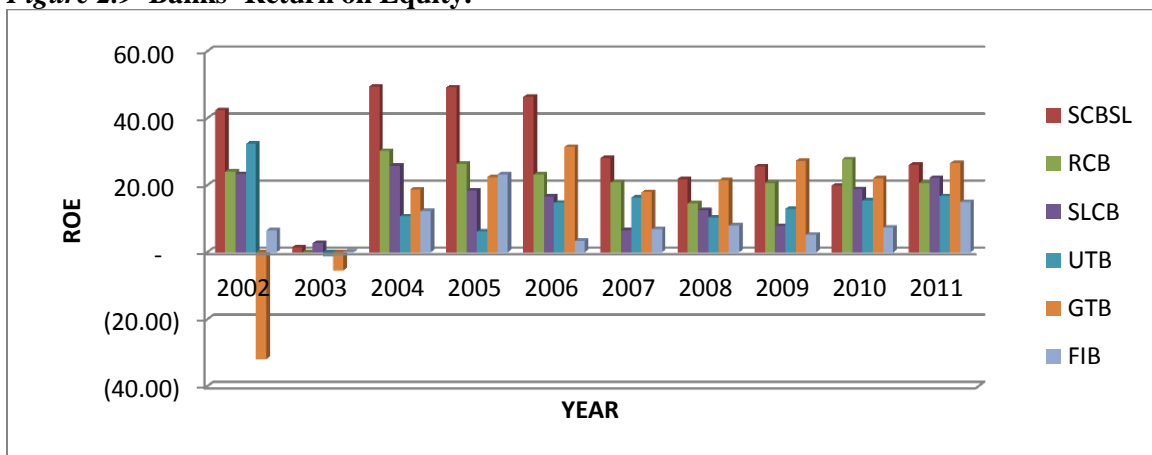
Source: Author's computation using data from BSL.

An analysis of profitability as measured by Return on Equity (ROE) shows that the industry had its worst performance in 2003. This holds so because of the lack of data on interest income for all banks in that year. The best performance (29.69%) was recorded in 2004. After a consistent dip in 2005 through 2009 (owing to new comers taking losses), ROE is on the rise again at the market level as shown in Figure 2.8. We can explain this by the increased lending activities as well as increasing returns on government securities (i.e., upward shift in treasury yield curve). From Figure 2.8, the position of GTB in 2002 and 2003 are expected of any new entrant in the market.

Figure 2.8 Industry Return on Equity.

Source: Author's computation using data from BSL.

The figure shows SCBSL as the most profitable bank in the market for the entire period under review, except for 2009, 2010 and 2011 when it gave way to GTB, RCB and GTB respectively. Return on equity is measured as a bank's net income (Before Tax Profit) divided by shareholders' Equity, reflecting the fact that a portion of a bank's total assets is financed from borrowed funds.

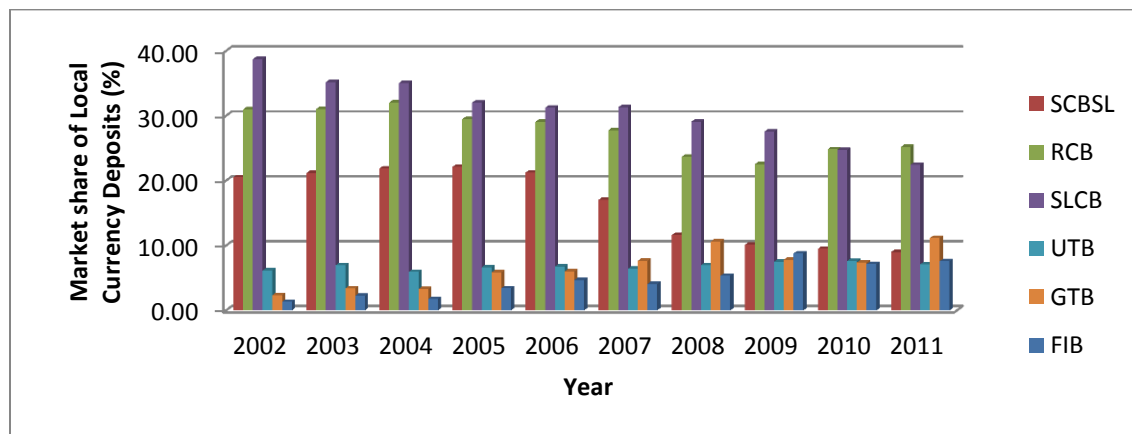
Figure 2.9 Banks' Return on Equity.

Source: Author's computation using data from BSL.

2.5 Market Shares

Analysis of available data in terms of local currency deposits mobilisation puts SLCB in the front row from 2002 through 2009, only overtaken by RCB in 2010. In 2002, SLCB maintained 39% market share of total local currency deposits. This value had witnessed a consistent drop over the years. In 2010, SLCB held 24.7% market share of local currency deposits, while RCB held 24.8% of it. Figure 2.10 highlights SCBSL holding the third position throughout the period, except in 2011 when it was overtaken by GTB.

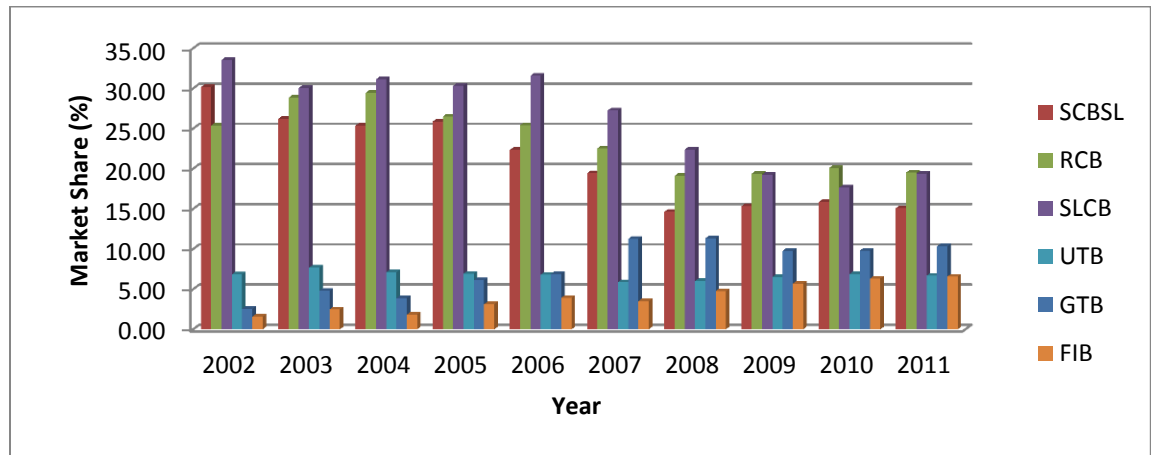
Figure 2.10 Bank Market Shares of Local Currency Deposits.



Source: Author's computation using data from BSL.

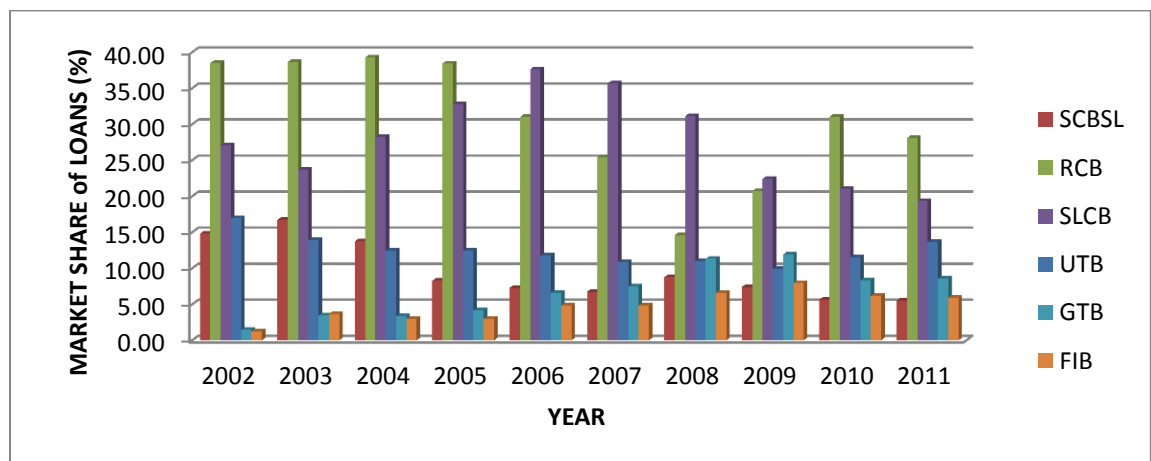
Figure 2.10 also shows a gradual erosion of the market shares of local currency deposits for the three big players over the years. As at 31st. December 2011, RCB held 25% of the market local currency deposits, followed by SLCB (22%) and then GTB (11%).

The shares of total assets also saw reductions since 2007, after Ecobank had entered the market in 2006. As at 31st. December 2011, RCB was seen as the largest bank in the market, holding 19.5% of total market assets, closely followed by SLCB (19.4%) and then SCBSL (15%). Figure 2.11 shows the positions.

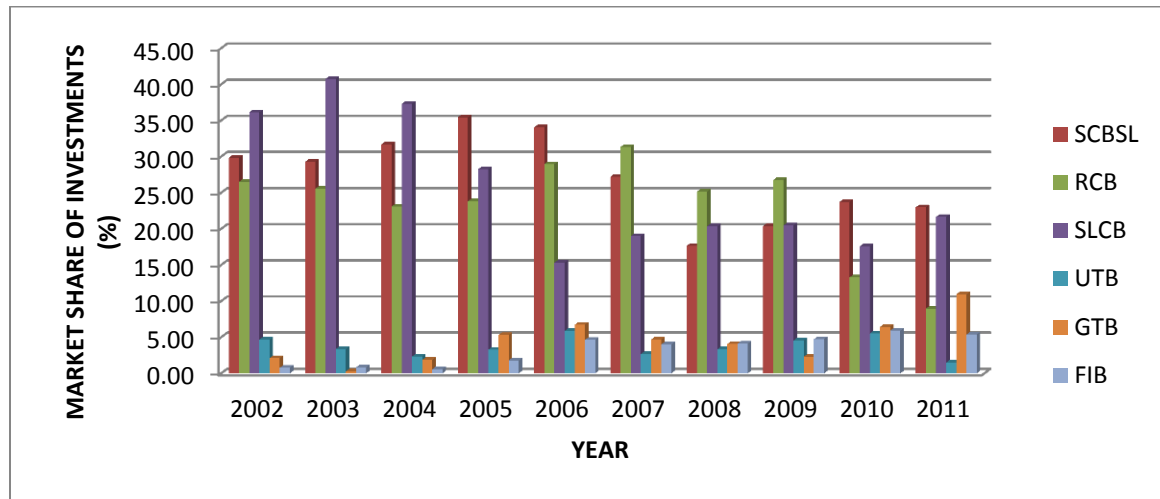
Figure 2.11 Bank Market Shares of Total Assets.

Source: Author's computation using data from BSL.

Considering loans to customers, RCB regained its first position in 2010 and 2011 (31% and 28% respectively) after it lost it to SLCB in 2006 (38%). In terms of investments, SLCB maintained leadership in 2002 (36%) through 2004 (37%), then SCBSL in 2005 (35%) and 2006 (34%), RCB in 2007 (31%) through 2009 (27%) and again SCBSL in 2010 and 2011 (24% and 23% respectively). Figures 2.12 and 2.13 illustrate market shares in terms of loans to the private sector and investments in that order.

Figure 2.12 Bank Market Shares of Bank Loans to the Private Sector.

Source: Author's computation using data from BSL.

Figure 2.13 Bank Market Shares of Investments.

Source: Author's computation using data from BSL.

2.6 Some Commercial Banking Regulations in Sierra Leone

The Banking Act of 2000 and the Banking Regulations Act of 2003 clarified the role of the Central Bank of Sierra Leone in developing and supporting an efficient banking and financial system in the country, through the introduction and implementation of prudential requirements. Among the prudential requirements are capital adequacy, provisioning and risk weighted capital requirements. To account for the shortcomings of the Banking Act of 2000, a new Act of 2011 has just been passed in parliament in January 2012. According to the Banking Act of 2011, the business of banking is defined as:

Accepting deposits from the public, repayable on demand or otherwise, and withdrawable by cheque, draft, order, or by any other means; and using the funds, whether in whole or in part, to make loans or investments for the account, and at the risk of the person doing the business.

Between 1999 and 2011, there have been several changes in the capital requirement of Commercial banks in Sierra Leone. The Banking Act of 2000 set the minimum capital requirement at SLL800 million for domestic banks and SLL1.6 billion for foreign banks⁹. In 2005, the minimum capital requirement was increased to SLL15 billion for all commercial banks effective 2009. At the end of 2010, the minimum capital was doubled to SLL30 billion for all commercial banks to cover a five year period effective 2014. The Central Bank of Sierra Leone (BSL) has also adopted the CAMELS rating system in its supervisory role to determine the banks' overall condition, identify their strengths and weaknesses and provide a summary measure of their overall financial conditions. The acronym CAMELS represents Capital Adequacy, Asset quality, Management quality, Earnings, Liquidity and Sensitivity to market risk. December 2011 examination of the banks by the Banking Supervision Department of BSL showed that the entire industry scored a satisfactory result. Two banks were in the marginal zone; seven as satisfactory; three as sound and only one bank viewed as very sound.

Generally, commercial banks in Sierra Leone are required by regulation to hold 12% of their local currency deposit liabilities in cash (whether in till or at the Bank of Sierra Leone)¹⁰. As at 31st. December 2011, five out of the thirteen operating banks in the market breached this prudential guideline. Additionally, 40% of demand deposits and 20% of quasi money (i.e., savings and time deposits) must be met by a bank's liquid assets which encompass cash in till and at BSL, placements with the discount houses and

⁹ Where the principal place of business of the licensed institution is in a country or territory outside of Sierra Leone

¹⁰ It is examined as at close of business on every Wednesday the previous week.

treasury bills and treasury bearer bonds. It is also stated that the ratio of Local Assets to Local Liabilities must not be less than 75%. According to the Banking Act of 2000,

No bank shall directly or indirectly, undertake one or more credit exposures to, or in respect of, any one person or group of connected persons, which in the aggregate –

a. In the case of an unsecured credit exposure, constitutes more than ten per cent of the capital base of the bank; or

b. In the case of a secured credit exposure, constitute more than twenty-five per cent of the capital base of the bank.

The percentage of largest borrowers' exposure to the banks' capital base as at 31st December 2011 stood at 24.99%, encompassing 116 unsecured exposures, 11 of which breached the 10% limit. Four secured exposures were in excess of the 25% limit imposed by BSL. The revised prudential guidelines of the Central Bank of Sierra Leone set a cap of 300% of their capital base on banks total exposures (including contingent liabilities).

At this juncture, it is very glaring that the capital size of a bank dictates its ability to lend, spend, carry on risk and to reward shareholders. For capital adequacy purposes, Table 2.3 shows the amount of capital required for each asset class.

Table 2.3 Capital Adequacy Weights for Bank Assets.

ASSET CLASS	WEIGHT
<i>On-Balance-Sheet Assets</i>	
<i>Cash in hand (Local)</i>	0%
<i>Balance held with</i>	
<i>I. Licensed institutions in S/L</i>	0%
<i>II. Deposit Taking institutions outside S/L, including Foreign Currencies held</i>	20%
<i>Government Stocks</i>	0%
<i>Treasury Bills & Treasury Bearer Bonds</i>	0%
<i>Advances Guaranteed by:</i>	
<i>(a) Cash</i>	0%
<i>(b) Licensed Financial institution in S/L & OECD countries</i>	20%
<i>(c) Legal Mortgage</i>	50%
<i>Other Advances</i>	100%
<i>Other assets</i>	100%
<i>Fixed Asset (Including Revenue Res.)</i>	100%
<i>Off Balance-Sheet Commitments</i>	
<i>Performance bond, acceptances (less Cash Securities)</i>	100%
<i>Bills receivable</i>	50%
<i>Confirmed documentary credit (less Cash Securities)</i>	50%

Source: Bank of Sierra Leone.

2.7 Sectoral Allocation of Bank Loans

From 2002 through 2006, the Commerce and Finance sector of the economy received the largest quantum of bank credits in the market. In 2002, 43.4% of total bank credit was directed to this sector. In 2007 however, the Services sector took over this position, attracting 31.2% of total bank credits. By 2009, the Services sector accounted for 29% of total bank credit. In 2010 and 2011, Commerce and Finance accounted for 29.7% and 29.8% of total bank credits respectively. Electricity, Gas and Water sector received the

least amount of bank credit in 2010 and 2011, followed by Mining and Quarrying. Table 2.4 illustrates better.

Table 2.4 Analysis of Overdrafts, Loans and Advances of Commercial Banks (% of share).

SECTOR	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Agric, Forestry & Fishing	1.12	1.75	1.93	1.97	0.88	2.48	4.58	4.74	6.69	7.08
Mining & Quarrying	0.35	0.23	0.23	0.76	1.55	1.52	1.79	1.69	1.92	2.80
Manufacturing	8.05	21.49	15.85	12.04	9.13	5.02	8.47	6.75	8.70	7.68
Construction	15.58	17.01	19.97	22.07	18.58	16.86	17.15	15.68	15.80	18.68
Electricity, Gas & Water	0.89	2.49	1.38	1.55	2.39	2.52	1.92	0.68	0.63	1.74
Commerce & Finance	43.44	35.51	40.96	35.08	33.14	28.84	25.90	26.97	29.68	29.76
Transport, Storage & Communication	1.02	2.77	5.51	9.76	11.94	10.13	7.24	12.16	10.42	9.35
Services	6.72	13.36	11.91	12.20	20.76	31.21	30.19	28.97	23.36	20.30
Miscellaneous	22.83	5.40	2.26	4.56	1.64	1.41	2.75	2.35	2.80	2.60

Source: Bank of Sierra Leone.

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

This chapter looks at both the growing theoretical literature in the area of the traditional role of commercial banks and the relevant empirical studies in the field. Because of the budding alarm over the associated risk of the business of commercial banking, a section is devoted to the risks of commercial banking, which entails the principal risk classifications and their measurements.

3.2 Theoretical Literature Review

The plethora of theoretical literature makes it impossible for their full review, and that is not attempted here. Focus is on those theories in line with the objectives of the study.

3.2.1 The Markowitz Portfolio Selection Model

Generalisation of the Markowitz (1952) portfolio selection problem to a case of multi-risky assets and a riskless asset entails three steps. The first step is to identify the risk return mix available from the set of assets. Then, identifying the optimal risky portfolio and finally, choosing an appropriate complete portfolio mix (Bodie, et al., 2009).

The process of identifying the risk return opportunities is summarised by the minimum-variance frontier of risky assets (Markowitz, 1952). The frontier as shown in Appendix A depicts the lowest possible variance that can be attained, given a portfolio expected return. It is a graph of the expected return on securities or risky assets and the risk as

measured by the standard deviation of the returns of the risky assets in the portfolio. When we allow for short sales, all the individual assets lie to the right, inside the frontier. The implication is that risky portfolios consisting of only one risky asset are considered inefficient (Sharpe, 1991). Diversification in the multi-risky assets model would lead to a portfolio of higher expected returns and lower standard deviations. From the graph in Appendix A, all the portfolios on the minimum variance frontier up from the global minimum variance provide the best risk return mix and are therefore candidates for the optimal portfolio. This is because for any extra risk taken, there is a more than offsetting reward to the investor. Portfolios below the global minimum variance portfolio are said to be inefficient. The inclusion of a riskless asset starts the second phase of the process. The optimal risky portfolio is given as the point of tangency of the Capital Allocation Line¹¹ to the efficient frontier. The third and final stage of the portfolio construction process involves the choice of the appropriate mix of the optimal risky portfolio and the riskless asset.

In the first stage of the process, a portfolio manager would need as inputs, a set of estimates for the expected return of each risky asset and a set of estimates for the covariance matrix. The expected return and variance of any risky portfolio with weights in each risky asset, w_i , can respectively be computed from the formulas:

$$E(r_p) = \sum_1^n w_i E(r_i) \quad (3.1)$$

And

¹¹ All the risk-return mix available to investors, which is known as the investment opportunity set

$$\sigma_r^2 = \sum_{i=1}^n \sum_{j=1}^n w_i w_j \text{Cov}(r_i r_j) \quad (3.2)$$

A rationale for this is that for any given risk level, our interest is that portfolio mix with the highest expected return. In a case where short sales are prohibited, the portfolio manager will add to the optimisation problem, constraints that rule out short positions in the search for efficient portfolios. In this special case, it is possible that a single asset class may be an efficient portfolio. It is however worth noting that any constraint carries a price tag in the sense that an efficient frontier constructed subject to extra constraints will offer risk-return ratio inferior to that of a lesser constraint one.

The reviewed literature suggests that there exist two alternative hypotheses regarding commercial bank portfolio behaviour: the accommodation principle and the profit maximizing principle.

3.2.2 The Accommodation Principle

The Accommodation principle originates from an earlier concept of the proper function of banking in the economy, widely known as the commercial loan theory of banking or the “real bill doctrine” of commercial banking. The concept is inevitably important for monetary management. By this principle, it is implied that the demand for loans is a major determinant of bank portfolio behaviour and that the supply of loan curve is infinitely elastic (Anderson and Burger, 1969). The theory postulates that bank earning assets should be limited to short term and self-liquidating loans to enhance commerce. Hence, proper banking practice is to accommodate the legitimate credit demands of

businesses, commerce and agriculture. This is clearly spelt out in most central bank Acts. What is derived from the theory is that monetary policy effect on the economy is dependent on whether or not it has any effect on the demand for loans, and hence, asset substitution on the balance sheet of the banks. The principle therefore suggests that the demand for business, agricultural and industrial production loans would mainly determine bank behaviour regarding borrowing from the central bank, holding of excess reserves and the split of interest earning assets between loans and investments. An increase in the loan demand of a bank, for example, is met, subject to deposit constraints, by reductions in investment and excess reserves, and an increase in borrowings from the central bank. The concept of client relationship is central under the accommodation principle. The point is that, refusing loans to certain key clients reduces both the expected return of the bank as well as the variability of returns from its loan portfolio (Kane and Malkiel, 1965). The desired supply of bank loans is therefore said to be determined by $L^* = L^*(r_s, r_L, GNP, M)$ where: L^* = desired level of bank loan supply, GNP = the level of economic activities, r_s = short term interest rate, r_L = long term interest rate, M = private non-bank wealth. $L_{r_s}^* < 0$ and $L_{r_L}^*, L_{GNP}^*, L_M^* > 0$

3.2.3 The Profit Maximising Principle

This principle is implied in recent developments in bank portfolio theory and related researches. It postulates that commercial banks' responses to market forces shape their portfolio behaviour. Commercial banks are viewed as any economic agent whose goal is profit maximisation. A typical commercial bank holds a portfolio of assets and given the features and distribution of its liabilities, a bank attempts to maximise its expected return

on assets subject to its deposit constraint (Anderson and Burger, 1969). Discipline of the central bank discount window¹² makes the cost of borrowing from the central bank less attractive and hence, raises the implicit return to commercial banks from holding excess reserves. Goldfeld and Kane (1966) first questioned the assumption that every bank reacts in the same way to changes in short term interest rates, the discount rate, the availability of reserves and new demand for loans. According to this theory, earning assets in the form of loans mainly comprise loans to households, businesses and financial institutions excluding the central bank, whose optimal level is given by $L^* = L^*(r_s, r_L, r_d, C, D)$, where C is the transaction cost of lending, r_d is the discount rate and D is the level of deposits; $L_{r_L}^*, L_C^*, L_{r_d}^* < 0$, whilst $L_{r_s}^*, L_D^* > 0$. Investments (illustrated here as residual items) are viewed to consist mainly of government securities whose desired level is given as $I^* = I^*(r_s, r_L, r_d, C, D)$; $I_{r_s}^*, I_{r_d}^*, I_C^* < 0$ and $I_{r_L}^*, I_D^* > 0$, where, C is the transaction cost of investment.

3.2.4 Bank Attitude towards Risk

With fractional reserve banking practices, commercial banks face uncertainty with regard to demand deposit shocks. A bank's liabilities consist of capital, demand deposits, time deposits¹³ and other liabilities. The assets comprise the bank's reserves¹⁴, government securities (investments), loans and advances, and other assets. A bank's objective is how to adjust these quantities so as to maximise its utility function. Define the interest rate paid on time deposits as $r_T = r_T(T)$, where T is the tenor of the deposit. $r'_T \geq 0$, depending

¹² Setting the discount rate and then administering the discount window to restrict credit flows.

¹³ All forms of savings deposits

¹⁴ Both required and excess reserves, which is made up of vault cash (cash in till) and the commercial bank's balance maintained at the central bank.

on whether the bank is a competitor or a monopsonist in that order. The return on loans on the other hand is defined as αr_L , where r_L is the contractual rate of return and $\alpha \leq 1$ (the probability of no default), dependent on whether or not the bank has a loss on the loans resulting from default. It is assumed that given the formulation of default risk, the expected rate of return on loans is a decreasing function of the amount of exposure. i.e., $r_L = r_L(L)$; $r'_L \leq 0$ if the bank is a monopolist or a pure competitor respectively.

Banks are seen as pure competitors in the government securities market, where they all can trade without having to significantly alter the rate paid on the securities. Generally, the contractually promised gross return on a loan, k , per money unit lent, or the Return on Assets per unit lent equals

$$1+k = 1 + \frac{F + (BR + m)}{1 - [b(1 - RR)]} \quad (3.3)$$

The numerator on the right hand side of equation (3.3) is the promised gross cash flow to the bank per unit lent, reflecting direct fees (F) plus the loan interest rate [Base rate (BR) plus Credit Risk premium or margin (m)]. B is the compensating balance¹⁵ and RR is the required reserve. When F and b are set at zero because of competition, the expression becomes $k = (BR + m)$. When default risk is incorporated into the model, the expected return on a loan is expressed as $E(r) = \rho(1+k) - 1$, where ρ is the probability of no default.

¹⁵ A percentage of a loan that a borrower is required to hold on a restricted deposit at the lending institution

3.2.5 The Risks of Banking Business

The asset transformation role of commercial banks creates maturity mismatches and other forms of risks for the institutions. Among the risk categories are:

Market risk – the risk incurred from assets and liabilities in a bank's book due to changes in interest rates, exchange rates and any other form of prices including those of commodities. It is also known as price risk.

Credit risk (Default risk) – the risk that contractual cash flows from loans and securities held by a bank may not be fully received.

Liquidity Risk – is the risk that a sudden negative shock in deposit liabilities may require a bank to liquidate its assets in a very short period of time and at a less than fair market value.

Operational risk – is the risk that existing technology, auditing, monitoring, human operations and other support systems may malfunction or break down.

Sovereign risk – is the risk that repayments to foreign lenders may be interrupted because of restrictions, interventions or interferences from foreign governments.

Off balance sheet risk – the risk incurred by a bank resulting from activities related to contingent assets and liabilities.

Other forms of associated risks may include reputational risk, regulatory risk, solvency risk, legal risk and systemic risk. In line with the objectives of this study, two key risk models, including capital adequacy, are provided in the following sub sections.

3.2.5.1 Interest Rate Risk

A bank is exposed to interest rate risk when it creates a maturity gap on its balance sheet (Saunders and Cornett, 2008). In the case where the bank is short funded¹⁶, the institution is exposed to refinancing risk, which is the risk that the cost of rolling over existing liabilities or borrowing fresh funds will rise above the returns earned on asset investment. When the bank is long funded on the other hand, it is exposed to reinvestment risk – the risk that returns on funds to be reinvested will fall below the cost of funds. Apart from the potential of refinancing and reinvestment risks, a bank is also faced with market value risk. A rising interest rate raises the discount rate and hence, reduces the present values of current and future cash flows from the bank's assets and liabilities (Greuning and Bratanovic, 2009). Additionally, when the bank is short funded, a rising interest rate would imply that the market value of its assets falls by a greater quantum than its liabilities, exposing the bank to the risk of economic loss and possibly, the risk of insolvency.

Because interest rate volatility affects banks' net income and their market value of assets and liabilities, financial economists as well as bank managers have devoted immense time and effort trying to identify the determinants of the level of interest rate at any moment of time (Saunders and Cornett, 2008). A commonly used model is the loanable funds theory, a theory of interest rate determination that views equilibrium interest rate in the financial market as a result of the supply of and demand for loanable funds. The equilibrium interest rate is however, only a temporary equilibrium. The supply and demand curves are continuously shifting owing to their determinants.

¹⁶ Longer asset tenor than liability tenor

3.2.5.2 *Measuring Interest Rate Risk*

Parametric measures of risk such as standard deviation follow from the portfolio selection theory of Markowitz (1952) and the fact that portfolio risk is not a sum of the component asset risks (Pyle, 1997). Discussion on measuring interest rate risk in this study is focused on four models: the Repricing Model, the Macauley's Duration Model, the Risk Matrices Model and the Historic Simulation Method.

3.2.5.2.1 *The Repricing (Or Funding Gap) Model*

This model is used by small depository institutions, because of its relative simplicity. It is a book value accounting cash flow analysis of the repricing gap between the interest income earned on the institution's assets and the interest expense paid on its liabilities (Net Interest Income (NII)) over a particular period of time. A repricing gap is the difference between assets whose interest rates will be repriced over some future period (Rate Sensitive Assets (RSA)) and liabilities whose interest rates will be repriced or changed over some future period (Rate Sensitive Liabilities (RSL)). By this model, a bank reports the gaps in each maturity bucket by calculating the rate sensitivity of each asset and liability (Santomero, 1997). Repricing can result from a rollover of an asset or liability, or because the balance sheet item is a floating rate instrument. Repricing gaps are usually reported for regulatory purposes for various maturities such as overnight, more than one day and up to one week, greater than one week and up to one month and so on. The advantage of the repricing gap model lies in its information content and its simplicity in pointing to an institution's net interest income exposure to interest rate

volatility in different maturity buckets. A negative gap¹⁷ exposes the bank to refinancing risk, in that an increase in interest rate would lower the bank's net interest income. The converse exposes the bank to reinvestment risk. Let us define GAP_i as the monetary value of the gap between the book value of rate sensitive assets and rate sensitive liabilities in maturity bucket i , ΔR_i as the change in the level of interest rate impacting assets and liabilities in the i th bucket, and ΔNII_i as the change in the net interest income in the i th bucket. Then, $\Delta NII_i = (GAP_i) \Delta R_i$, which is also expressed as $\Delta NII_i = (RSA_i - RSL_i) \Delta R_i$. If ΔR_i is the average interest rate change affecting assets and liabilities that can be repriced within a year, then, the cumulative effect on the bank's NII is given as $\Delta NII_i = (CGAP_i) \Delta R_i$, where $CGAP_i$ is the cumulative GAP . The repricing gap model requires managers and regulators to distinguish between contractual and behavioural profiling of assets and liabilities.

There are arguments for and against the inclusion of demand deposit as rate sensitive liabilities. The arguments against its inclusion are that, firstly, the explicit interest rate on most demand deposits is zero by regulation. Secondly, although explicit rates are paid on accounts like current accounts, these rates do not fluctuate directly with changes in the general level of interest rates. Thirdly, about sixty per cent (60%) of demand deposits behaviourally act as core deposits¹⁸.

¹⁷ Rate Sensitive Assets (RAS) is less than rate sensitive liabilities.

¹⁸ Those deposits that stay on the bank's balance sheet for at least one year.

The argument in favour of its inclusion is that demand deposits attract implicit interest. If interest rates increase, depositors would be inclined to draw down or run off their accounts, forcing the bank to fund at higher market interest rates.

Banks often express interest rate sensitivity as a percentage of total assets, commonly called the *GAP Ratio*¹⁹. Generally, when CGAP is positive, and rates on RSA and RSL change equally, the change in NII is positively related to the change in interest rates. On the contrary, when CGAP is negative, if interest rates rise by equal amount for RSA and RSL, NII will fall. Banks will therefore want their CGAP to be positive when interest rates are rising and the converse holds true. These effects are termed as the CGAP Effect (Saunders and Cornett, 2008). But the assumption that the interest spread between RSA and RSL remains the same does not always hold true. This provides a room for considering a spread effect²⁰ in addition to the CGAP effect, which gives $\Delta NII = (RSA * \Delta R_{RSA}) - (RSL * \Delta R_{RSL})$; where the first term on the right hand side is the change in interest revenue and the second term is the change in interest expense. From the expression above, if the *RSA-RSL* spread increases, when interest rates rise (fall), interest revenue increases (decreases) by more (less) than interest expense, which increases *NII*. The idea is that with the spread effect, regardless of the direction of interest rate changes, a positive relationship exists between changes in *NII* and changes in spread.

The Repricing model has been criticised on a number of grounds:

¹⁹ It tells us the direction of the interest rate exposures and the scale of that exposure.

²⁰ The effect that a change in the spread between rates on RSA and RSL has on NII as interest rates change.

- It ignores market value effects of interest rate changes, making it only a partial measure of the true interest rate exposure of a bank.
- It is over aggregative. The definition of maturity buckets over a range of time ignores information regarding the distribution of items within those buckets.
- It also fails to deal with the problem of rate sensitive asset and liability runoffs²¹ and repayments
- It ignores cash flows from off-balance sheet activities.

These aforementioned weaknesses of the Repricing model render some advantages to the Macauley's Duration model discussed below.

3.2.5.2.2 *The Macauley's (1938) Duration Model*

This model is a market based measure of interest rate risk. It is believed to be a more complete measure of an asset or liability's interest rate sensitivity than is maturity, because it takes into account all cash flows and maturities. Duration is the weighted average time to maturity of loans and other asset forms, using the relative present values of the cash flows as weights (Saunders and Cornett, 2008; Greuning and Bratanovic, 2009). It measures the period required to recover the initial investment on a loan. To account for the degree of leverage on a bank's balance sheet as well as the timing of receipt and payment of cash flows of assets and liabilities, Duration Gap is used instead. Duration Gap is therefore seen to be a more comprehensive measure of a bank's interest rate risk.

²¹Periodic cash flow of interest and principal amortization payments on long term assets that can be reinvested at market rates.

For a one year fixed rate loan with required repayment of half the principal amount at the end of the first six months and the other half at the end of the one year, the duration would be computed as

$$D_1 = PV_{\frac{1}{2}}\left(\frac{1}{2}\right) + PV_1(1) \quad (3.4)$$

Where D_1 is the duration of the loan, $PV_{\frac{1}{2}}$ is the present value of cash flow after the first six months expressed as a proportion of total cash flow, and PV_1 is the present value of cash flow on maturity. $\frac{1}{2}$ and 1 are the time for repayment in years. From equation (3.4) above, when all cash flows are limited to one repayment at the end of the period with no intervening cash flows, the duration of an asset will equal its maturity. Otherwise, the duration is expected to be less than maturity. For any fixed income asset that pays interest annually, the duration is computed as

$$D = \frac{\sum_{t=1}^N CF_t * DF_t * t}{\sum_{t=1}^N CF_t * DF_t}$$

$$= \frac{\sum_{t=1}^N PV_t * t}{\sum_{t=1}^N PV_t} \quad (3.5)$$

Where D is Duration measured in years, CF_t is cash flow received on the asset at the end of the period t , N is the last period in which the cash flow is received, $DF_t = \frac{1}{(1+R)^t}$ is

the discount factor, R is the annual yield or current level of interest in the market, and $PV_t = CF_t * DF_t$ is the present value of cash flow at the end of period t . For interest paid or earned semi-annually, the formula becomes

$$D = \frac{\sum_{t=\frac{1}{2}}^N \frac{CF_t * t}{\left(1 + \frac{R}{2}\right)^{2t}}}{\sum_{t=\frac{1}{2}}^N \frac{CF_t}{\left(1 + \frac{R}{2}\right)^{2t}}}; t = \frac{1}{2}, 1, \frac{3}{2}, \dots, N \quad (3.6)$$

Generally,

$$D = \frac{\sum_{t=\frac{1}{m}}^N \frac{CF_t * t}{\left(1 + \frac{R}{m}\right)^{mt}}}{\sum_{t=\frac{1}{m}}^N \frac{CF_t}{\left(1 + \frac{R}{m}\right)^{mt}}} \quad (3.7)$$

The duration of an asset or a liability tells us about the asset or liability's interest elasticity of prices, otherwise known as the sensitivity of the asset or liability's prices to shocks in interest rates. The implication is that between the duration and maturity of an asset, the asset returns a profit to its holder. Among its determinants, duration increases with the maturity of a fixed income asset, but at a decreasing rate. It is however a decreasing function of yield to maturity of the asset (R) and the rate of interest. The duration of a balance sheet item is related to its interest rate sensitivity by:

$$D = \frac{-dP}{dR} \cdot \frac{(1+R)}{P} \quad (3.8)$$

A more intuitive form of the duration model is the Modified Duration (MD) expressed as

$$MD = \frac{D}{(1+R)}, \text{ for annual compounding of interest. Estimating the overall duration gap}$$

of a bank entails determining the duration of the bank's asset and liability portfolios (Saunders and Cornett, 2008). The duration of a portfolio is the market value weighted average of the individual duration of the components.

Assuming annual compounding of interest,

$$\Delta E = -(D_A - D_L k) A \frac{\Delta R}{(1+R)} \quad (3.9)$$

where $k = \frac{L}{A}$ is the bank's leverage, L is liabilities, A is assets, D_A is duration of assets, and D_L is duration of liabilities. What this is saying is that with the knowledge of the accounting or balance sheet identity that assets equal the sum of liabilities and the bank's net worth, it becomes evident that a change in the bank's net worth (a change in a bank's equity capital) is explained by the gap in the change in the market value of its assets and liabilities.

An underlying assumption of the duration model is that the yield curve is flat and that when rates change, the yield curve shifts in a parallel form (Saunders and Cornett, 2008). It is further assumed that the borrower repays the principal plus the contractual interest as promised; no default risk²². Besides, the difficulty in applying the duration model includes the fact that duration matching can be costly, and that interest rates can change

²² See Saunders and Cornett (2008) for a model with default risk and yield curve curvature incorporated.

at any time over the holding period, requiring frequent and continuous portfolio rebalancing (Santomero, 1997).

3.2.5.2.3 *The Risk Matrics Model*

Ground breaking researches on Capital Asset Pricing Model (Sharpe, 1964), Option Pricing (Black and Scholes, 1973 and Merton, 1973) and Term Structure Modelling (Vasicek, 1977) have provided the basis for increasingly accurate and applicable models of valuation. Most commercial banks make marked distinction between their trading and banking books for interest rate exposures. For institutions with less active trading activities, Value at Risk (VaR) model has become the standard approach for interest rate risk management, following the release of Risk Matrics by J.P. Morgan in 1994 (Santomero, 1997). In this model, the Daily Earnings at Risk (DEAR) – a measure of market risk exposure over the next 24 hours is decomposed into three components.

$$\begin{aligned} \text{DEAR} &= (\text{Monetary Value of the Position}) * (\text{Price Sensitivity of the Position (PVO1)}) * (\text{Potential Adverse Move in Yield}) \\ &= (\text{Monetary Value of the Position}) * (\text{Price Volatility}) \\ &= (\text{Monetary Value of the Position}) * MD * (\text{Adverse Daily Yield Move}) \end{aligned}$$

Assuming that yield shocks are independent and daily volatility is approximately constant, and that a bank is locked in to holding this asset for N number of days, then the N day market value at risk (VaR) is related to daily earnings at risk by $VaR = DEAR * \sqrt{N}$. VaR analysis uses distributions and predicted return parameters to estimate potential portfolio losses. Specifically, a measure used is the loss in value over X

days that will not be exceeded by more than $Y\%$ of the time. The Basel Accord (2006)²³ sets Y at 1% and X at 10days. The J.P. Morgan Risk Matrics VaR method sets X at 5% and Y at 1day. These values vary across major banks who have adopted this model of interest rate risk measurement. VaR generally measures the maximum loss in portfolio value over a one day horizon with 97.5% confidence. The portfolio return distribution is described in terms of a covariance matrix representing the risk attributes of the portfolio over each horizon. The standard deviation of the portfolio value (v) is obtained by pre and post multiplying the covariance matrix (Q) by the position vector (P) and taking the square root of the resultant scalar. The standard deviation is then scaled to find the desired centile of portfolio value that is the VaR (Pyle, 1997). i.e., $VaR = Vf(Y)$, where $f(Y)$ is the scale factor for the centile Y .

The VaR model is not free from criticisms. It does not capture the very low probability events that are of real concern. Besides, it is difficult to exactly measure the potential loss for each of the different market risks experienced by a financial institution (Saita, 1999). It also assumes that changes in asset prices follow a normal distribution. Modelling portfolio returns as a multivariate normal distribution has many advantages in terms of computational efficiency and tractability (Saunders and Cornett, 2008). But there is evidence dating back to Mandelbrot (1963) and beyond that some asset returns display non-normal distributions. In extreme circumstances, the distribution of asset prices can change shape quite significantly. According to Kupiec (1999), the Risk Matrics Model ignores the risk in the payments of accrued interest on the bank's debt securities. Hence,

²³ An agreement by member of the Bank for International settlement (BIS) to impose risk based capital ratios on banks.

it will underestimate the true probability of default and the appropriate level of capital to be held against this risk.

3.2.5.2.4 *Historic (Back) Simulation Model*

Because of the problems associated with the Risk Metrics Model of VaR, a large majority of banks are employing a historic or back simulation approach to market risk measurement. The rationale behind this is that the model does not require the asset returns to be normally distributed, and that it does not need any computation of a covariance matrix or standard deviation of the asset returns. The idea is to take the current market portfolio of assets and revalue them on the basis of actual prices that existed on those assets yesterday, the day before yesterday and so on, until the last 500 days. Some institutions use 250 data points. Then, the 5% worst case (25/500 lowest value) is chosen. In some other cases, the 7th worst observed loss over a 21 working day period is taken to mean the market value at risk. In the case of limited availability of actual observations, a Monte Carlo Simulation approach is used to generate additional observations (Santomero, 1997).

3.2.5.3 *Credit Risk*

Credit risk is decomposed into firm specific or idiosyncratic credit risk – the risk of default of the borrowing entity, and systematic credit risk, which is the risk of default associated with the general economic trend affecting all borrowers. Discussions on credit quality as measured by the share of non-performing loans²⁴ in gross loans have gained momentum in recent times. Poor credit quality can cause a significant deep in a bank's

²⁴ Loans that are 90days or more past due dates or are not accruing interest

capital through the income statement item “provision for loan losses or bad debt²⁵” or can cause a bank to become insolvent. Studies have also shown that returns on commercial banks’ common stocks significantly decrease on announcement of bankruptcy and default by a bank’s borrowers (Dahiya et al., 2003).

3.2.5.4 *Measuring Credit Risk*

The credit risk measurement models vary from relatively qualitative to the highly quantitative ones, all of which are not mutually exclusive. The inputs in a qualitative model include both idiosyncratic and systematic factors. Among the idiosyncratic factors are the following:

3.2.5.4.1 *Reputation*

An established reputation for prompt and timely repayment enhances the borrower’s attractiveness to a given bank. This however works to the disadvantage of small and newly established borrowers, one of the reasons for which initial public offerings of debt securities by small firms often require higher yields than do offerings of older or more seasoned firms.

3.2.5.4.2 *Leverage*

The ratio of a borrower’s debt to equity or the capital structure affects the borrower’s probability of default due to its effect on the borrowing entity’s interest expense. It has been shown that the risk of bankruptcy increases with leverage (Ross, et al., 2003). But

²⁵A non-cash, tax deductible expense representing the bank’s management’s prediction of loan at risk of default for the current period.

high leverage can serve a very important control function to replace what seems to be the failed model in which the public board of directors monitors management and its strategy directly (Jensen, 1989). Grossman and Hart (1982) also argue that high debt (leverage) may be a signal of managerial efficiency and may in fact lower bankruptcy risk. According to Modigliani and Miller (1958), the tax advantage of leverage makes it attractive to financial managers.

3.2.5.4.3 *Volatility of Earnings*

A higher volatility of earnings flow is said to increase the probability of default of a borrower and hence, the individual becomes a less attractive credit risk to a bank.

3.2.5.4.4 *Collateral*

A key feature in any lending pricing decision is the degree of collateral or asset backing the security of the loan. Loans can be issued on secured or unsecured basis. Collateralised loans are however still subject to some default risk, unless those loans are significantly over-securitised. Arguably, the most credit worthy borrowers need not post collateral, since they are good credit risks.

The systematic factors in measuring credit risk are classified into business cycle and the level of interest rate. Although these can be quantified, they do not need their computations by the banks themselves.

3.2.5.4.5 Business Cycle

Basic Macroeconomics confirms that during economic downturns, firms in the consumer durable goods sector do so badly than those in the non-durable goods sector. This holds when people cut back on their expenditure on luxuries, but less so on necessities. Banks are therefore more likely to employ credit rationing techniques in periods of economic recession.

3.2.5.4.6 The Level of Interest Rates

High interest rate originating from the central bank does not only signal a restrictive monetary policy which raises the cost of borrowing through the lender of last resort funding window, but it is recognised that higher interest rates are correlated with higher credit risk coming from high default risk. It is a recipe for the problems of adverse selection and moral hazard, where only the most risky borrowers are left in the credit market (Akerlof, 1970). Akerlof maintains that the credit markets in developing or under developed countries often strongly reflect the operations of the *lemon* principle.

Loans are granted in terms of fixed or floating rates of interest. Because a floating rate loan agreement passes on the risk of interest rate volatility to the client, in a rising interest rate environment, holders of the floating rate liability (loan) are more likely to default, making it more credit risky than the fixed rate loan (Saunders and Cornett, 2008).

The quantitative models of credit risk measures are discussed under the following headings:

3.2.5.4.7 Credit Scoring Model

Mathematical and statistical models are used, given observed loan applicant's features, to either calculate a score representing the client's probability of default or to sort borrowers into distinct default risk groups. Credit scoring models are broadly classified into Linear Probability Models (LPM), Logit Models and Linear Discriminant Models (Saunders and Cornett, 2008). Among the three models, this study will look into the Linear Discriminant Model, which is commonly used to determine the solvency statuses of firms.

The Altmans (1968) discriminant function (The Z Score) uses multiple corporate income and balance sheet values to measure the financial health of a company. The classification model for a public manufacturing company takes the form:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.999X_5 \quad (3.10)$$

where X_1 is Working Capital²⁶ divided by Total Assets; a measure of liquid assets in relation to the size of the borrowing entity, X_2 is Retained Earnings divided by Total Assets; a measure of profitability that reflects the borrowing entity's age and earning power, X_3 is Earnings before Interest and Tax, divided by Total Assets; a measure of the operating efficiency apart from tax and leveraging factors, which recognises operating earnings as being important to long term viability, X_4 is Market Value of Equity divided by the book value of liabilities, which adds market dimension that can show up security price fluctuation as a possible red flag; and X_5 is Sales divided by Total Assets as a

²⁶ Current Assets less current Liabilities

standard measure of total asset turnover. The interpretation of the Z score takes the following form:

$$Z > 2.99 \rightarrow \text{“Safe” Zone}$$

$$1.81 < Z \leq 2.99 \rightarrow \text{“Grey” (Not too safe) Zone}$$

$$Z \leq 1.81 \rightarrow \text{“Distress” Zone}$$

The Z-score model is a customised version of the discriminant analysis technique of Fisher (1936) and Beaver (1966, 1968). For a private firm, X_4 is the ratio of the book value of equity to total liabilities and the Z-score model is modified as:

$$Z = 0.717X_1 + 0.847X_2 + 3.107X_3 + 0.42X_4 + 0.998X_5 \quad (3.11)$$

where “ $Z > 2.9$ ” means a “Safe” Zone, $1.23 < Z \leq 2.9$ means a “Grey” Zone and $Z \leq 1.23$ means “Distress” Zone.

For non-manufacturing industrial and emerging market credits, no X_5 exists and the model becomes:

$$Z = 6.56X_1 + 2.26X_2 + 6.72X_3 + 1.04X_4 \quad (3.12)$$

X_4 in equation (3.12) is the ratio of the book value of equity to total liabilities. There are however newer market based models of credit risk measurement and pricing²⁷. Risk rating agencies such as Standard and Poor’s (S&P) categorise corporate bond issuers into

²⁷ See Saunders & Cornett(2008) for details.

at least seven groups: AAA, AA, A, BBB, BB, B and CCC. Borrowers in the first four classes are said to be investment quality borrowers.

In the market based models, banks rely on third party information to assess the probability of default of borrowers. An increasingly popular model used to evaluate (and price) credit risk based on market data is the Risk –Adjusted Return on Capital (RAROC) (Guill, 2009). The idea behind RAROC is that instead of evaluating the actual or contractual annual Return on Asset (ROA) on a loan, the bank balances expected interest and fee income, less the cost of funds against a loan’s expected risk.

$$RAROC = \frac{\text{One Year Net Income on Loans}}{\text{Loan (Asset) Risk or Capital at Risk}} \quad (3.13)$$

One Year Net Income on Loan = (Spread+Fees)*Amount of Loan Outstanding .

Capital at Risk is computed using two methods: the duration method and the method of loan default rate. Using the duration method,

$$\text{Capital at Risk } (\Delta LN) = -D_{LN} LN \frac{\Delta R}{(1+R)} \quad (3.14)$$

where D_{LN} is the loan duration, LN is the loan amount outstanding and $\frac{\Delta R}{(1+R)}$ is the

maximum change in the loan rate due to changes in the risk premium. Using the loan default rate method,

$$\Delta LN = (\text{Unexpected Default Risk}) * (\text{Loss Given Default (LGD) as a percentage of Gross Loans})$$

Normally, a loan is approved only when RAROC is sufficiently higher than a bank's Return on Equity (ROE).

3.2.5.4.8 Capital Adequacy

A bank's first shield against insolvency is its capital. Anticipated losses are provided for. The bank's capital absorbs unanticipated losses with enough margins to inspire confidence to make the institution a going concern. Capital meant to protect against the risk of large unexpected losses is what is referred to as *economic capital* (Guill, 2009). Banks are faced with two different capital requirements: a capital-asset (Leverage) ratio or just Capital Ratio and a risk based capital ratio that is subdivided into *tier I* risk based capital ratio and total capital (*tier I* plus *tier II* plus *tier III* capital) risk based ratio.

3.2.5.4.9 The Leverage Ratio

The leverage ratio is a measure of the bank's core (primary) capital to its book value of assets.

$$\text{Leverage Ratio (L)} = \frac{\text{Book Value of Primary or Core Capital}}{\text{Book Value of Assets}} \quad (3.15)$$

The bank's core capital is the sum of its book value of equity, qualifying cumulative perpetual preferred stock and minority interests in equity accounts of consolidated subsidiaries. For leverage ratio greater than 5%, the bank is said to be more capitalised. For $4\% \leq L < 5\%$ the bank is said to be adequately capitalised. For $3\% \leq L < 4\%$ the bank is considered as undercapitalised. The bank is significantly undercapitalised when

$2\% \leq L < 3\%$ and critically undercapitalised when $L \leq 2\%$. The lower the leverage ratio, the more levered a bank is. This ratio is also used by banks to assess the credit worthiness of borrowers.

The leverage ratio is criticised on the basis that it is based on book value accounting. With a low leverage ratio, the market value of the bank's capital can be negative (Saunders and Cornett, 2008). Also, no capital is allocated for off balance sheet risks as a cushion. It again fails to account for the different credit, interest rate and other forms of risks of the components of total assets.

3.2.5.4.10 Risk Based Capital Ratio

The Basel I Accord (1988)²⁸ incorporated the different credit risks of both on and off balance sheet assets in capital adequacy measures. In 1998 and 2001, market and operational risks were respectively added to the measures in what is referred to as the New Basel Accord²⁹. The latest modified form is Basel III (2010).

Basel I is a set of minimum capital requirements for banks, initially meant to be enforced by law in the Group of Ten (G-10) countries by 1992. The Basel I Accord dealt with only parts of each of the risk categories. For example, credit risk was dealt with in a simple manner, while market risk was an afterthought; operational risk was not dealt with at all.

²⁸ An agreement by members of the Bank for International Settlement (BIS) to impose risk based capital ratio on banks. The agreement that explicitly incorporated the different credit risks of assets into capital adequacy measures was published in 1993.

²⁹ See Saunders and Cornett (2008) pp 599-619 for details.

Basel II is the second of the Basel Accords initially published in June 2004, intended to create an international standard for banking regulators to control how much capital banks need to put aside to guard against the types of financial and operational risks banks (and the whole economy) face. Basel II uses a "three pillars" concept – (Pillar 1) which covers minimum capital requirements (addressing risk), (Pillar 2) which is about supervisory review and (Pillar 3) which focuses on market discipline.

Basel III is a global regulatory standard on bank capital adequacy, stress testing and market liquidity risk agreed upon by the members of the Basel Committee on Banking Supervision in 2010. Basel III comes in response to the deficiencies in financial regulation revealed by the 2007 financial crisis. It strengthens bank capital requirements and introduces new regulatory requirements on bank liquidity and bank leverage.

By the Basel regulation,

$$\text{Tier I Capital Ratio} = \frac{\text{Tier I Capital}}{\text{Credit Risk Adjusted Assets}} \geq 4\% \quad (3.16)$$

$$\text{Total Risk Based Capital Ratio} = \frac{\text{Total Capital}}{\text{Credit Risk Adjusted Assets}} \geq 8\% \quad (3.17)$$

Tier 1 (core) Capital broadly includes elements such as common stock, qualifying preferred stock, and surplus and retained earnings. It is made up of the book value of a bank's common equity plus an amount of perpetual (non-maturing) preferred stock plus minority interests held by the bank in subsidiaries less goodwill.

Tier 2 (Supplementary) Capital is a term used to describe the secondary bank capital that includes items such as undisclosed reserves, general loan loss reserves, certain forms of preferred stock (non-qualifying perpetual preferred stock), term subordinated debt, perpetual debt, and other hybrid debt and equity instruments.

Tier 3 Capital is a tertiary capital held by banks to meet part of their market risks, that includes a greater variety of debt than tier 1 and tier 2 capitals. Tier 3 capital debts may include a greater number of subordinated issues, undisclosed reserves and general loss reserves compared to tier 2 capital. It includes short-term subordinated debt and net trading book profits that have not been externally verified. Tier 3 Capital is used to support market risk, commodities risk and foreign currency risk. To qualify as tier 3 capital, assets must be limited to 250% of a bank's tier 1 capital, be unsecured, subordinated and have a minimum maturity of two years.

The intuition behind the imposition of risk based capital requirements is to limit excessive risk taking activities by banking institutions. However, available empirical evidence holds that this is not always the case, especially for well capitalised banks.

3.2 Empirical Literature Review

A number of authors have investigated the link between bank loan supply to the private sector and a host of predetermined variables, including bank risk measures and capital adequacy. While some authors pay much attention to relationship banking, others have

focused on four major institution-specific characteristics that are likely to influence traditional lending activities: liquidity, capital, market value and securitisation intensity. Some other studies have suggested that credit creation is influenced by both macroeconomic variables that impact loan uptake as well as internal structures such as the composition of a bank's balance sheet and the demand for loans.

By modifying a Tobin-Markowitz portfolio model to account for the phenomenon of deposit variability, Kane and Malkiel (1965) discover cogent reasons for rejecting formulations of the manner in which certain availability effects operate. They make two additions to the traditional bank portfolio model: deposit variability and consideration of long run profits. Their argument is that given an existing optimum portfolio, a certain class of loan demand creates a dilemma for a bank. Granting such a loan according to the writers, adds to the risk-return ratio, but increases the strength of a bank's client relationship and may increase a bank's expected return, while reducing overall risk. Refusal will nevertheless increase the risk and reduce the expected (long run) return. Their study rejects the hypothesis that credit rationing is purely on the basis of credit risk. Their findings support the assertion that credit rationing is on the basis of client features which entail: the strength of the existing client relationship, the size of the borrower, stability and the prospects for long term growth of deposits, and the existence of profitable future lending opportunities.

Using a model in first difference form to eliminate trend and mitigate the influence of multicollinearity and autocorrelation inherent in the use of quarterly time series data,

Smith (1967) analyses the lending behaviour of Post war Canadian banks and other financial intermediaries in the mortgage market. The result of his study substantiates his contention that the volume of institutional mortgage lending activity is highly sensitive to variations in relative interest yield and gross flow of fund considerations, as well as to stock adjustment considerations. He finds out that the allocation of funds between the conventional and government insured sectors of the mortgage market in Canada is strongly influenced by variations in the yield spread between these mortgages.

Anderson and Burger (1969) employ a multiple regression analysis to analyse Asset Management and Commercial Bank Portfolio Behaviour in the United States of America. Monthly data spanning 1953-1967 are used in their study with three equations specified. Borrowing from the Federal Reserve, excess reserves and the stock of loans, all as a proportion of deposits are used as the dependent variables respectively in the three equations. Short term interest rate, federal discount rate, long term interest rate, gross national product deflated by total deposits and a one period lagged value of the dependent variables are used as the independent variables. Short and long term interest rates are considered endogenous among the independent variables within a more complete model of bank behaviour. Two-stage Least Squares estimation procedure is employed for that matter, to account for the problem of endogeneity. A result of their study reveals that commercial banks' behaviour is inconsistent with the accommodation principle. The result however provides the base that banks' behaviour responds to short term and long term interest rates, and GNP-Total deposits ratio in a way consistent with the profit maximizing principle. Application of a chow test shows a significant structural change

between 1953-1960 and 1961-1967. Hence, separate regressions are run for the two periods.

Hess (1975) addresses the question of how the market price of risk responds to changes in the riskless rate of interest. He finds out that a change in the riskless rate of interest causes changes in relative rates of return on risky assets. Given an initial position of equilibrium, he notes that an increase in the money supply or its growth rate, accomplished through purchases of the riskless assets, lowers the riskless rate, causing the rate to be lower than those on alternative assets such as common stocks and loans. Asset substitution is induced (risky for riskless assets) in the portfolio, resulting in decreases in yields on risky assets.

Campbell (1978) presents a result showing that in the long run, it makes little difference whether monetary policy influences bank securities holdings as opposed to loans, since neither loans nor securities nor their proportion of total bank assets makes a significant contribution to the explanation of fluctuations of GNP when they are used as independent variables in equations with the standard indicators of monetary policy. However, the paper asserts that an expansion in loans has a more immediate impact on fluctuations in GNP than does an expansion in securities. The results drawn from quarterly data for 1951-1972 show that loans have an immediate impact, whereas the impact of a change in securities holdings is delayed at least one quarter. Therefore, if the policy makers' time horizon is short (where short is less than six months), portfolio composition is important.

But, if their position is one of non-interference in short-term swings, then it should be appropriate to ignore aggregate bank portfolio composition.

Ratti (1980) presents an analysis of a partially risk averse bank facing uncertainty about the flow of demand deposits and the risk of default on loans in the United States of America. Using simultaneous equations method with secondary data covering 1976 to 1977, three alternative income measures, Net Operating Income; Income before Tax and Net Income after Tax are regressed in turn on balance sheet assets and liabilities. The income measures as well as asset and liability items are deflated by total assets and each equation contains an intercept and an inverse of total assets as a measure of a scale variable. In each regression, the coefficients of the six liability variables are negative and statistically significant at the 1% level, whilst the coefficients of the asset variables are positive and statistically significant at the 5% level. The result confirms that commercial banks in the sample are risk averse.

Batavia and Lash (1982) contradict Studies by Campbell (1978) and others on the importance of the composition of bank portfolios on economic activity. They note that an increase in bank loans will have a larger impact on GNP than an equivalent increase in bank investments, because Campbell (1978) and others assumed bank loans are exogenous. Batavia and Lash (1982) infer that once the feedback effects of GNP onto the loan ratio are allowed for, the importance of the loan ratio declines substantially. Testing using simultaneous estimation methods, they fail to find any significant impact from portfolio composition onto GNP. Their results contrast with earlier studies, suggesting

that policymakers need not concern themselves with the impact of the composition of bank portfolios upon economic activity, even in the short run.

Using seasonally adjusted quarterly averages of data from 1959 to 1979, Batavia and Lash (1988) employ a simultaneous equation model to analyse bank loan accommodation in the United States of America. The writers use both Two-Stage and Three-Stage Least Squares (2SLS and 3SLS) estimation techniques. Both methods yield similar results, but only the 3SLS results are reported. Both loan demand and supply functions are estimated. The loan supply equation is specified as a function of the loan rate, the riskless rate of return (the opportunity cost of lending), the bank's cost of deposits, and adjusted asset – a scale variable to reflect the constraint on a bank to raise funds. The adjusted asset variable is measured as the sum of the bank's excess reserves and investments, which represents the bank's ability to expand loans through adjustments to assets. The Federal Funds Rate (the U.S. Interbank lending rate) is dropped from the model because of the problem of multicollinearity. All the included variables have the expected signs and are all significant at the 5% level. The loan rate has a positive sign, as well as the adjusted asset and deposit cost variables. As expected, loan supply is negatively related to its opportunity cost. The study finds out that the loan supply curve is positively sloped, inconsistent with the Accommodation principle which holds that the loan supply curve is perfectly elastic. The study confirms that loans are determined by the interplay of demand and supply.

Peek and Rosengren (1995) argue that an important determinant of a bank's reaction to shocks in relation to loan supply would be its capital-to-asset ratio. If banks find it difficult (or expensive) to raise capital, for example, they could be reluctant to lend even if there is ample demand for credit.

Chakravarty and Scott (1999) employ a logistic regression model measuring the probability of being rationed as a function of borrower-specific and relationship variables to analyse the effect of relationships on credit rationing of consumer loans in Chicago. They empirically examine how relationships between individual households and their creditors affect the probability of being credit-rationed. Using a data set where the credit-rationing of individual households is directly observed, they show that relationship length and the amount of activities between a family and a prospective lender significantly lower the probability of being credit-rationed. Moreover, the study examines the relative role of relationships in determining the interest rates of two consumer loans - a mortgage loan and a "special purposes" loan - and shows that mortgage loan rates are driven less by relationship factors than the special purposes loan rates.

Druck and Garibaldi (2000) in explaining inflation and portfolio allocation in the banking system of Argentina, look at the dynamic behaviour of the composition of banks' assets in Argentina between 1983 and 1998. They find a robust relationship between relative price variability and the fraction of banks' portfolio invested in government securities, controlling for the level of economic activities and the size of government budget deficit.

According to Druck and Garibaldi (2000), when a firm's failure is viewed as costly to banks, an increase in the interest rate charged on loans and advances may decrease the net return to a bank, because it increases the probability of default of the clients. They argue therefore that banks' portfolio allocation between risky assets and the alternative riskless asset is a function of the difference between the expected returns on the two asset classes and the variance of the risky return. The study uses quarterly data. Banks' claim on the central government as a proportion of the sum of the claims on the private sector and the central government is regressed on relative price variability, whilst controlling for output growth and government fiscal deficit as a percentage of GDP for the research period. The paper uses Akaike and Schwarz criteria to determine the appropriate lag lengths in their error correction modelling. The writers specify two separate equations; the basic equation without any additional regressors and another one with a dummy variable to account for convertibility of the Argentina Peso.

Druck and Garibaldi (2000) find out that both relative price variability and government budget deficit are significant determinants of the allocation of capital in the banking industry, while the role of output growth is found to be negligible. Also, controlling for the convertibility law seems to be unimportant, while the lagged dependent variable is found to be significant, all at the five per cent level. Among the significant variables, only relative price variability is persistently significant at the 5% level (a long run relationship). The model predicts that an increase in the variability of assets returns would reduce banks' profits, increases the real rate of interest and raises the fraction of

banks' earning assets in government securities. The study however neglects individual bank specific effects.

Furfine (2000) develops a structural dynamic model of a banking firm to analyse how banks adjust their loan portfolios over time. In his model, banks experience capital shocks, face uncertain future loan demand, and incur costs based on their closeness to regulatory minimum capital requirements. Non-linear relationships between bank capital levels and lending are derived from the model, and key parameters are estimated using quarterly panel data on large US commercial banks operating continuously between December 1989 and December 1997. Simulations predict that increases in risk-based and leverage capital requirements, negative capital shocks, or a decline in loan demand cause a reduction in loan growth. Nevertheless, by calculating the optimal portfolio response to these various changes, it is shown that changes in capital regulation are a necessary feature to explain the decline in loan growth and the rise in bank capital ratios in the US witnessed slightly over a decade ago. Consequently, the study suggests that the effort to redesign bank capital requirements should work under the assumption that banks will optimally respond to the economic incentives found in the regulation.

Agung et al. (2001) use macro and micro panel data analyses to study the existence of a credit crunch in Indonesia after the 1997 credit crisis. They investigate the relationship between the loan supply and real lending capacity, lending rates, real output, bank's capital ratio, and non-performing loan. The results show that the coefficients on NPLs are

negative and statistically significant, which indicate that bank credit supply declines with the worsening of the problem of NPLs.

Baum et al. (2002) empirically investigate the link between bank lending and macroeconomic uncertainty using annual and quarterly U.S. bank level data. They conclude that with greater macroeconomic uncertainty, banks collectively become more conservative, and this concerted action will lead to a narrowing of the cross-sectional distribution of banks' loan-to-asset ratios.

Dahiya et al. (2003) analyse the bank's share price reaction when one of its corporate borrowers enters financial distress. They use four different windows: 11days, 7days, 5days and 3days to measure the market reaction to the news of a borrower's default and bankruptcy on the bank. Findings from their study using OLS estimation technique are consistent with the adverse news hypothesis of negative wealth effect of lead bank's shareholders. For a lead bank, the study shows that the news of default of a corporate borrower is associated with an average decline of 3.8% in its stock returns over an 11day period around the default date. Similarly, news of a corporate bankruptcy is associated with a 1.8% decline in the bank's returns on stocks over the same 11day horizon. When the banks are ranked in order of the magnitude of exposures, the price decline is statistically significant for highly exposed banks, but statistically insignificant for less exposed banks to distressed firms.

In investigating whether a securities market may play a role similar to that of a lender of last resort by being of assistance to banks who face possible liquidity shortages, Franck and Krausz (2005) reveal that development of the securities market in Argentina boosts the level of liquidity of the banks' asset allocation as well as the amount of long term loans the banks are willing to lend. But they show that this holds better when the lender of last resort exists alongside the securities market. The study also supports the fact that a high return on securities and a high cost of borrowing from the central bank reduce the amount of loans a bank chooses to hold in its portfolio.

Montgomery (2005) investigates the hypothesis that stricter capital adequacy requirements introduced under the Basel Accord caused Japanese banks to alter their portfolios away from heavily weighted risky assets such as loans and corporate bonds and into unweighted assets such as government bonds. Using a panel of Japanese bank balance sheets for fiscal years 1982–1999, the study finds that neither international nor domestic bank asset portfolios are strongly affected by the total regulatory capital ratio. The study explores the sensitivity of various risk weight categories of assets to both total regulatory capital and core regulatory capital and to examine differences in the sensitivity of asset growth to regulatory capital for domestic and international banks in Japan. The results make obvious that capital adequacy requirements introduced under the Basel Accord of 1988 affect the behaviour of international and domestic banks in Japan very differently. International bank portfolios are found to be marginally sensitive to total regulatory capital, but their portfolio allocation is highly sensitive to the core *tier I* capital ratio. It is evident that the International banks with relatively low core capital ratios tend

to shrink their overall assets and to shift their asset portfolio out of heavily-weighted risky assets such as loans and corporate bonds and into zero-weighted riskless assets such as government bonds. The portfolio allocation of domestic banks, on the contrary, does not appear to have been affected by the change in capital requirement.

Amidu (2006) examines whether bank lending is constrained by monetary policy in Ghana. Using panel cross sectional data covering the period from 1998 to 2004, he models the share of loans and advances in banks' total assets as a function of the growth rate of real GDP, the rate of inflation, the Central Bank of Ghana prime rate, broad money supply, bank size measured as the logarithm of a bank's total assets, and liquidity as measured by the share of a bank's liquid assets to total assets. Among the findings, the study shows that during the period of the investigation, Ghanaian banks preferred to invest in Government treasury bills and bonds. The result shows a statistically significant positive relationship between bank's credit and GDP growth and broad money supply. Also, a negative relationship exists between inflation and bank loans. With the firm level characteristics, the study reveals that a bank's size and liquidity positively influence its ability to extend credit when demanded.

In a discussion by Sawada (2008), the writer puts it that bank runs are attributed to two alternative views; the random withdrawal theory on the one hand, which considers bank runs as a self-fulfilling phenomenon, and the information based theory which considers bank runs as a phenomenon induced by the market discipline of depositors under asymmetric information on the other hand. To investigate portfolio management with

respect to banks exposed to liquidity risk, the author uses micro level data pertaining to the pre-war era of the Japanese banking industry (1927-1932), since the study is centred on a market without deposit insurance. The study focuses on deposit shocks of a bank to capture its liquidity risk, and analyses its effect on the proportions of three asset classes in its asset portfolio; cash, loans and securities. The study employs the use of an annual panel data for the period. The author estimates three equations, each with a change in cash, securities and liquid assets as a proportion of total financial assets (cash-asset, security-asset and liquid-asset ratios respectively) as dependent variables. A one period lagged differenced liquidity risk and a host of lagged controlled variables are used as the independent variables to take simultaneity into account, and the model is estimated by OLS. The findings show that liquidity risk as captured in the study is negatively and statistically significantly related at the 1% level of significance to the cash-asset ratio, positively related to the security-asset ratio and insignificantly related to the liquid-asset ratio.

Tracey (2011) employs an Ordinary Least Square (OLS) model to ascertain the minimum and maximum threshold points for NPLs at which commercial banks become risk adverse in the disbursement of loans. Using the study by Hou and Dickinson (2007) as the launching pad, the study looks at the risk aversion of banks in supplying loans through the modelling of loan supply on balance sheet variables such as the growth rate of the ratio of Non-performing loans to total loans, its square, the growth rates of deposits, other earning assets and capital. The study detects some level of evidence that at higher level of NPLs/Loan ratio, banks become more risk adverse in loan disbursement. It is also observed

that the two countries used have varying level of risk aversion behavioural patterns. The deposits growth rate is found to move in the same direction as loan supply.

Bathalomew (2005) uses a panel of seven banks in Sierra Leone with monthly data collected between March, 1999 and December, 2004. He finds out some mixed results. Estimating three equations to test the collusion hypothesis, the efficient market hypothesis and a joint hypothesis of collusion and efficient market hypotheses, he confirms support for the collusion hypothesis for the dominant banks, suggesting the role of monopoly power in driving dominant commercial banks' profitability in Sierra Leone, but rejects same for the fringe banks. His study however suggests that smaller banks derive profits from efficiency and not from monopoly rent. The study uses three measures of profitability; Return on Equity, Return on Capital, and Return on Assets for analytical purposes.

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

This chapter discusses the theoretical framework of the study. The chapter also justifies the inclusion of other relevant variables into the model for estimation. Special attention is paid to the technique of estimation, after a battery of tests are run to eliminate or reduce biases and inefficiencies in the parameter estimates.

4.2 Theoretical Framework and Model Specification

Markowitz (1959) developed a theory of an individual investor's optimal portfolio selection in terms of the trade-off between the expected return (mean) and risk (variance of the return). Sharpe (1964) and Lintner (1965) showed how the theory could be extended to the market portfolio, producing the following model for the expected excess return from an asset i :

$$E(R_i) - R_f = \beta_i [E(R_m) - R_f] \quad (4.1)$$

where $E(R_i)$ is the expected return on asset i , R_f is the riskless rate of return, $E(R_m)$ is the expected return on the market portfolio, β_i is the asset's market beta (a measure of market risk, otherwise known as the sensitivity of the expected excess asset returns to the expected excess market returns), $E(R_i) - R_f$ is the individual risk premium (or the expected excess asset returns) and $E(R_m) - R_f$ is the market premium (or the expected excess market returns). The asset's beta is defined as:

$$\beta_i = \frac{Cov(R_i, R_m)}{Var(R_m)} \quad (4.2)$$

The model used in this study is derived from the Capital Assets Pricing Model³⁰ (CAPM) tested by Fischer Black, Michael C. Johnson and Myron Scholes (1972). Black (1972) considered a more general case in which there is no riskless asset, where the observed R_f is replaced by the unobservable return on a zero beta portfolio, $E(R_0) = \gamma$. With this, equation (4.1) becomes

$$E(R_i) - \gamma = \beta_i [E(R_m) - \gamma] \quad (4.3)$$

where $E(R_i)$ = the expected return on the efficient portfolio i , β_i is the coefficient of the expected return of the market portfolio and γ is the unobserved return on the zero beta portfolio. The general idea behind CAPM is that investors (in this case, banks) need to be compensated in two ways: time value of money and risk. The time value of money is represented by the riskless rate of return (R_f) in equation (4.1) and compensates the investors for placing money in any investment over a period of time. The right hand side of the formula represents risk and calculates the amount of compensation the investor needs for taking on additional risk.

However, the classical portfolio allocation approach is not feasible in bank loan allocation because the expected return and the variance in bank loan allocation are in

³⁰ A model that describes the relationship between risk and expected return and that is used in the pricing of risky assets.

theory, functions of the allocation. Second, modern portfolio theory is mainly about finding optimal risk/return trade-offs for (financial) assets. Unfortunately, loan portfolio adjustments cannot occur instantaneously, like in most other asset categories. Third, in most cases, a bank has pre-knowledge of its expected returns and risks. As for the correlation matrix, the problem is more complex: the bank does not have enough internal data and information to estimate it accurately. Still, the problem is more complicated for the correlation matrix of individual loans because some of these loans are not traded in the stock market, like the loans of small firms and private individuals.

Our central concern therefore is the fraction of the investment budget that is allocated to the risky portfolio, in relation to the stock of interest earning assets in the portfolio p . Let y be the share of the investment budget that is allocated to the risky portfolio. The remaining $(1-y)$ is to be allocated to the riskless asset. We will define for our purpose here, the rate of return on risky assets as R_p and the expected rate of risky return as $E(R_p)$. If R_f is defined as the riskless rate of return and that the return on the complete portfolio is R_c , then,

$$R_c = yR_p + (1-y)R_f \quad (4.4)$$

Taking expectations of equation (4.4) and rearranging will yield

$$E(R_c) = R_f + [E(R_p) - R_f]y \quad (4.5)$$

When we combine a risky asset and a riskless asset in a portfolio, the standard deviation of the resultant complete portfolio is the standard deviation of the risky asset, multiplied by the weight of the risky asset in that portfolio. i.e., $\sigma_c = y\sigma_p$. The implication is that

$$\sigma_c^2 = y^2\sigma_p^2 \quad (4.6)$$

A commercial bank attempts to maximize utility by choosing the best allocation y , the share of the investment budget allocated to the risky assets. At this point, we assume that each bank can assign a utility score to competing investment assets based on the expected return and risk of those assets. One reasonable utility function that has been employed by financial theorists (Bodie, et al., 2009) assigns a portfolio with expected return $E(R)$ and variance σ^2 the following score:

$$U = E(R_c) - \frac{1}{2}A\sigma_c^2 \quad (4.7)$$

Where A is an index of the investor's risk aversion, R_c is the return on the complete portfolio, σ_c^2 is the variance of the portfolio and $\frac{1}{2}$ is just a scaling convention. The

problem then is one of maximising $U = E(R_c) - \frac{1}{2}A\sigma_c^2$ with respect to y . Substituting equations (4.5) and (4.6) in equation (4.7) gives the objective function:

$$\underset{y}{Max} U = R_f + y[E(R_p) - R_f] - \frac{1}{2}Ay^2\sigma_p^2 \quad (4.8)$$

The first order condition for maximising equation (4.8) is given as

$$\begin{aligned} \frac{\partial U}{\partial y} &= 0 \\ \Rightarrow E(R_p) - R_f - Ay\sigma_p^2 &= 0 \\ \Rightarrow y^* &= \frac{[E(R_p) - R_f]}{A\sigma_p^2} \end{aligned} \quad (4.9)$$

To linearise equation (4.9), natural logarithms are taken on both sides to give:

$$\ln y^* = \ln [E(R_p) - R_f] - \ln A - \ln \sigma_p^2 \quad (4.10)$$

Following the works of Druck and Garibaldi(2000), Furfine (2000), Montgomery (2005) and Sawada (2008), our model is augmented in line with the objectives of our study to become:

$$\ln CPS_{it} = \lambda_0 + \lambda_1 \ln RP_{it} + \lambda_2 NPL_{it} + \lambda_3 ADR_{it} + \lambda_4 CAR_{it} + \lambda_5 \ln VRL_{it} + \lambda_6 \ln TA_{it} + \lambda_7 \ln D_{it} + \varepsilon_{it} \quad \text{---- (4.11)}$$

4.3 Expected Signs of the Parameters

A priori, the expected signs of the parameters are as follows:

- ❖ λ_1 is expected to be positive. Banks are seen to be risk averse, based on theory and available empirical evidence. As such, an increase in the risk premium provides an incentive for banks to lend more to the private sector. This reinforces the profit

maximising principle of banking discussed in the theoretical literature (Batavia and Lash, 1988).

- ❖ λ_2 is expected to be negative. If banks are truly risk averse, then an increase in the share of non-performing loans in the stock of credit to the private sector raises the level of client credit risk and hence reduces the level of private sector lending by banks. That is to say that as the quality of a bank's loan portfolio deteriorates, a bank becomes less inclined to give out more loans (Agung, et al., 2000 & Tracy, 2011).
- ❖ λ_3 is also expected to be negative, indicating the fact that the higher the ratio of private sector loans to total local currency deposit liabilities, the more illiquid the bank becomes and the less inclined the bank would be to lend to the private sector (Amidu, 2006).
- ❖ λ_4 is expected to be positive in sign. Banks are required by central bank regulation to keep a certain level of capital allocated to risky assets. The higher the bank's level of equity capital relative to total assets (higher leverage ratio), the more capitalised or sound the bank is said be in terms of capital adequacy and can therefore expand its lending portfolio at any given extra loan demand (Furfine, 2000).
- ❖ λ_5 is expected to be negative. Stability of earnings is a key factor in financial management. Higher variability of earnings is a deterrent factor for investment (derived from the specified model).
- ❖ The expected sign of λ_6 is positive. Large banks may have a comparative advantage in lending to large customers as they can exploit scale economies in

evaluating the hard information that is available on such customers. Small banks, however, may not be able to lend to large companies because of size limitations. However, small banks may have a comparative advantage in processing soft information on SMEs. Nonetheless, to the extent that large banks may use technologies such as credit scoring and asset-based lending to get around the “soft information problem”, they may actually be well suited to lend to SMEs. Since such technologies benefit from economies of scale, large banks may eventually develop a comparative advantage in SME lending (Amidu, 2006).

- ❖ λ_7 is also expected to be positive. Theory holds that banks with larger deposit base are likely to lend more to the private sector relative to banks with smaller deposits base (Amidu, 2006).
- ❖ The expected sign of δ_t is ambiguous. It would depend on what actually occurs in a particular period. The coefficient of GDP is expected to be positive, based on the reviewed literature.

4.4 Estimation Technique

The panel character of the data allows for a panel methodology for estimation. According to Arellono and Bover (1990), this reduces collinearity among the included variables and eliminates biases due to correlation between the individual specific effects and the regressors. But panel data alone do not remedy the problem of unobserved heterogeneity. One has to apply special regression models. The general form of a panel model is

$$Y_{it} = \alpha_i + \beta X_{it} + U_{it} \quad (4.12)$$

where Y_{it} is the dependent variable, X_{it} is a vector of regressors, β is a matrix of coefficients to be estimated, α_i is the unobservable individual specific effect that is assumed to be time invariant and which accounts for the intercept, and U_{it} is the random error term. The subscripts i and t denote an individual bank and time respectively.

To ascertain the appropriate model and estimation technique to be employed, a battery of tests are carried out. First, the Breusch and Pagan Lagrangian Multiplier test for random effects is conducted. Next, the Hausman (1978) specification test for fixed against random effects is conducted. The null hypothesis tested in the latter is the absence of correlation between α_i and X_{it} [i.e., $Cov(\alpha_i, X_{it}) = 0$], implying that the random effects model is appropriate for estimation. Additionally, a test for time-fixed effect under the null that all the year coefficients are jointly equal to zero is carried out. In reality, there are various forms of fixed effects models. There are those with no temporal effects but with significant differences among entities (individual specific intercepts). As well, there are those models with no significant entity differences but intercepts that vary according to time. Another form of fixed effects models is that with constant slopes but with intercepts that vary across entities. Also, a fixed effects model would have differential intercepts and slopes across entity and/or time. As dictated by the test result, when the time effects are added to the bank effects, we get the bank and time Fixed Effects Model (a two-way error component model) of the general form:

$$Y_{it} = \alpha_0 + \lambda X_{it} + E_i + \tau_t + \varepsilon_{it} \quad (4.13)$$

Where E_i is the bank specific effect such as management quality, bank policies and procedures that do not readily change with time, and τ_t is the time specific effect such as macroeconomic conditions which are fixed across banks. More specifically, the time and bank specific fixed effect model is given as:

$$Y_{it} = \beta_0 + \beta X_{it} + \gamma_2 E_2 + \dots + \gamma_n E_n + \delta_2 \tau_2 + \dots + \delta_t \tau_t + u_{it} \quad (4.14)$$

E_i in equation (4.14) is an entity (bank) dummy that takes a certain value from one (1) to N (where N is the number of cross sections) for a given bank and zero otherwise. $N-1$ bank dummies are included in the model. τ_t is a binary time variable (dummy) that takes a certain value from one to T (where T is the number of observed years) for a particular year and zero otherwise; $T-1$ time dummies are also added to the model. It is worth noting that these bank and time dummies are introduced by the econometric software, Stata, not the researcher.

The final model that is estimated is of the form

$$\ln CPS_{it} = \lambda_0 + \lambda_1 \ln RP_{it} + \lambda_2 NPL_{it} + \lambda_3 ADR_{it} + \lambda_4 CAR_{it} + \lambda_5 \ln VRL_{it} + \lambda_6 \ln TA_{it} + \lambda_7 \ln D_{it} + \sum_2^N \gamma_i E_i + \sum_2^T \delta_i \tau_i + \varepsilon_{it} \quad (4.15)$$

All the variables in equation (4.15) are as defined earlier. Equation (4.15) is a linear regression with a set of dummy-variables on which all the tests and the final estimations are based.

There is no reason to be worried over autocorrelation in the specified model because, autocorrelation is only a problem in macro panels with long dates; more than 20 or 30

years (Torres-Reyna, 2012). Also, an attempt to justify the use of a dynamic panel model broke down, given the insignificance of the lagged dependent variable as a predictor variable.

Generally, Fixed Effects Models rest on the assumption of strict exogeneity. That is, $Cov(X_{it}, U_{it}) = 0$. A violation of this assumption (endogeneity problem) renders the Fixed Effects estimator biased. Endogeneity is introduced into any model in three ways; omitted variables (or selection bias), measurement errors and simultaneity. The problem of endogeneity is theoretically taken care of by the use of an Instrumental Variable Estimator. There are two ways of doing this; the Two Stage Least Squares (TSLS or 2SLS) method and the Generalised Method of Moments (GMM) technique, assuming that the instruments used highly correlate with the regressors, but not with the error term. The presence of heteroskedasticity makes GMM a more efficient method of estimation over the simple IV estimator (2SLS), whereas if heteroskedasticity is not present, the GMM estimator is no worse asymptotically than the simple IV estimator (Baum, et al., 2002). Nonetheless, the use of GMM comes with a price tag. According to Hayashi (2000), the optimal weighting matrix at the core of efficient GMM is a function of fourth moments, and obtaining reasonable estimates of fourth moments may require very large sample sizes. The resultant effect is that the efficient GMM estimator can have poor small sample properties. According to Brüderl (2005), IV methods of estimation have produced a big mess in social research. The use of an IV estimation technique comes with the price tag of a loss of efficiency (and hence wider confidence intervals) and may lead to bias. Additionally, two issues usually plague the IV method. Either no IV is available

in practice or that the quality of a potential IV is uncertain. Since the size of the IV bias is increasing in the number of instruments used, one recommendation is to be parsimonious in the choice of instruments (Hahn and Hausman, 2002a).

NPL and *ADR* were suspected to be endogenous, based on their computations. The presence of endogeneity is tested in this study using the Davidson-MacKinnon test of exogeneity via instrumental variables. Actual provisions for bad and doubtful debts and profit before tax are used as instruments for that purpose. A rejection of the null hypothesis of the Davidson-MacKinnon test of exogeneity would indicate the presence of endogeneity. According to Davidson and MacKinnon, this test is similar to the Durbin-Wu-Hausman (DWH) test for endogeneity. It will always yield a computable test statistic, whereas the Hausman test, depending on the difference of estimated covariance matrices being a positive definite matrix, often cannot be computed by standard matrix inverse methods.

A Modified Wald test for groupwise heteroskedasticity in the Fixed Effect Regression Model is carried out, so as to ascertain whether or not to correct for groupwise heteroskedasticity in order to have a robust standard error.

Equation (4.15) is estimated using the “*areg*” command of Stata version 11. The command fits a linear regression absorbing one categorical factor. It is designed for datasets with many groups, but not a number of groups that increases with the sample size. The limitation of this mode of estimation is that it is not possible to estimate time invariant variables such as a dummy for bank type. Similarly, the presence of the time

specific fixed effects makes it difficult to add cross section invariant variables such as GDP growth rate. To account for the effect of such important variables on bank loan supply, a dummy variable, TYPE that takes the value of 1 for a state owned bank (TYPE 1), 2 for a private domestic bank (TYPE 2) and 3 for a foreign bank (TYPE 3), while using TYPE 2 as the reference group, and GDP (real GDP growth rate) as a control for economic activities and hence, bank loan demand are added to equation (4.15) and estimated using a random effects model.

4.5 Definition of Variables

The variables are defined as follows:

- *lnCPS* is the natural logarithm of the stock of bank credit to the private sector as a percentage of the stock of Interest Earning Assets (IEA). That is, the banks' share of loans in their total interest earning assets, used as a measure for the proportion of a bank's investment budget that is allocated to risky assets as dictated by the theoretical model.
- *lnRP* is the natural logarithm of the difference between the risky rate of return on loans (risky asset) and the return (annual percentage yield) on 91days treasury bills (riskless assets), used a measure for risk premium. The choice of this variable is also based on the theoretical model. Since some observations on *RP* take values less than zero, one is added to this series to enable us take natural logarithms.
- *NPL* is the share of non-performing loans in the stock of gross bank credit to the private sector (quality of bank loans) used as a measure for clients' credit or

default risk. The derived model has in it, variability of returns on risky assets as the only risk parameter. This captures only market risk of a representative bank. We have added to the theoretical model *NPL* and *ADR* to account for credit risk and liquidity risk respectively based on the reviewed empirical literature such as Agung, et al. (2001) and Amidu (2006).

- *ADR* is a ratio of a bank's gross loans and advances to local currency deposits, used as a measure for liquidity risk. Higher values imply higher position of illiquidity.
- *CAR* is a bank's tier 1 capital as a proportion of total assets (Leverage Ratio). The choice of this variable rests on the fact that the level of risk assumed by a bank and hence its reward to its shareholders is dictated by the bank's level of capitalisation as discussed in the reviewed literature. This is because every risk category is assigned a specific amount of risk capital.
- *lnVRL* is the natural logarithm of the variability of the interest rate on loans and advances as a measure of market risk of a representative bank as seen in the theoretical model.
- *lnTA* is the natural logarithm of a bank's Total Assets, used in the study as a measure of a bank's size (a bank specific observed variable). This variable is borrowed from the work of Bathalomew (2005).
- *lnD* is the natural logarithm of local currency deposits of a representative bank, borrowed from the work of Tracey (2011). As financial intermediaries, commercial banks' main function is to receive deposits and make loans to facilitate the flow of capital. Mostly, deposits are the main funding sources for

commercial banks' assets. Local currency deposit instead of total deposit, is used because in Sierra Leone, lending is permitted only in local currency.

4.6 Data Type and Sources

The study purely makes use of secondary data collected from various sources. The principal data source is the individual banks' balance sheets and income statements as submitted to the Central Bank of Sierra Leone for supervisory purposes. Complementary sources include the Central Bank of Sierra Leone Monthly Economic Reviews (various issues), their Semi-annual bulletins, the World Bank Development Indicators and the International Financial Statistics (IFS) year books (various issues) published by the International Monetary Fund (IMF). The data set consists of an unbalanced panel of all thirteen Commercial Banks operating in Sierra Leone, observed over a period of 10 years (2002 to 2011).

CHAPTER FIVE

EMPIRICAL RESULTS AND DISCUSSIONS.

5.0 Introduction

This chapter presents analysis of the empirical findings of the research. The chapter starts with a presentation of the results of the diagnostic tests to validate the estimation techniques employed in the study. As well, the results of the regression estimations are presented for discussion, after a brief presentation of summary statistics.

5.1 Diagnostic Tests

5.1.1 Test for Endogeneity

Before estimating the derived model, it is important to first test the appropriateness of the techniques employed. What is tested here is not endogeneity per se. We have employed the Davidson-MacKinnon Test of Exogeneity. The null hypothesis tested is that Ordinary Least Squares (OLS) Fixed Effect would yield consistent estimates. The test result is as presented in Table 5.1. Three cases were tested:

- Case One: that *NPL* and *ADR* are exogenous in the model
- Case Two: that *NPL* is exogenous in the model
- Case Three: that *ADR* is exogenous in the model

Table 5.1 Results of the Davidson-Mackinnon Test of Exogeneity

CASE	F & Chi-Sqr. STATISTICS	P VALUE
Case 1	F(2, 74) = 0.0235051	(0.9768)
Case 2	Chi-sqr (1) = 0.033	(0.8564)
Case 3	Chi-sqr (1) = 0.33	(0.8561)

Source: Author's computation using STATA version 11.

We failed to reject the null hypothesis at all conventional levels of significance (based on the probability values in Table 5.1) that an Ordinary Least Squares (OLS) Fixed Effects estimation of equation (4.15) would yield consistent estimates. In effect, this explains that *NPL* and *ADR* are not endogenous in the model as perceived from first sight. The actual Stata output of the test is shown in Figure C.2.

5.1.2 Tests for Consistencies of OLS, Random and Fixed Effects Estimators.

Having failed to reject the hypothesis that *NPL* and *ADR* are truly exogenous, the Breusch and Pagan Lagrangian multiplier test for Random Effects was conducted. The test result is as shown in Table 5.2. We rejected the null of Random Effects at the 1% level of significance as illustrated by Table 5.2. This suggests that Random Effects model will yield inconsistent estimates of equation (4.15). The Stata output for the test is presented in Figure C.3.

Table 5.2 Result of the Breusch and Pagan Lagrangian Multiplier Test for Random Effects.

	Var	Sd = sqrt(var)
lnCPS	0.0622211	0.2494416
e	0.0167278	0.1293359
u	0.0056798	0.0753647

Test: var(u) = 0

Chi sqr. (1) = 23.51

Prob.>Chi sqr. = 0.000

Source: Author's computations using STATA version 11.

5.1.3 The Hausman (1978) Specification Test

For consistency of the parameter estimates, we further tested the null hypothesis that the difference in coefficients from a random effects model and fixed effects model is not systematic. That is to say that a random effects model will yield consistent estimates of equation (4.16). Table 5.3 shows that we rejected the null hypothesis at the 1% level of significance. This validates the use of a Fixed Effect Model for estimation.

Table 5.3 Result of the Hausman Specification Test

VARIABLE	Coefficients			
	(b) FIXED	(B) RANDOM	(b-B) DIFFERENCE	sqrt(diag(V_b-V_B)) S.E.
InRP	-0.0059315	0.0360744	-0.0420059	0.0503311
NPL	0.1933108	0.1617214	0.0315894	0.0236849
ADR	-0.1560785	-0.217545	0.0614666	0.0265302
CAR	0.3825155	0.4435134	-0.0609979	0.1031563
InVRL	6.553333	5.132879	1.420453	2.089766
InTA	-0.0931386	-0.1287828	0.0356443	0.0238235
InD	0.1232562	0.1322042	-0.0089479	0.0119141

b = consistent under Ho and Ha; obtained from xtreg

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

Test: Ho: difference in coefficients not systematic

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

$$= 26.48$$

Prob>chi2 = 0.0004

(V_b-V_B is not positive definite)

Source: Author's computation using STATA version 11

5.1.4 Test for Groupwise Heteroskedasticity

To account for loss of efficiency of the Fixed Effects estimators, the model was tested for groupwise heteroskedasticity using the Modified Wald test for groupwise heteroskedasticity in the Fixed Effect Regression Model. Given that $\chi^2(13) = 98.39$ and $\text{Prob}>\chi^2 = 0.0000$ as obtained from the test result; we rejected the null hypothesis of groupwise homoscedasticity (equal variance for all banks) at the 1% level of significance, suggesting that the model be corrected for groupwise heteroskedasticity. The Stata output of the test is shown in Figure C.5.

5.1.5 Test for Time Specific Fixed Effects

Before the final model is estimated, it was tested for the presence of any significant time specific fixed effects to see if time fixed effects are needed when running the Fixed Effects Model. For this purpose, a Fixed-Effects (within) regression with 94 observations and 13 groups including $T-1$ year dummies was estimated. The test performed is a joint test to see if the dummies for all years are equal to zero. If they are, then no time fixed effects are needed. Given that $F(9, 65) = 5.23$ and $\text{Prob.} > F = 0.0000$, we rejected the null hypothesis of no time Fixed Effects. The result of the test is as shown in Figure C.6.

5.2 Descriptive Statistics

From the available data, the overall mean value of bank credit to the private sector for the period 2002 to 2011 stood at 52% of total interest earning assets, with a standard deviation of 25%. Whilst the market risk premium averaged 0.4%, it ranged from a low of -20% to a high of 35%. Risk Premium is defined as the excess of the return on risky assets (the return on commercial and retail loans in this case) over the return on government securities or riskless assets (Treasury Bills in this case). The value becomes less than zero when the return on Treasury Bills is greater than the average lending rate by banks.

The minimum value for Non-Performing Loans as a fraction of Gross Loans and Advances by Banks shows 0.000. This is explained by the fact some of the banks sampled here had just started operation with no record of doubt loans. Detail of the descriptive statistics is recorded in Table 5.4.

Table 5.4 Descriptive statistics of the data used in the regression analysis.

VARIABLE	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM
CPS	0.5182	0.2494	0.0003	1.0000
RP	0.0039	0.1119	-0.2020	0.3538
NPL	0.1377	0.2233	0.0000	0.6935
ADR	0.7451	0.6788	0.0013	5.6039
CAR	0.2696	0.1811	0.0694	0.9127
VRL	0.0060	0.0041	0.0000	0.0173
TA**	133	132	5	582
D**	62	70	0.142	331

Source: Author's computations using STATA version 11. ** means the values are expressed in billions of Leones.

5.3 Regression Results and Analysis

For the purpose of clarity and juxtaposition, equation (4.15) was estimated in two forms. The first form entails the estimation without any correction for heteroskedasticity (Result in Table 5.5), whilst the second estimation is the form with correction for heteroskedasticity (Result in Table 5.6). The second form is said to have a robust standard error to account for groupwise heteroskedasticity.

Next, the model was augmented as discussed in chapter four, and estimated using a random effects model. All the seven explanatory variables in equation (4.15) were used in all regressions so as to compare the magnitudes, directions and significance of the coefficients. The *areg* command (with the option to absorb bank *id*) was used in the first two regressions, since the model was found to be a Fixed Effects Model with both bank and time fixed effects.

Table 5.5 Result 1: The Linear Regression, absorbing indicators.

				Number of obs.	=	94
				F(16, 65)	=	11.46
				Prob.> F	=	0.0000
				R-squared	=	0.8760
				Adj. R-squared	=	0.8225
				Root MSE	=	0.1051
lnCPS	Coef.	Std. Err.	t Stat.	Prob. > t 	[95% Conf. Interval]	
lnRP	1.425873	0.367597	3.88	0.0000	0.6917311	2.160016
NPL	0.217684	0.078227	2.78	0.0070	0.061454	0.3739134
ADR	-0.12544	0.033827	-3.71	0.0000	-0.1930005	-0.0578849
CAR	0.35522	0.189283	1.88	0.0650	-0.0228046	0.7332455
lnVRL	8.879144	6.028977	1.47	0.1460	-3.161554	20.91984
lnTA	-0.3107	0.060347	-5.15	0.0000	-0.4312163	-0.1901738
lnD	0.12611	0.037262	3.38	0.0010	0.0516924	0.2005281
year						
2003	0.418088	0.103508	4.04	0.0000	0.2113676	0.6248088
2004	0.181235	0.073244	2.47	0.0160	0.0349569	0.327512
2005	0.135336	0.073858	1.83	0.0710	-0.0121681	0.2828399
2006	0.098581	0.074645	1.32	0.1910	-0.0504959	0.2476582
2007	0.348665	0.085378	4.08	0.0000	0.1781535	0.5191762
2008	0.244089	0.097376	2.51	0.0150	0.0496159	0.4385611
2009	0.467975	0.109853	4.26	0.0000	0.2485839	0.6873661
2010	0.629906	0.125265	5.03	0.0000	0.3797355	0.880077
2011	0.245617	0.132338	1.86	0.0680	-0.01868	0.5099135
_cons	3.655637	0.847751	4.31	0.0000	1.96256	5.348713
ld	F(12, 65)=		8.7310	0.0000	(13 Categories)	

Source: Author's computation using Stata version 11.

From the result in Table 5.5, six out of the seven explanatory variables included in the estimation process (*lnRP*, *NPL*, *ADR*, *CAR*, *lnTA* and *lnD*) are found to be significant determinants of the proportion of a bank's interest earning assets that is allocated to the private sector in the form of loans and advances (without correcting for groupwise heteroskedasticity). Among the statistically significant variables, only *CAR* is found to be weakly significant at the 10% level; all the others are significant at the 1% level. *lnVRL* is found to have a negligible or an insignificant influence on bank credit supply to the

private sector in Sierra Leone for the period considered, and its sign is contrary to expectations. When corrections are made for groupwise heteroskedasticity, the result does not change much as shown in Table 5.6. The explanatory power of the model remains the same in both cases. The reasons underpinning the behaviour of these variables are discussed ahead in this chapter.

In both outputs (Tables 5.5 and 5.6), 88% of the total variations in the dependent or predicted variable are explained by variations in the predictor variables as included in the model. Nevertheless, with adjustments made for the number of cases and the number of included variables, the explanatory power of the model drops to 82% as indicated by the Adjusted R^2 . A test (F) to see whether all the coefficients in the model are different from zero gives $\text{Prob.} > F = 0.0000$, which is an indication that the model is a good one, since all the included variables are jointly significant at the 1% level (in both results).

From Table 5.6, it is deduced that for a given bank, as the level of risk premium (RP) increases across time by a percentage, the share of the bank's interest earning assets that is allocated to loans and advances to the private sector (CPS) increases by 1.43%, all other determinants remaining the same. This confirms that commercial banks operating in Sierra Leone like any other normal commercial bank in the world are risk averse, willing to venture out to the perceived risky sector of the economy only when the risk premium is sufficiently appreciable. This outcome contradicts the accommodation principle of commercial banking discussed in chapter three, but conforms to the profit maximising

hypothesis of commercial banking. Batavia and Lash (1988) had a similar result for the United States of America.

Table 5.6 Result 2 of the Linear Regression, absorbing indicators and with Robust Standard Errors.

	Number of obs.	=	94
	F(16, 65)	=	18.73
	Prob.> F	=	0.0000
	R-squared	=	0.8760
	Adj. R-squared	=	0.8225
	Root MSE	=	0.1051

InCPS	Coef.	Robust Std. Err.	T	Prob. > t	[95% Conf. Interval]	
lnRP	1.425873	0.438076	3.25	0.0020	0.5509756	2.300771
NPL	0.217684	0.063446	3.43	0.0010	0.0909724	0.344395
ADR	-0.12544	0.055998	-2.24	0.0290	-0.2372775	-0.0136079
CAR	0.35522	0.195035	1.82	0.0730	-0.0342908	0.7447316
lnVRL	8.879144	5.829454	1.52	0.1330	-2.763079	20.52137
lnTA	-0.3107	0.080188	-3.87	0.0000	-0.4708411	-0.150549
lnD	0.12611	0.048493	2.6	0.0120	0.0292636	0.2229569
year						
2003	0.418088	0.115473	3.62	0.0010	0.1874737	0.6487027
2004	0.181235	0.071359	2.54	0.0130	0.0387209	0.323748
2005	0.135336	0.046382	2.92	0.0050	0.0427057	0.2279661
2006	0.098581	0.049811	1.98	0.0520	-0.000899	0.1980614
2007	0.348665	0.069344	5.03	0.0000	0.2101753	0.4871544
2008	0.244089	0.075214	3.25	0.0020	0.093875	0.394302
2009	0.467975	0.086596	5.4	0.0000	0.2950306	0.6409194
2010	0.629906	0.118178	5.33	0.0000	0.3938892	0.8659233
2011	0.245617	0.108655	2.26	0.0270	0.0286169	0.4626166
_cons	3.655637	0.987396	3.7	0.0000	1.683671	5.627602
id	absorbed		(13 Categories)			

Source: Author's computation using Stata 11.

NPL shows a positive and statistically significant influence on banks' loan supply to the private sector at the 1% level. For a given bank, as the share of non-performing loans in total loans increases across time by 1%, the share of loans in a bank's interest earning

assets increases by 0.22%, all other determinants of bank loan supply remaining the same. The sign of the coefficient is contrary to expectations. Two reasons may account for this behaviour. The first is the concept of *ever-greening* or *loan rescheduling*. Here, new loans are advanced by banks in order to encourage repayment of doubtful debts. In such a case, as the level of non-performing loans increases, so is the amount of outstanding loans and advances in the market. The second point is that the actual provisions that banks make for bad and doubtful debt is so small relative to the size of non-performing loans, so that its effect on loan supply to the private sector is infinitesimal. In fact, to smooth out its income from one year to the next, a bank can overestimate reserves for loan losses in good years and underestimate same in bad years. Additionally, a bank can resort to artificial ways of avoiding the recognition of loan losses, since actual loan losses are charged against capital reserves. This outcome is in line with the work of Kane and Malkiel (1965), but conflicts with that of Agung et al. (2001).

ADR is also a statistically significant variable at the 5% level in the second regression as shown in Table 5.6. It has a negative influence on bank loan supply as expected. It is observed from the result that an increase in a bank's *ADR* by 1% reduces the share loans in the bank's earning assets by 0.13% over time, other factors remaining the same. The negative relationship between *ADR* and *CPS* is explained by the fact that the liquidity of a bank loan as evident in the market is dependent on the loan's behavioural maturity profile, making banks less inclined to give out more loans relative to local currency

deposits. Sawada (2008) found out in the case of Japan that liquidity risk is negatively and statistically significantly related at the 1% level to the supply of commercial loans.

In the same vein, at the bank level, the supply of bank loans to the private sector moves in the same direction as the level of a bank's leverage ratio or Tier 1 Capital Asset Ratio (CAR) – a measure of the bank's capital adequacy, albeit at the 10% level of significance in both results. The result indicates that for a given bank, loan supply to the private sector rises by 0.36 unit, for any 1 unit increase in the Capital Asset Ratio. This comes in as expected and conforms to the work of Furfine (2000). Capital is always required to absorb the risks undertaken by a bank. Different risk categories attract different capital requirements, and loans and advances in general take up huge capital as already highlighted in chapter three. Additionally, the revised prudential guidelines by the Central Bank of Sierra Leone (BSL) cap the total exposures (including contingent liabilities) of commercial banks operating in Sierra Leone at 300% of their capital base (net worth).

For variability of loan interest rate (*VRL*), it turned out to be an insignificant variable in the model, and has a positive influence on bank loan supply, contrary to expectations. Because of the underdeveloped nature of the Sierra Leone banking sector, this counter intuitive result confirms that no much attention is paid by most banks to market risk measurements and mitigation when making loan supply decisions.

The measure of bank size ($\ln TA$) is found to have a statistically significant negative relationship with bank loan supply (at the 1% level), against our postulations and contrary to the result obtained by Amidu (2006) for Ghana. The result shows that large banks hold higher proportions of other earning assets (government securities) and less of loans to the private sector in their asset portfolio. On the contrary, bank loan supply in this study has been found to be positively responsive to growth in a bank's local currency deposit base, consistent with the finding of Tracey (2010).

In Table 5.5, the last row shows that overall, the share of loan supply to the private sector in banks' interest earning assets are significantly different across individual banks as shown by the F-Statistic. This explains the effect of individual bank's unobserved heterogeneity such as a bank's policies and procedures. Also, all the time coefficients turned out to be positive, an indication that on the average, credit to the private sector relative to banks' holding of total interest earning assets increased over the time period considered. For example, in 2005, the proportion of bank loan supply in total interest earning assets increased by 14% relative to 2002, taking the effects of all other variables as given.

Table 5.7 shows the fixed effects result with robust standard errors alongside the result obtained from the random effects estimation. The focus on the random effects result is to show how bank loan supply in Sierra Leone responds to the proxy for loan demand (GDP) and ownership. The result shows that increasing loan demand leads to credit rationing in Sierra Leone as shown by the negative coefficient of the variable. Looked at

from another angle, slowing down of economic activities does not deter banks from lending out credit, because their capital levels can well accommodate any needed provisions for bad and doubtful debts; the banks are well capitalised. Also, it is shown that state-owned banks (TYPE 1) hold on the average, less loans to earning assets ratio by 18%, relative to the private domestic bank (TYPE 2). Similarly, foreign banks (TYPE 3) hold 22% less of CPS relative to the private domestic bank (TYPE 2).

Table 5.7 Fixed and Random Effects Results Compared.

lnCPS	Fixed Effects Coefficients.	Prob. > t 	Random Effects Coefficients	Prob. > z
lnRP	1.425873	0.0020	0.09999	0.417
NPL	0.217684	0.0010	0.13732	0.0140
ADR	-0.12544	0.0290	-0.21872	0.0000
CAR	0.35522	0.0730	0.564994	0.0340
lnTA	-0.3107	0.0000	-0.16222	0.0540
lnD	0.12611	0.0120	0.132029	0.117
GDP	-	-	-0.53293	0.0580
TYPE1	-	-	-0.17753	0.0000
TYPE3	-	-	-0.22076	0.0000

Source: Author's computation using Stata Version 11.

CHAPTER SIX

CONCLUSION AND POLICY RECOMMENDATIONS

6.1 Conclusion

The general purpose of this work has been to investigate the factors that influence banks' portfolio allocation in Sierra Leone. Specifically, the study has looked into the effects of risk premium, credit risks as well as capital adequacy on bank asset portfolio allocation in Sierra Leone between 2002 and 2011.

To achieve its objectives, the study first provided an overview of the banking sector and then carried out an econometric analysis of the derived model. Towards this end, preliminary tests were carried out to assess the validity of the model that is used.

Two years after the number of operating commercial banks in Sierra Leone reached thirteen, the banking industry remains a profitable business, contradicting the concern that increased competition will eat into banks' profitability performance. Twelve out of the thirteen operating commercial banks recorded a before tax profit of over SLL 103Billion (USD 26 Million) with only one bank suffering a loss for the year ending 2011. Financial records from BSL indicate that for 2011, total local currency assets of the banking industry grew by 18% with industry profits increasing by 19.7% compared to the year 2010 when only eight banks recorded profits. The industry holds 42% of total local currency deposits in government securities, whilst loans as a percentage of local currency deposits stood at 81% as at 31st December 2011. Clearly, the sum of bank loans and their

holdings of government securities exceed 100% of their local currency deposit base. This highlights how heavy banks rely on other funding sources other than local currency deposits. However, 12% of gross loans are non-performing.

A diagnostic check using the Davidson-MacKinnon test of exogeneity confirmed that the perceived endogenous regressors (*NPL* and *ADR*) were indeed exogenous in the model. The use of a Random Effects model was rejected based on the result of the Breusch-Pagan LM test as well as the Hausman specification test. The estimated model suffered from groupwise heteroskedasticity for which corrections were made. Subsequently, it was found that the model contained both bank and time specific fixed effects. Both Fixed and Random Effects models were estimated for the sake of comparison.

Using annual bank level data on an unbalanced panel of thirteen banks in the market for the study period, and employing a time and bank specific fixed effects model, the principal hypothesis that the level of risk premium influences the share of loans to the private sector in interest earning asset of banks has been confirmed. Additionally, the study has shown that non-performing loans, tier 1 capital ratio and local currency deposit levels positively and statistically significantly affect banks' loan supply to the private sector, while *ADR* and bank size have significant negative effect on the dependent variable. Also, using random effect model estimation, bank loan demand as proxied by real national income growth rate, and bank type are found to be significant determinants of bank portfolio composition. Nevertheless, the market risk component of the model

(variability of loan interest rate) was found to play a negligible role in shaping banks' loan supply.

Attempts were made, first to estimate a dynamic panel model and, second, to account for the fact that a bank's loan portfolio adjustment process is not instantaneous, by regressing the predicted variable (*CPS*) on its own lagged value and the lagged values of the predictor covariates. Both attempts broke down, given the insignificant parameter estimates obtained from such regressions. The result of the attempted dynamic panel estimation is presented in Table B.6.

6.2 Policy Recommendations

The results discussed in chapter five clearly reveal that except for *lnVRL*, all the included explanatory variables in the model are significant determinants of bank loan supply. The results obtained in this study have significant implications for effective monetary policy formulations and implementations. As a matter of policy considerations, the following have to be strongly noted:

First, bank loan supply as a fraction of bank interest earning assets has been found to be positively responsive to risk premium. To that end, government should play the needed role for risk premium to be sufficient enough for banks to lend more to the private sector, relative to acquiring government securities. After all, banks are in the business of taking calculated risk to make money. Admittedly, this policy advice in no way advocates for a rising loan interest rate, because that would have the effect of adverse selection and moral

hazard. One way to enable the interest rates on treasury bills and treasury bearer bonds to be appreciably lower than the returns on loans and advances is for government to exercise fiscal discipline in line with the West Africa Monetary Zone's benchmark. That is, the Central Bank's financing of the budget deficit as a percentage of the previous year's tax revenue should be not more than 10%, and fiscal deficit as a percentage of GDP should not be more than 4%. That would reduce the amount of government's public sector borrowing requirements so as to bring down the yield on government securities through the interaction of demand and supply. Additionally, there should be an upper limit on how much in proportion a bank should hold in government securities at any given period of time.

Second, non-performing loan is found to have a positive influence on bank loan supply in Sierra Leone. We have advanced in this study that this may be because actual provisions for loan losses are far less than the value of non-performing loans on the banks' books which makes banks lend more to encourage repayment of doubtful debts. Non-performing loans do not show in the banks' audited accounts (the usual accounting practice). What is reported in the banks' income statements is "net recoveries/ (impairment losses) on loans and advances", a figure that is far less than the value of non-performing loans of the banks. This underestimates the portfolio risk of a bank. Banking supervisors should pay keen attention to the level of the banks' actual value of non-performing loans so as to truly capture the magnitude of the potential default rate of borrowers.

Third, the study finds a negative relationship between the loan-deposit ratio and a bank's loan supply. This is because banks cannot sell loans off their books, once they have originated it. We recommend that the Central Bank of Sierra Leone should play a parental role in strengthening the depth of the Interbank Market operations as a secondary market. This will have the effect of increasing access of banks to short term liquidity for intraday position management, enhance market depth to beyond the traditional overnight to one week tenor, and subsequently promote financial stability through confidence building. The availability of more funding sources other than client deposits reduces the risk of adverse deposits shocks.

Finally, a positive relationship has been established between bank loan supply and a bank's leverage ratio measured by a bank's equity divided by total assets, albeit at the 10% level of significance. On this note, the current effort of the Central Bank of Sierra Leone to double banks' capitalisation by 2014 as discussed in Chapter Two should not be relented upon. This is not justifying any increases in the risk capital requirements for the individual risk categories. Instead, we recommend a reduction in the risk capital requirements for fully secured credit exposures. Further, banks should be encouraged to have capital in excess of the minimum paid up capital (Capital buffers) so as have more room to absorb the inherent risk in the business of banking. Additionally, the current guideline of the Central Bank of Sierra Leone that set banks total exposure at a maximum of 300% of their net worth is recommended to be reviewed upwards, if banks are to lend more to the private sector.

6.3 Research Limitations

The data set used in this study was obtained from the Banking Supervision Department of the Bank of Sierra Leone as submitted by the respective banks for supervisory purposes. As such, we cannot vouch for the absolute accuracy of the data used. Besides, bank risk is a forward looking exercise that it becomes increasingly difficult to have a comprehensive measure for it. On this note, the measures of credit, liquidity and market risks as employed in the study are just one out of the numerous ways of capturing the respective risks. Moreover, the unavailability of data prior to 2002 limited the study period to between 2002 and 2011, both ends inclusive.

6.4 Areas for Further Research

In the future, interested candidates or researchers can investigate into the determinants of the sectoral allocation of bank credits. Additionally, with the availability of data, a time series analysis of this topic using aggregated data is advisable, where an impulse response analysis can be carried out.

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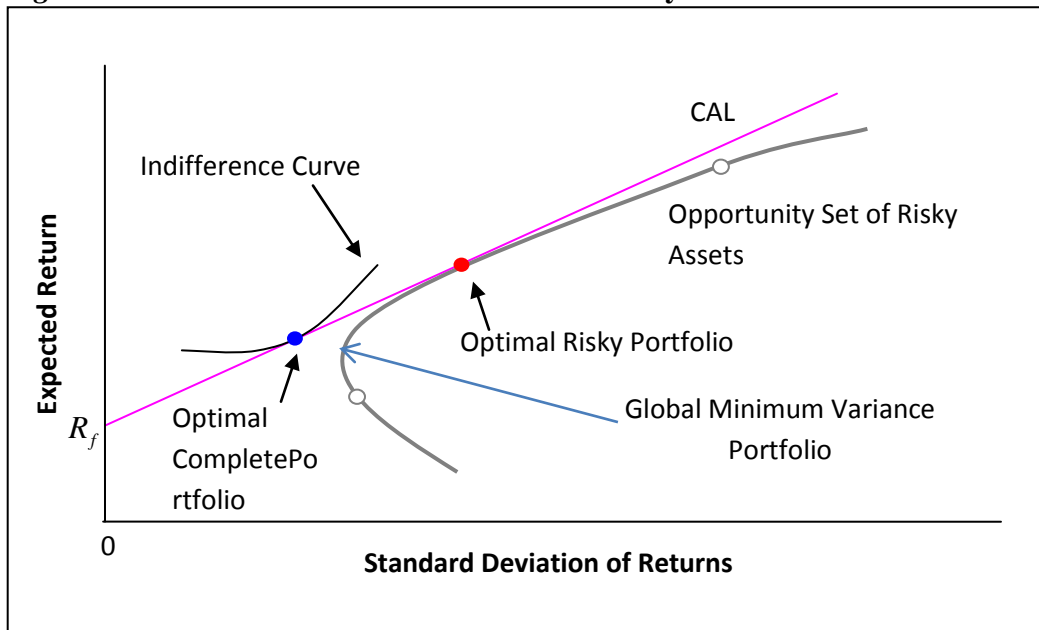
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APPENDIX A

THE MINIMUM VARIANCE FRONTIER OF RISKY ASSETS

Figure A.1: Minimum Variance Frontier of Risky Assets.

Source: Bodie et al., 2009

APPENDIX B

BANKING ACTIVITIES AND MARKET SHARES.

Table B.1 Industry NPL, ADR and IDR.

YEAR	NPL (SLL'000)	GROSS LOANS (SLL'000)	NPL(% OF GROSS LOANS)	Advances (SLL'000)	Deposits (SLL'000)	ADR	IDR
2002	28,362,979	58,644,559	48.36	58,644,559	174,322,932	33.64	74.73
2003	9,855,401	103,847,889	9.49	103,847,889	200,650,231	51.76	60.69
2004	17,654,155	145,248,849	12.15	145,248,849	250,095,502	58.08	60.25
2005	28,377,979	167,543,187	16.94	167,543,187	350,443,622	47.81	58.16
2006	39,747,897	201,275,320	19.75	201,275,320	407,620,203	49.38	58.22
2007	58,084,424	279,092,556	20.81	279,092,556	493,513,018	56.55	45.92
2008	73,942,166	439,820,084	16.81	439,820,084	705,465,261	62.34	54.70
2009	62,488,236	658,966,802	9.48	658,966,802	909,706,776	72.44	38.36
2010	92,326,434	874,704,758	10.56	874,704,758	1,089,699,599	80.27	42.85
2011	133,156,848	1,072,303,947	12.42	1,072,303,947	1,315,870,573	81.49	41.74

Source: Author's Computation using data from BSL.

Table B.2 Non-performing Loans as a percentage of Gross Loans and Advances (%)

YEAR	SCBSL	RCB	SLCB	UTB	GTB	FIB
2002	9.19	8.90	41.68	13.41	23.69	1.00
2003	1.57	5.72	16.42	19.43	11.53	1.00
2004	0.50	12.41	13.30	23.08	16.18	1.48
2005	4.84	20.42	11.06	33.02	21.31	2.08
2006	4.61	27.69	10.29	47.97	12.71	9.65
2007	5.35	35.02	15.76	46.55	5.54	7.66
2008	3.27	17.19	27.54	41.74	3.04	4.37
2009	3.55	10.10	18.81	14.21	3.93	6.53
2010	4.48	5.14	18.90	22.00	9.33	6.94
2011	4.46	7.66	10.77	26.35	9.74	10.53

Source: Author's Computation using data from BSL

Table B.3 Bank Advances to Deposits Ratio (ADR) (%)

YEAR	SCBSL	RCB	SLCB	UTB	GTB	FIB
2002	24.27	41.81	23.53	92.74	20.69	32.03
2003	40.85	64.43	34.81	103.21	52.52	84.12
2004	36.45	71.18	46.82	121.84	58.72	98.07
2005	17.85	62.30	48.99	89.57	33.83	42.10
2006	16.92	52.66	59.47	86.15	54.27	50.68
2007	22.41	51.96	64.69	96.16	55.57	67.17
2008	47.70	38.95	67.52	99.62	67.26	77.83
2009	54.33	68.38	60.46	98.29	113.22	67.41
2010	47.62	100.32	68.36	121.62	90.42	69.11
2011	49.96	90.86	70.22	156.32	62.37	63.17

Source: Author's Computation using data from BSL.

Table B.4 Bank Investments to Deposits Ratio (IDR) (%)

YEAR	SCBSL	RCB	SLCB	UTB	GTB	FIB
2002	108.68	63.98	69.72	56.74	66.86	43.53
2003	83.96	49.94	70.29	29.13	4.77	22.11
2004	87.30	43.43	64.11	23.52	33.95	19.78
2005	93.07	46.96	51.33	28.70	52.73	30.51
2006	93.29	57.99	28.54	50.64	65.28	57.51
2007	73.51	52.01	27.96	19.15	28.25	45.26
2008	84.07	58.82	38.75	26.42	21.24	42.61
2009	79.25	46.83	29.25	23.84	11.54	21.22
2010	106.81	22.91	30.45	31.06	37.33	35.44
2011	106.70	14.84	40.26	8.74	40.92	29.58

Source: Author's Computation using data from BSL.

Table B.5 Bank Tier 1 Capital to Assets Ratio (%).

YEAR	SCBSL	RCB	SLCB	UTB	GTB	FIB
2002	21.11	19.62	16.08	33.31	32.59	35.23
2003	18.77	19.96	19.54	31.46	13.27	21.04
2004	21.13	18.60	19.56	28.15	14.79	26.43
2005	14.72	16.62	22.78	21.75	9.20	14.63
2006	13.87	14.29	19.30	25.02	13.21	23.18
2007	14.06	12.90	16.55	25.78	16.53	27.29
2008	14.62	10.76	13.75	22.66	13.85	19.34
2009	12.76	13.98	11.12	26.81	15.08	15.00
2010	11.89	12.98	11.56	23.39	13.48	16.77
2011	13.26	11.96	9.89	22.97	13.30	13.30

Source: Author's Computation using data from BSL.

Table B.6 Return on Equity at the bank level (%).

YEAR	Industry	SCBSL	RCB	SLCB	UTB	GTB	FIB
2002	27.75	42.34	24.06	23.34	32.34	(31.88)	6.53
2003	0.79	1.46	(0.09)	2.70	(1.33)	(5.41)	0.16
2004	29.69	49.44	30.23	25.82	10.70	18.73	12.26
2005	25.25	49.18	26.37	18.44	6.14	22.42	23.24
2006	20.72	46.35	23.13	16.62	14.75	31.40	3.37
2007	9.65	28.06	20.82	6.62	16.27	17.90	6.92
2008	6.85	21.84	14.63	12.49	10.37	21.42	7.94
2009	3.08	25.61	20.66	7.83	12.96	27.26	5.22
2010	10.92	19.89	27.66	18.77	15.40	21.98	7.30
2011	14.88	26.03	20.68	22.18	16.74	26.57	14.99

Source: Author's Computation using data from BSL.

Table B.7 Market Share of Local Currency Deposits (%).

YEAR	SCBSL	RCB	SLCB	UTB	GTB	FIB
2002	20.52	30.97	38.71	6.14	2.34	1.32
2003	21.17	31.04	35.19	6.96	3.39	2.25
2004	21.87	32.02	35.05	5.94	3.30	1.76
2005	22.14	29.49	32.01	6.64	5.86	3.40
2006	21.25	29.06	31.24	6.75	6.01	4.69
2007	17.07	27.77	31.30	6.43	7.63	4.07
2008	11.62	23.66	29.07	6.96	10.62	5.34
2009	10.13	22.50	27.55	7.50	7.82	8.77
2010	9.51	24.83	24.72	7.61	7.39	7.14
2011	8.99	25.18	22.44	7.10	11.16	7.59

Source: Author's Computation using data from BSL.

Table B.8 Market Share of Total Assets (%).

YEAR	SCBSL	RCB	SLCB	UTB	GTB	FIB
2002	30.15	25.38	33.53	6.83	2.54	1.58
2003	26.20	28.82	30.05	7.67	4.79	2.48
2004	25.35	29.44	31.13	7.09	3.90	1.84
2005	25.86	26.49	30.33	6.91	6.11	3.12
2006	22.33	25.41	31.56	6.80	6.89	3.91
2007	19.42	22.53	27.24	5.85	11.25	3.52
2008	14.62	19.10	22.38	6.00	11.33	4.75
2009	15.33	19.38	19.23	6.50	9.77	5.70
2010	15.84	20.07	17.64	6.89	9.79	6.32
2011	15.09	19.52	19.38	6.68	10.33	6.56

Source: Author's Computation using data from BSL.

Table B.9 Market Share of Bank Loans (%).

YEAR	SCBSL	RCB	SLCB	UTB	GTB	FIB
2002	14.81	38.49	27.08	16.93	1.44	1.25
2003	16.70	38.64	23.66	13.89	3.44	3.66
2004	13.73	39.25	28.26	12.45	3.33	2.97
2005	8.27	38.43	32.80	12.45	4.14	3.00
2006	7.28	30.99	37.62	11.77	6.60	4.81
2007	6.73	25.41	35.66	10.88	7.46	4.82
2008	8.78	14.61	31.11	10.99	11.32	6.58
2009	7.40	20.69	22.41	9.92	11.91	7.96
2010	5.64	31.03	21.05	11.54	8.32	6.15
2011	5.51	28.08	19.34	13.63	8.54	5.88

Source: Author's Computation using data from BSL.

Table B.10 Market Share of Investments (%).

YEAR	SCBSL	RCB	SLCB	UTB	GTB	FIB
2002	29.85	26.51	36.12	4.66	2.09	0.77
2003	29.28	25.54	40.75	3.34	0.27	0.82
2004	31.70	23.08	37.30	2.32	1.86	0.58
2005	35.43	23.81	28.25	3.28	5.31	1.78
2006	34.04	28.94	15.31	5.87	6.74	4.63
2007	27.21	31.33	18.98	2.67	4.67	4.00
2008	17.64	25.14	20.35	3.32	4.07	4.11
2009	20.39	26.76	20.47	4.54	2.29	4.73
2010	23.70	13.28	17.57	5.52	6.44	5.91
2011	22.97	8.95	21.64	1.49	10.94	5.38

Source: Author's Computation using data from BSL.

APPENDIX C

OUTPUTS OF STATA VERSION 11

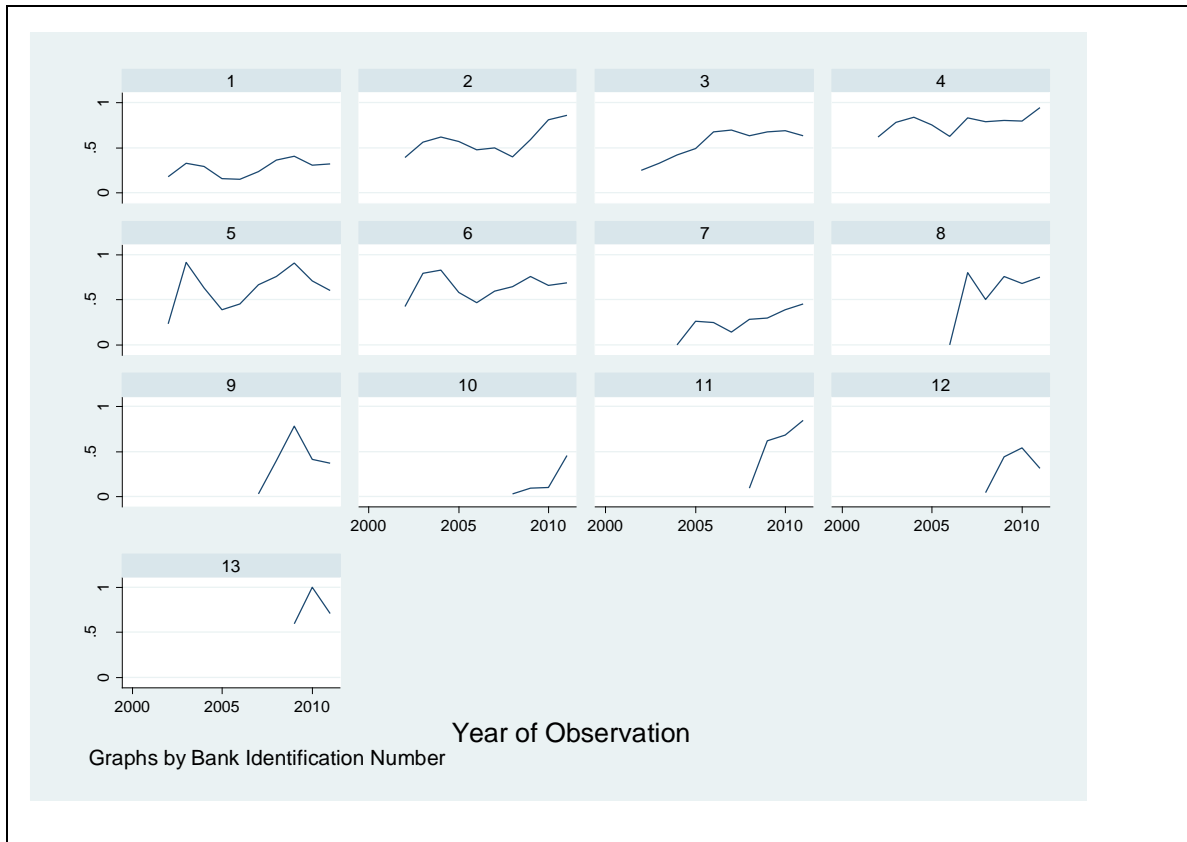
Figure C.1 Trend in Bank Loan Supply at the bank level

Figure C.2 Result of the Davidson-Mackinnon Test for Exogeneity

Fixed-effects (within) IV regression		Number of obs = 93				
Group variable: id		Number of groups = 13				
R-sq: within = 0.3451		Obs per group: min = 3				
between = 0.6448		avg = 7.2				
overall = 0.5179		max = 10				
corr(u_i, xb) = -0.3365		wald chi2(7) = 1079.70				
		Prob > chi2 = 0.0000				
lncps	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
np1	.0067882	1.058147	0.01	0.995	-2.067141	2.080718
adr	-.3692389	1.357656	-0.27	0.786	-3.030196	2.291719
lnrp	-.0954657	.5510959	-0.17	0.862	-1.175594	.9846625
car	.3552791	.2837823	1.25	0.211	-.200924	.9114822
lnvr1	11.7841	28.64658	0.41	0.681	-44.36216	67.93037
lna	-.0608792	.187731	-0.32	0.746	-.4288252	.3070667
lnl	-.0951158	.1668714	0.57	0.569	-.2319461	.4221778
_cons	-.2566137	1.906389	-0.13	0.893	-3.993067	3.47984
sigma_u	.15773596					
sigma_e	.15658495					
rho	.50366186	(fraction of variance due to u_i)				
F test that all u_i=0:		F(12,73) =	2.69	Prob > F =	0.0047	
Instrumented: np1 adr						
Instruments: lnrp car lnvr1 lna lnl l1p pbt						
. dmexogt						
Davidson-Mackinnon test of exogeneity:		.0235051	F(2,71)	P-value =	.9768	
. dmexogt np1						
Davidson-Mackinnon test of exogeneity:		0.033	chi-sqr(1)	P-value =	.8564	
. dmexogt adr						
Davidson-Mackinnon test of exogeneity:		0.033	chi-sqr(1)	P-value =	.8561	

Source: Author's computation using STATA 11.

Figure C.3 Result of the Bruesch and Pagan LM Test for Random Effects

Breusch and Pagan Lagrangian multiplier test for random effects		
lncps[id,t] = xb + u[id] + e[id,t]		
Estimated results:		
	Var	sd = sqrt(Var)
lncps	.0622211	.2494416
e	.0167278	.1293359
u	.0056798	.0753647
Test: Var(u) = 0	chi2(1) =	23.51
	Prob > chi2 =	0.0000

Source: Author's computation using STATA 11.

Figure C.4: Result of the Hausman (1978) Specification Test

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) fixed	(B) random		
lnrp	-.0059315	.0360744	-.0420059	.0503311
np1	.1933108	.1617214	.0315894	.0236849
adr	-.1560785	-.217545	.0614666	.0265302
car	.3825155	.4435134	-.0609979	.1031563
lnvr1	6.553333	5.132879	1.420453	2.089766
lna	-.0931386	-.1287828	.0356443	.0238235
lna	.1232562	.1322042	-.0089479	.0119141

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

Test: Ho: difference in coefficients not systematic
 $\chi^2(7) = (b-B)'[(V_b-V_B)^{-1}](b-B)$
 = 26.48
 Prob>chi2 = 0.0004
 (V_b-V_B is not positive definite)

Figure C.5 Result of the Modified Wald test for Groupwise Heteroskedasticity

Modified Wald test for groupwise heteroskedasticity in fixed effect regression model	
H0: $\sigma(i)^2 = \sigma^2$ for all i	
chi2 (13) =	98.39
Prob>chi2 =	0.0000

Source: Author's computation using STATA 11.

Figure C.6 Result of the test for Time Fixed Effects

lncps	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
lnrp	1.425873	.3675972	3.88	0.000	.6917311	2.160016
np1	.2176837	.0782268	2.78	0.007	.061454	.3739134
adr	-.1254427	.0338273	-3.71	0.000	-.1930005	-.0578849
car	.3552204	.1892834	1.88	0.065	-.0228046	.7332455
lnvr1	8.879144	6.028977	1.47	0.146	-3.161554	20.91984
lna	-.3106951	.060347	-5.15	0.000	-.4312163	-.1901738
lna	.1261102	.0372622	3.38	0.001	.0516924	.2005281
year						
2003	.4180882	.1035084	4.04	0.000	.2113676	.6248088
2004	.1812345	.0732436	2.47	0.016	.0349569	.327512
2005	.1353359	.0738577	1.83	0.071	-.0121681	.2828399
2006	.0985812	.0746453	1.32	0.191	-.0504959	.2476582
2007	.3486649	.0853778	4.08	0.000	.1781535	.5191762
2008	.2440885	.0973756	2.51	0.015	.0496159	.4385611
2009	.467975	.1098527	4.26	0.000	.2485839	.6873661
2010	.6299062	.1252646	5.03	0.000	.3797355	.880077
2011	.2456167	.1323378	1.86	0.068	-.01868	.5099135
_cons	3.655637	.8477513	4.31	0.000	1.96256	5.348713
sigma_u	.21989434					
sigma_e	.10508412					
rho	.81408452	(fraction of variance due to u_i)				
F test that all u_i=0: F(12, 65) = 8.73 Prob > F = 0.0000						
. testparm i.year						
(1) 2003.year = 0						
(2) 2004.year = 0						
(3) 2005.year = 0						
(4) 2006.year = 0						
(5) 2007.year = 0						
(6) 2008.year = 0						
(7) 2009.year = 0						
(8) 2010.year = 0						
(9) 2011.year = 0						
F(9, 65) = 5.23						
Prob > F = 0.0000						

Source: Author's computation using STATA 11.

FigureC.7 Result of the Attempted Dynamic Panel Estimation

Arellano-Bond dynamic panel-data estimation		Number of obs	=	68		
Group variable: id		Number of groups	=	13		
Time variable: year		Obs per group:	min =	1		
			avg =	5.230769		
			max =	8		
Number of instruments = 44		Wald chi2(8)	=	139.15		
		Prob > chi2	=	0.0000		
One-step results						
	Incps	Coef.	Std. Err.	z	P> z 	[95% Conf. Interval]
	Incps					
	L1.	-.0962216	.0708802	-1.36	0.175	-.2351443 .0427011
	Inrp	-.0795316	.0958689	-0.83	0.407	-.2674313 .1083681
	np1	.215838	.1294932	1.67	0.096	-.037964 .46964
	adr	-.5711087	.0568469	-10.05	0.000	-.6825265 -.4596909
	car	-.1173211	.2263421	-0.52	0.604	-.5609434 .3263012
	lnvr1	2.826877	4.217708	0.67	0.503	-5.439678 11.09343
	lnta	-.1935028	.0783801	-2.47	0.014	-.347125 -.0398807
	lnd	.2179311	.0747898	2.91	0.004	.0713457 .3645165
	_cons	-.0944566	.4221738	-0.22	0.823	-.9219021 .732989
Instruments for differenced equation						
GMM-type: L(2/.)_Incps						
Standard: D.lnvr1 D.np1 D.adr D.car D.lnvr1 D.lnta D.lnd						
Instruments for level equation						
Standard: _cons						

Source: Author's computation using STATA 11.

FigureC.8 Output of the Estimated Model

Linear regression, absorbing indicators		Number of obs =	94			
		F(16, 65) =	18.73			
		Prob > F =	0.0000			
		R-squared =	0.8760			
		Adj R-squared =	0.8225			
		Root MSE =	.10508			
	Incps	Coef.	Robust Std. Err.	t	P> t 	[95% Conf. Interval]
	Inrp	1.425873	.4380758	3.25	0.002	.5509756 2.300771
	np1	.2176837	.0634464	3.43	0.001	.0909724 .344395
	adr	-.1254427	.0559975	-2.24	0.029	-.2372775 -.0136079
	car	.3552204	.1950347	1.82	0.073	-.0342908 .7447316
	lnvr1	8.879144	5.829454	1.52	0.133	-2.763079 20.52137
	lnta	-.3106951	.0801878	-3.87	0.000	-.4708411 -.150549
	lnd	.1261102	.0484927	2.60	0.012	.0292636 .2229569
	year					
	2003	.4180882	.1154725	3.62	0.001	.1874737 .6487027
	2004	.1812345	.0713589	2.54	0.013	.0387209 .323748
	2005	.1353359	.0463815	2.92	0.005	.0427057 .2279661
	2006	.0985812	.0498114	1.98	0.052	-.000899 .1980614
	2007	.3486649	.069344	5.03	0.000	.2101753 .4871544
	2008	.2440885	.0752144	3.25	0.002	.093875 .394302
	2009	.467975	.0865961	5.40	0.000	.2950306 .6409194
	2010	.6299062	.1181777	5.33	0.000	.3938892 .8659233
	2011	.2456167	.1086554	2.26	0.027	.0286169 .4626166
	_cons	3.655637	.9873957	3.70	0.000	1.683671 5.627602
	id	absorbed				(13 categories)

Source: Author's computation using STATA 11.