# Determinants of Commercial Banks Interest Rate Margins in Postwar Liberia

**BY**

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## DECLARATION

This research paper is my original work and has not been presented for a degree in any other university or for any other award.

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## DEDICATION

I dedicate this work to my family especially children who had to endure those lonely months while I was away for their support. Just so you all know that I was doing all this for you to have a better future. I would also like to dedicate this thesis to my parents who dedicated their lives to giving me a good education and upbringing and especially to some loving brothers, sisters and friends who have all inspired me to go through this process.

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## LIST OF ABBREVIATIONS

| | |
|---|---|
| CAR | Currency Adequacy Ratio |
| CBL | Central Bank of Liberia |
| EBLL | Ecobank Bank Liberia Limited |
| GBLL | Globah Bank Liberia Limited |
| HHI | Herfindahl-Hirschman Index |
| IBLL | International Bank Liberia Limited |
| INEFF | Inefficiency or Loan Loss Provision |
| LBDI | Liberia Bank for Development and Investment |
| LLP | Loan Loss Provision |
| MSD | Market Share Deposits |
| NBL | National Bank of Liberia |
| NAIM | Narrow Interest Rate Margin |
| NIM | Net Interest Margin |
| NPLs | Non Performing Loans |
| OECD | Organization for Economic Co-operation and Development |
| OC | Operation Efficiency |
| OHC | Over Head Costs |
| OLS | Ordinary Least Squares |

## LIST OF ACRONYMS

| | |
|---|---|
| DOMINF | Domestic Inflation |
| EQUR | Equity Ratio |
| EXCR | Exchange Rates |
| INT | Intermediation |
| LIQ | Liquidity |
| TAX | Tax |

## ABSTRACT

The role of commercial banks is vital to jump start the economy as many citizens are engaged in commercial activities to meet the needs for their families. Also, macroeconomic phenomenon in the economy affects the interest rate margin (the spread or margin between lending and deposit interest rates) remain vitally important barometers of financial performance in depository institutions. Therefore, it is important to understand this measure and how it is affected by both internal factors peculiar to a bank and external conditions that bank can hardly influence. Banks usually borrow short-term funds from depositors and provide long term loans. There is a need to know the interest rate margins of commercial banks: there is limited or complete absence of empirical clarity in Liberia.

This study has empirically tested the determinants of commercial bank interest rate margins in Liberia using bank-specific, industry-specific and macroeconomic data. It is well noted that the determinants of interest rate margins are unclear in nature in different countries. There have been numerous studies that discovered that these determinants are either bank-specific, industry-specific or macroeconomic determined. Annual reports of the Central Bank of Liberia, annual balance sheets of the commercial banks and income statements were the main sources of data for the period 2004-2010.

Pooled OLS was conducted making use of cross-section fixed effects since it is consistent with the data used in this study. The theoretical basic for this study is the Ho and Saunders (1981) dealership-model which proxied banks as dealers in securities.

This study used the net and narrow interest rate margins (NIM and NAIM) to get good results. The empirical results indicate that increases in equity, liquidity, overhead costs, bank market power and changes in exchange rates all lead to an increase in NAIM while intermediation has a negative correlation with NAIM. All these effects are statistically significant. An increase in overhead costs increases the NIM while liquidity has a negative association with NIM. More emphasis is placed on policy implementation compared to formulation in this study since there are more policies and initiatives to improve efficiency but lack of implementation in the Liberian banking sector.

# CHAPTER ONE:

# INTRODUCTION

## 1.1 Background of the study

Despite the widespread implementation of costly financial sector reform programmes being undertaken globally, banking sectors in many developing countries are still characterized by persistence of high interest rate spreads. Studies by Randall (1998), Gelbard and Leite (1999), and Brock and Rojas-Suarez (2000) all show that interest rate spreads in Sub-Saharan Africa, Latin America and the Caribbean are wider than in Organization for Economic Co-operation and Development (OECD) countries. This phenomenon is indicative of inefficiency in the banking sectors of developing countries, because of wide acknowledgement that interest rate spreads are an adequate measure of bank intermediation efficiency (Sologoub, 2006). Such spreads reflect the costs of intermediation that banks incur, inclusive of their normal profits (Robinson 2002).

Quaden (2004) for example argues that a more efficient banking system benefits the real economy by allowing "higher expected returns for savers with a financial surplus, and lower borrowing costs for investing in new projects that need external finance." Therefore, large interest rate spread within a banking sector discourages potential savers due to low returns on deposits and thus limits financing for potential borrowers (Ndung'u and Ngugi, 2000).

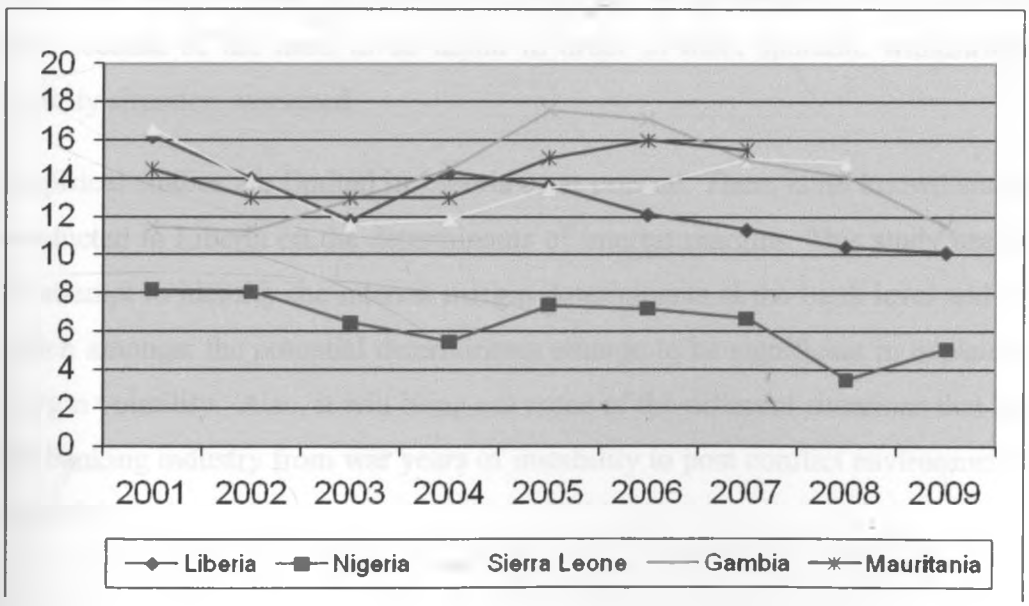
The interest rate spread, which is also related to the degree of efficiency of the financial sector, is an offshoot of a competitive environment (Jayaraman and Sharma, 2001). It reflects the banks' additional cost of borrowing relating to intermediation activities by linking borrowers with the ultimate lenders. Therefore, banks and financial institutions play a key role in the efficient allocation of resources and analysis of credit risk that make rapid growth possible.

## 1.2 Statement of the problem

Theoretically, there is strong argument that different countries have different economic growth rates and the developing countries grow faster than the industrial countries (Caselli, Esquivel, and Lefort (1996). There are also arguments that high interest rate margins are

some of the major factors behind poor economic growth and development. The developing countries are characterized by high interest rate margins (Turtelboom, 1991). A significant amount of research has been conducted in developed countries to prove and establish this hypothesis. Molyneux and Thornton (1992) were the first to explore thoroughly the determinants of bank profitability on a set of countries. They found a significant positive relationship between the return on equity and the level of interest rates in each country, bank concentration and government ownership. Berger (1995) examined the relationship between the return on equity and the capital asset ratio for a sample of US banks for the period 1983-1992. He shows that the proceeds of equity and capital to asset ratio tend to be positively related. However, explorative research into this relationship within developing countries has been sparse. The role of commercial banks is vital to jump start the economy as many citizens are engaged in commercial activities to meet the needs for their families. As from a bank's perspective, interest rate margin is a return for the risk banks bear. It compensates for loan defaulting and also for the risk related to funding cost (Van Der Merwe, 2004). The margin may move up or down depending on the predictions of future short term interest rate (Ramful 2001). The figure below shows the annual average interest rate margins for selected countries in the ECOWAS block from the year 2001 to 2009 taken from the World Development Indicators.

**Figure 1: Annual Average Interest Margins for Selected Ecowas Countries (2001-2009)**



From the above graph, Gambia has relatively high interest rate margins in 2005 than the rest of the other countries but, the margin started dropping from 2006 to 2009. Only Nigeria has a lower interest rate margin to the rest of the selected countries. This is a clear indication of Nigeria's economic strength in the sub-region. In Sierra Leone, on the other hand, which is a neighboring country to Liberia, the interest rate margins were lower to that of Liberia from 2002 to 2005. This was because the civil war in Liberia had just ended and the country was preparing for elections. At this time, the economy of Sierra Leone was improving because a democratically elected government was already seated. However, from the graph, the interest rate margins in Liberia started to drop from 2005 to 2009. This was due to the fact that the war had ended and the country was preparing for the national elections. Currently, Liberia has lower interest rate margins than some of the countries in the region. Sierra Leone, Gambia and Mauritania have higher interest rate margins that Liberia. This is a clear indication that the economy is improving which can be seen by the establishment of new banks.

The significant economic meltdown during the years of conflict weakened the country's banks and the financial sector in general, rendering financial institutions under-capitalized and saddled with huge non-performing assets. The security situation also meant that banks were exposed to sudden and large withdrawals of deposits thereby forcing them to commit huge resources in cash to meet potential withdrawals. Thus, banks became reluctant to extend credit not only because of default risk generated by the security and economic situation but also because of the need to be liquid in order to meet sporadic withdrawals anytime the security situation worsened.

Empirical studies are limited in Liberia as at present. There is no known study that has been conducted in Liberia on the determinants of interest margins. This study uses Liberia data in an attempt to identify the interest margin determinants at the bank level and to bring to light which amongst the potential determinants emerge to be significant in explaining interest rate margin volatility. Also, it will bring out some of the different situations that have occurred in the banking industry from war years of instability to post conflict environment which is more peaceful.

## 1.3 Objectives of the Study

### 1.3.1 General Objective

The broad objective of this study is to examine the behavior of commercial bank interest rate margins on macroeconomic and financial indicators in Post-war Liberia.

The specific objectives are to:

i. identify the determinants of interest rate margins in post war Liberia; and

ii. make policy recommendations based on how interest rate margins can be reduced.

## 1.4 Significance of the Study

The study will not only inform monetary policy in Liberia, but will also provide a clear understanding of commercial bank interest rate margins in Liberia. This will ensure a systematic understanding of commercial bank interest rate margins which have never been studied in Liberia to the best of my knowledge.

Study on interest rate margins in Kenya by Ndung'u and Ngugi (2000) did not analyze cross-country differences in the financial sector determinants of interest rates margins to establish whether the determinants significantly differ across countries. They did not capture the influence of non-performing loans (credit risks), market power or structure, and the transaction costs which are very important variables in explaining the financial market efficiency. However, Oduor et al (2011) conducted a study to fill this gap and also help to inform policy on the major focus areas in line with the significance of the fundamentals in other countries as compared to their significance in Kenya.

In identifying the determinants of interest rate margins, this study focuses on the period 2004 to 2010 as there are possibilities to get consistent data.

## 1.5 Scope of the Study

In identifying the determinants of interest rate margins in Liberia, this study focuses on the period after the establishment of the Central Bank of Liberia (CBL). Before the establishment of the CBL, Liberia had the National Bank of Liberia (NBL) which did not have all of the characteristics of a central bank. There were no proper supervision structures put in place to monitor the banks' operations and the civil conflict destroyed all of the available data.

### 1.6 An Overview of the Liberian Economy

Liberia is located on the west coast of Africa. It is bordered by Cote d'Ivoire on the east, Guinea on the north, Sierra Leone on the west and the Atlantic Ocean on the south. The current population of the country is estimated at 3,786,764 (CIA World Factbook, 2011). The country was set up in 1822 as a colony for freed slaves from America and it became an independent state in 1847. The unemployment rate is 85%[1] (CBL, 2009) that results in making half of the population to live in abject poverty and with an annual economic growth rate of 4.6 per cent (CBL, 2009). The country is endowed with natural resources such as diamond, gold, iron ore, timber, rubber, etc. However, many years of mismanagement and corruption led to fourteen years of civil crisis which started in 1989 and ended in 2003. The war destroyed more than 250,000 lives with massive displacement of citizens both externally and internally making the country one of the poorest in the world.

Liberia's recent history has been characterized by conflict that has affected the overall growth of the country and especially the banking sector. Liberia was one of the prosperous countries in the West African block. However; the destruction characterized by many years of civil conflict has left the country in complete shambles. Major infrastructures were destroyed including schools, health centers, banks, etc. This has led to slow economic growth, migration of professional which has left a big gap in the country that has a high level of illiteracy rate, the unemployment rate has sky rocketed, a decline of GDP by 90% reflected from 1987-1995 showing the highest rate of decline ever recorded in the World, a very high poverty rate and a rise in the crime rate, etc (PRSP, 2008). The sectors that provided revenue for the government were seriously affected making it difficult for the government to meet the basic needs of the citizens. This is a post- conflict country that lacks information concerning the operations of commercial banks and the effects of inflation. Since the end of the fourteen year civil war, many banks have emerged in the economy. However, there are little or no information concerning the determinants of commercial bank interest rate margins and the effect of inflation over this period.

The economy of Liberia experienced a stable macroeconomic environment in the year 2007. This happened as an indication of the proper monetary and fiscal policies that were implemented. Although national accounts data are weak, growth in real Gross Domestic

[1] Ministry of planning and economic affairs and Liberia institute of statistics and Geo-information services.

Product (GDP) was estimated at 9.5 percent (CBL, 2008). Commencement of operations in the rubber industry, resumption of diamond exports, and continued strong growth in the services sector were responsible for the growth in GDP. Inflation broadly remained stable in the low double digits.

In 2008, the economy continued to improve but at a lower rate (8.8 percent) than in 2007. This was due to the delay in the start of logging activities and the slow pace of mining. There were further shortcoming risks to the growth due to a decline in rubber production more than expected and the sharp meltdown in global economic growth seriously affected the country's exports. The Government of Liberia initiated three-year (2008-2011) Poverty Reduction Strategy (PRS), which provides a comprehensive framework to economic recovery. The strategies focus on enhancing national security, revitalizing economic growth, strengthening governance and the rule of law and rehabilitating infrastructure and improved delivery of basic services.

Any economy experiencing economic growth must endeavor to translate such growth into economic development—i.e., infrastructural development, improved provision of basic social services, increased job opportunities, wider dispersion of economic activities, etc. This is the challenge for the Poverty Reduction Program, requiring policy reforms; enhanced donor coordination so that external assistance can better reflect the priorities of the Government and that such assistance is made on a timely basis. Recent developments regarding the food situation suggest that the question of food security has taken on added importance, and should be addressed as part of the Poverty Reduction Strategy.

Against this background, several steps taken by the Government aimed at supporting private sector development are in the right direction, as the private sector has to be the engine of growth and development. A Public-Private Sector Dialogue on legal and regulatory reforms, strengthening public and private sector capacity, and improving infrastructure services and access to finance was established by the Government with assistance from the World Bank. The Government, in partnership with the International Finance Corporation (IFC), also began work aimed at improving the investment climate in the context of providing an environment that will reduce the cost of doing business in Liberia.

For 2008, inflation in Liberia remained in double digits on account of the recent sharp increases in world fuel and food prices. Also, depreciation of the United States dollar against

the Euro and other major foreign currencies has implications for domestic inflation. At end-March, 2008, €1.00 was exchanged for US$1.55. The Eurozone accounted for 13.6 percent of Liberia's imports in 2007 compared to 6.0 percent for the USA. A weak dollar would mean more US dollars have to be offered in exchange for imports and this leads to higher import costs and higher domestic prices for the imported goods.

Regulatory policies relating to diamond exports were put in place to make Liberia Kimberly compliant. As a result, Liberia can now export diamonds, which is contributing towards enhancing employment and its economic recovery. A national mineral policy framework to govern mining activities was put into place which has helped the economy to benefit more from mineral resources. Government's policies have continued to emphasize putting in place appropriate regulations to better manage national resources and strengthen measures to increase agricultural productivity. The Agriculture Ministry is already taking steps aimed at increasing yields and building its institutional capacity. Also, the new forestry law is helping to lead to a sustainable forestry industry. Bidding for timber sales and forest management contracts have commenced. The Government made some progress in the restoration of power to parts of Monrovia and its environs and the rehabilitation of roads, health facilities, and schools. However, due to the damages caused as a result of the many years of civil conflict, strong donor support for the timely rebuilding of key infrastructure is necessary.

The country's extended arrears and debt were cancelled making it capable to borrow to implement the necessary projects that will put the country on the proper road to recovery. However, this will only lead to overall development if the resources borrowed will be used in the right direction and not misused like in the past. Aggregate foreign trade in 2007 expanded to US$716.0 million, an increase of US$158.0 million over the level recorded for 2006. The trade deficit increased, from US$243.0 million in 2006 to US$266.0 million in 2007. The current account deficit, excluding grants, widened to about 99.0 percent of GDP in 2008 fueled by solid growth in imports of goods and services to support increasing economic activity. However, the large inflow of foreign direct investment (FDI) into the mining sector in 2007 and the increase in 2008 helped finance the current account deficit and supported further accumulation of international reserves by the country.

A major challenge for the Liberian economy is the unprecedented 40.0 percent increase in global food prices, including that of rice, in the last 12 months and the steep rise in the price

of oil due to conflict in the oil producing nations . International rice price has risen by 73.0 percent and oil price by 85.0 percent between January 2010 and April 2011. This is having a significant impact on the cost of living in Liberia that has an unemployment rate of about 85 percent. Another major challenge of the economy is the current political problem in Ivory Coast a major trade partner with Liberia. The government needs to address the issue of refugees at the same time implementing policies that will continue to move the economy forward.

**1.7 Liberia's Financial Sector**

The financial sector experienced substantial growth in the industry's loan portfolio, deposits, total assets and total capital positions in 2010. Also, there were positive developments with respect to ensuring stability and protecting the integrity of the banking sector through more robust regulation and supervision by the Central Bank of Liberia; improving the operating environment; enhancing the supervisory capacity; and enhancing transparency and disclosure of financial information.

The Liberian financial sector is dominated by eight commercial banks (as shown in table 1.1) which currently operate in the country, seven of which are foreign owned and the LBDI is the only domestic bank owned by the government. Asset quality of the banking industry continued to exhibit slow but steady improvement in 2010. There was decline in the ratio of non-performing loans to total loan by 3.4 percentage points to 10.3 percent in 2010 compared with 13.4 percent in 2009. In absolute terms, however, non-performing loans increased by 5.7 percent in 2010, from L$1.22 billion in 2009 to L$1.30 billion in 2010.

**Table 1.1: Information on banks in Liberia**

| Name of Bank | Year of Establishment | Ownership | Products |
|---|---|---|---|
| Liberia Bank for Development & Investment (LBDI) | 1965 | Government of Liberia (Liberian) | Saving A/C, Current A/C, Western Union, Corporate A/C, Current A/C, Internet Banking, Direct Deposit, Manager Cheques, Transfers, FX Trading ,Loans Etc. |
| Ecobank Liberia Limited (EBLL) | 1999 | Ecobank transactional incorporated(ETI) (Foreign) | Western Union, VISA Card, Mortgage Loans, Personal & Corporate Savings, U. S. A Visa Fees Payment, ATM |
| International Bank Liberia Limited (IBLL) | 2000 | Trust Bank of the Gambia, Databank Financial Services of Ghana and Pan African Capital Group, LLC of United States of America. (Foreign) | Checking account, Savings account, personal loans, business credit facilities, inward and outward remittances, Moneygram services and payment centres. |
| Global Bank Liberia Limited (GBLL) | 2004 | Bank PHB Of Nigeria (Foreign) | Current A/C, saving A/C, loans, moneygram services, corporate A/C, internet banking, |
| First International Bank Liberia Limited (FILL) | 2009 | Foreign | Current A/C, saving A/C, money gram services, corporate A/C, internet banking, loans, time deposit, sme, etc. |
| United Bank for Africa Liberia (UBA) | July 2008 | United Bank for Africa Tlc (Foreign) | ATM, POS, VISA Card, Mobile Money, Prestige Savings, Current & Savings Accounts |
| AccessBank Liberia (ABL) | January 2009 | Accessholding International Finance Corporation (foreign) European Investment Bank, African Development Bank | Saving A/C,Current A/C,Term Deposit A/C ,Micro Loan |
| Guaranty Trust Bank Liberia (GTBL) | March 2009 | Liberian And Nigeria Business (Foreign) | Western Union, saving A/C, current A/C, internet banking, ATM ,corporate A/C, loan etc. corporate saving, |

**Source: Central Bank of Liberia (CBL)**

The major factors for the relatively high NPLs are weak credit administration within a few banks, which the Central Bank corrected over years, and the poor credit culture still existing in the country due to the many years of civil conflict that affected every aspect of the economy. The industry's CAR declined due to increase in risk assets, mainly loans, even though it was more than 13.9 percentage points above the regulatory minimum ratio of 10%. The CAR for the industry in 2010 was 23.9 percent, down from 27.9 percent in 2009. All of the banks, except one, had higher than the 10% minimum requirement.

The banking industry recorded an increased in gross earnings of 21.1 percent and operating profit of 5.9 percent (before loan loss provisions and taxes) in 2010. Earnings in the industry are skewed towards non-interest sources, as 56.7 percent of the industry's earnings come from fee-based activities. The ROA and ROE for the industry in 2010 were negative 0.2 percent and negative 1.1 percent, respectively, compared to 0.2 percent and 1.3 percent in 2009. This was due largely to extra loan loss provisions on non-performing loans and high pre-operating expenses recorded by the new banks.

Liberian banks have registered improvements in loan portfolio quality since the end of the conflict in 2003. With the exception of Ecobank, the other operating banks have reduced the proportion of non-performing loans consistently on their balance sheets since 2003. Despite a 30% spike in non-performing loans ratio for Ecobank which is the biggest bank in the country, the average non-performing loans ratio has dropped consistently from 36% in 2003 to 25% in 2005. The industry's weighted average non-performing loans ratio has also fallen from 41% in 2003 to 34% in 2005 though it hit a low of 13% in 2004 (although this in part likely reflected the misclassification of non-performing or poorly restructured loans as current).

The improvement in loan portfolio quality is a result of the combined effect of a recovering economy and huge loan write offs. High provisions were made for potential defaults in 2003 and 2004 averaging 49% and 168% of loans, respectively. This has dropped to 27% in 2005. These have helped to improve the quality of the industry's balance sheet. The industry's provisioning as a proportion of loans declined from 10% in 2003 and 22% in 2004 to 5% in 2005 and this has continued up to 2009 showing that the industry is now recovered fully from the shocks experienced over that last decade.

## 1.8 Structure of Chapters

This research work is divided into five chapters. Chapter One consists of the introductory part with an overview of the Liberian economy and the banking industry, while Chapter Two presents theoretical and empirical literature. Chapter Three has the research methodology and Chapter Four consists of the estimated results from econometric modeling and interpretations. Chapter Five provides a summary of the main results and policy recommendations as well as conclusions.

# CHAPTER TWO:

# LITERATURE REVIEW

## 2.1 Introduction

This chapter reviews the existing literature on the subject under the study, in specific it reviews the theoretical and empirical literature on the net interest margin determinants. The likely determinants of interest rate margins with different analytical and empirical evidence from different authors will be made clear. That is, this chapter summarizes the major findings of reviewed literature that serve as a guide in the formulation of our model. There are three sections in the literature review. The first section is a review of theoretical literature while the second focuses on the empirical works. The last section is mainly concludes.

## 2.2 Theoretical Literature Review

The dealership model of banking firm, presented by Ho and Saunders (1981), and the Firm Theoretic Approach by Klein (1971) and Monti (1972) otherwise known as the Monti-Klein Model were among the earliest theoretical models that dealt with interest-rate spread determinants. Ho and Saunders model is based on the assumption that banks demand a type of deposit and supply a type of loan. Those demands and supplies are stochastic and asynchronous, so that a bank must hold an inventory and thus takes the interest-rate risk. Angbazo (1997) extends the Ho and Saunders model to include default risk and its interaction with interest-rate risk. Apart from interest rate and default risk, Wong (1997) spreads the determinants analysis over the group of factors like degree of competition in banking industry, a bank's market power, as well as operating expenses. The author underlined positive expected relation between the whole set of factors except the degree of competition which is expected to be opposite. Also the author has modelled the incentive problems a` la Stiglitz and Weiss (1981) and found that an introduction of incentive problems among borrowers lowered the optimal bank interest margin. This happens because asymmetric information makes adverse selection and moral hazard more likely, thus we might have here Ackerlof-type (1970) failure of competitive market. An intuition behind the statement should be clear. The presence of the incentive problems in the loan market penalizes any aggressive loan pricing behaviour of the bank. As a result, the bank lowers its loan rate in order to partially insulate itself from the opportunistic behaviour of the borrowers. But, it is worth noting that for Stiglitz-Weiss rationing to work, the banks' shareholders must be incentive compatible.

As known from the theory, presence of risk and uncertainty is only a part of the whole story. In order to have risks included into bank margins, specific risk attitude is needed. Thus, a related task is to consider the impact of an increase in the banks' degree of risk aversion on theirs spread decisions. Like in Wong (1997), we expect the bank interest margin to be larger when a bank and/or banking system are more risk averse. Having in mind incentive structure of domestic banks before reform starts, hardening budget constraints should be a big step forward to incentive compatible financial intermediary. An assumption that hardening budget constraints brings necessary stimulus for banks to behave prudently, weakens risk tolerance, is intuition for considering restructuring efforts as possible explanatory variables. However, we cannot produce a time consistent series to present influence of restructuring.

Economic models that tend to explain the behaviour of contemporary corporations state that managers, operating with greater degrees of monopoly power (i.e. control over price/ rates) tend to hire more staff, pay higher wages, and be less conscious of costs in general. In other words, they exhibit expense-preference behaviour and perhaps, propensity to the best of all monopoly profits: a quiet life. More competitive markets do not allow such behaviour, so that sub-optimal maximizing would be eliminated (Sinkey, 2002, p. 195). Theory recognizes (Bonin et al., 2005) that foreign entry in transition banking could be followed both by positive and negative external effects.

Among positive ones, the following are often stressed: possibility to get more funds for the economy, increased stability of the financial system, improved quality of services, and some positive ''spillover'' effects, such as transfer and dissemination of technology through vertical and horizontal chains, internationalization of R&D, and increased mobility of skilled labour force. Negative effects could be ''cherry-pick'' attitude and ''crowding-out'' effect, decreased stability in an strategic industry and, finally, difficult supervision. Regardless of the positive-negative dilemma, it is still unambiguous that new banks entry, especially foreign entry, implies more competitive industry. A number of empirical studies support assumed positive effect of increasing foreign share in banking industry, especially with respect to its competitiveness and efficiency. Recent studies (Dages et al., 2000) show that foreign bank presence is associated with reduced profitability and diminished overhead expenses for domestic banks, and therefore with enhanced domestic bank efficiency.

Findings of increased domestic bank efficiency and heightened competition are also supported in the Argentine experience of the mid-1990s (Clarke et al., 1999). They support our starting assumption that increased foreign competition in loan market reduces associated net margins.

Those studies are descriptive ones, so they derive relevant conclusions without exploring high-frequency data. Therefore, although we agree with the importance of operating expenses as an explanatory variable, data availability does not satisfy requests of any rigorous statistical analysis. Additionally, currency mismatch emerged, in early period, merely due to gap in foreign assets and liabilities amounts in ''frozen items'' of balance sheet. So, pre-tax profit was influenced, but without any significant impact on cash flow.

Since, bank balance sheets have been cleaned up from ''frozen items'', big part of currency mismatch disappeared. The reason why we do not consider here the influence of inflation on interest margin is because our model covers period with significant monetary stability. Besides, the so-called Fisher equation applies to both deposit and loan market, so we could expect the interest margin to remain more or less resistant to inflation influence. However, a researcher should bear in mind that there are many ambiguousness that make interest margin most sensitive variable in banking business. For instance, in studies exploring efficiency of a banking sector (Dziobek and Pazarbasioglu, 1998, p. 3), interest margin is used as a leading indicator of achieved or restored efficiency, as well as a sign of success in restructuring efforts. But, analysing margin data through time may be biased. Changing deposit and particularly credit market condition in terms of different borrowers' selection makes a comparison not perfectly consistent. Holmstrom and Tirole (1997) stress a significant empirical problem. Because of a possible flight to quality, interest-rate spread across different periods is not fully comparable. Composition of borrowers is changed so that in bad times there is a decline in the share of credit flowing to borrowers with high agency costs, that is, small firms. This may explain why the findings based on interest-rate spread are less consistent (Bernanke, 1993).

Nevertheless, interest-rate spread/margin can be taken as an indicator (albeit an imperfect one) of the effective cost of intermediation to the users of the banking system. Its macroeconomic importance comes from the fact that widening of interest margin influences economic activity in the way similar to an increase of the fiscal burden on bank borrowers

and depositors (Daniel and Saal, 1997, p. 17). Among other possible determinants, theory indicates a number of imperfections and regulatory restrictions, which are likely to impact on actual margins, that is, opportunity costs of required reserves, the cost of implicit interest payments on deposits in the form of service charge remissions or subsidies, deposit insurance premiums, and finally capital requirements. However, during the test period all these elements remained constant, and thus without influence on margin variation.

According to Ho and Saunders (1981), risk averse banks have to deal with demands for loans, and offers of deposits. These banks set their interest rates as a margin relative to the interest rate of the money. The key determinants of the interest rates are as follows: variables which determine the value of interest rates (that is the value of the lending rate and the value of the deposit rate) and not the value of bank margins, are the net credit inventory, risk aversion, and the interest rates volatility and variables which positively affect the interest margin are risk aversion, market power, volatility of interest rates, and market size.

In the Monti (1972)-Klein (1971) approach which looks at the fact that there is a lack of explanation in most theories to discuss interest rate determination while the size of the bank is assumed to be given, they revealed that both the loan rate and deposit rate are connected to the given interest rate on securities which also determine the optimal quantity of securities. They gathered that the banks' lending decision (loan rate and loan volume) is independent of the deposit rate and the amount of deposits. This received much attention in contributions subsequent to the work of Klein and Monti.

In short, the introduction of risk aversion in firm theoretic models leads to increasing bank interest margin. The behaviour of banks towards risk becomes clearly a major determinant of its price setting. This firm theoretic approach developed by Klein (1971) and Monti (1972) views the banking firm in a stationary setting where demands and supplies of deposits and loans concurrently clear both markets. On the same line of research, this framework was advanced by Zarruk (1989) and Wong (1997). The estimation and specification of Barajas et al.(1999) can also be categorized under the firm theoretic approach.

## 2.3 Empirical Review

### 2.3.1 Literature on Interest Rate Margins

Demirguc-Kunt and Huizinga (1998), Moore and Craigwell (2000) and Sologoub (2006) note that the specific characteristics of commercial banks that are usually theorized to have an impact on their spreads include the size of the bank, ownership pattern, the quality of the loan portfolio, capital adequacy, overhead costs, operating expenses, and shares of liquid and fixed assets. Robinson (2002) further notes that the incidence of fraud, the ease with which bad credit risks survive due diligence, and the state of corporate governance within banks all lead to higher operating costs, asset deterioration and ultimately wider interest rate spreads. These studies all show that such bank-specific factors impact significantly on commercial banks' net interest margins. Notwithstanding this, Brock and Franken (2002) note that the results of many other studies suggest that individual bank characteristics are often not tightly correlated with interest rate spreads. It is asserted that this may be because spreads are largely determined at the industry level, thus making individual bank characteristics more relevant to other variables, such as bank profitability.

Cross-country studies have also established that banking spreads tend to fall as institutional factors improve. Such factors include the efficiency of the legal system, contract enforcement, and decreased levels of corruption, which are all critical elements of the basic infrastructure needed to support efficient banking. Studies on small island developing states (SIDS) further note that interest rate spreads are widened by scale diseconomies due to the small size of markets (Demirguc-Kunt and Huizinga (1998); Moore and Craigwell (2000); Robinson (2002); Jayaraman and Sharma (2003); and Chirwa and Mlachila (2004). Of these factors, evidence has been found that interest rate spreads (as proxied by NIMs) are increased by:

- Greater market power of commercial banks (Barajas et al 2000);
- Poorly-developed banking sectors (Demirguc-Kunt and Huizinga 1998);
- High reserve requirements (Barajas et al. 2000); and
- Inefficiency of the legal system and high corruption (Demirguc-Kunt and Huizinga 1998).

Macroeconomic factors have also been shown to explain significant variation in commercial bank interest rate spreads. Brock and Franken (2003) quote from a Moody's report which argues that, "macroeconomic factors are certainly among the most influential sources for variations in credit spreads." Chirwa and Mlachila (2004) concur and assert that macroeconomic instability and the policy environment have important impacts on the pricing behaviour of commercial banks. They note that the macroeconomic variables typically thought to be determinants of interest rate spreads include inflation, growth of output, and money market real interest rates.

Brock and Franken (2002) include interest rate uncertainty and exchange rate volatility, and Randall (1998) also includes the share of commercial bank public sector loans in her list of determinants of spreads in the Caribbean. Randall's inclusion is similar to the additional variables suggested by stakeholders in Jamaica, as Tennant (2006) showed that macro policy variables, such as public sector domestic borrowing, discount rates and Treasury Bill rates, are commonly perceived to impact on commercial bank spreads. The macroeconomic variables which have been empirically shown to increase interest rate spreads include:

- High and variable inflation and real interest rates (Demirguc-Kunt and Huizinga 1998);
- Interest rate uncertainty - proxied by inter-bank interest rate volatility (Brock and Franken 2002); and

- a high share of commercial bank public sector loans (Randall 1998).

Using bank level data for 80 countries in the 1988–95 period, Demirgüç-Kunt and Huizinga (1998) analyze how bank characteristics and the overall banking environment affect both interest rate margins and bank returns. In considering both measures, this study provides a decomposition of the income effects of a number of determinants that affect depositor and borrower behavior, as opposed to that of shareholders. Results suggest that macroeconomic and regulatory conditions have a pronounced impact on margins and profitability. Lower market concentration ratios lead to lower margins and profits, while the effect of foreign ownership varies between industrialized and developing countries. In particular, foreign banks have higher margins and profits compared to domestic banks in developing countries, while the opposite holds in developed countries. Gelos (2006) studies the determinants of bank interest margins in Latin America using bank and country level data. He finds that spreads are large because of relatively high interest rates (which in the study is a proxy for

high macroeconomic risk, including from inflation), less efficient banks, and higher reserve requirements.

Saunders and Schumacher (2000) apply the model of Ho and Saunders (1981) to analyze the determinants of interest margins in six countries of the European Union and the US during the period 1988–95. They find that macroeconomic volatility and regulations have a significant impact on bank interest rate margins. Their results also suggest an important trade-off between ensuring bank solvency, as defined by high capital to asset ratios, and lowering the cost of financial services to consumers, as measured by low interest rate margins.

Ngugi (2004) using micro panal level data with a sample of 36 banks covering the period 1998-2002 shows that wide interest margins are explained by an imperfect credit market that is characterized with high real interest rate and liquidity risk. Other factors included limited diversity of bank's asset portfolio, weak management, capital cost, financial innovation costs, operational costs, and failure to maintain price stability in the economy.

In general, the empirical evidence suggests that the level of interest margins in developing economies is persistently higher than in developed economies. Using data on Central and Eastern European (CEE) banks that included Russia, Claeys and Vander Vennet (2008) attribute these differences to low efficiency and low degree of market competition in these developing countries. Barajas et al. (2000) also note the role of financial liberalization in improving market competition and enhancing banking sector efficiencies in the case of Colombia that led to lower interest margins and better financial intermediation.

Changes in interest rates affect many macroeconomic factors leading to fluctuations in GDP growth rate. It is obvious that the interest rate is one of the key costs of any investment project that any firm has to pay for when borrowing from financial intermediaries, or the interest rate is the opportunity cost of the firm's own funds when they are spent on the project instead of being lent to someone else at the going interest rate. So, interest rate changes influence the amount of investment spending. In addition to investment spending, the interest rate also affects the behaviors of consumption spending on consumer durables such as refrigerators, cars, furniture. Spending on these consumer durables is very sensitive to interest rate changes for all persons because a lower interest rate leads to higher consumption spending at any level of disposal income (Hall and Lieberman, 2005), and thereby bringing about a change in the consumption behavior of people.

# CHAPTER THREE:

# RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter outlines the overall methodology used in the study. This includes model specification, diagnostic tests, statistical tests, unit root tests, co-integration test, definition of variables, data sources, tool of analysis and conclusion.

## 3.2 Theoretical Framework

In the literature, the net interest margin is usually expressed as a function of internal (bank-specific) and external (macroeconomic and industry-specific) factors. This approach is widely used in both single and cross-country studies. The significance of the relationship between interest rate volatility and bank portfolio behavior was initially recognized by Samuelson (1945), however, the starting point for analysing the determinants of the interest margin, is the model of Ho and Saunders (1981). At least two identification frameworks have been proposed, a single and a two-stage approach. Under the latter, in the pioneering study of Ho and Saunders (1981) for a sample of US banks over the period 1976-1979, an estimate of the so-called "pure margin" is obtained in the first stage, while the second stage analyses the relationship between this margin and a number of variables posited by the theoretical background. They computed interest margins for financial intermediaries that offer identical loans and deposits (single product intermediaries). In their model, the size of the margin was found to be a function of four variables: the degree of managerial risk aversion, the variance of interest rates, the size of undertaken transactions and bank market structure (Ho and Saunders, 1981). Using a similar methodology, Saunders and Schumacher (2000) studied the banking systems of six European countries and the US, over the period 1988-1995. In an empirical application of the two-stage approach for seven Latin American countries, Brock and Suarez (2000) reported that bank spreads in the 1990s were influenced by liquidity and capital risk at the bank level, and by interest rate volatility, inflation and GDP growth at the macroeconomic level, although the results differed across countries.

The model used in this study is the Dealer Model developed by Ho and Saunders. The framework was originally intended for the analysis of the trading activities of security dealers. The Dealership Model and its extension proposed by Maudos and Guevara (2004),

amongst others, a bank is taken as a risk-averse dealer in the credit market acting as an intermediary between demanders and suppliers of funds, providing immediate services for flows of funds. When there are supplies of deposits, the bank can accept deposits and when there are demands for loans, the bank provides funds.

Interest margins were computed by Ho and Saunders for financial intermediaries that offer identical loans and deposits (single product intermediaries). Most industrialized and developing countries have more than one bank operating in the economy. Monopoly in the banking sector is non-existent as governments promote competition in their endeavor to cater for the welfare of their citizens. Monopoly means high bank fees as the bank is a price maker and this has negative effects on the economy. Practically, the Monti-Klein framework (with the assumption of one bank in the economy) cannot yield the desired results.

### 3.3 Model specification

The optimal bank behavior can be captured through the bank interest margin which can be estimated with the implicit solutions obtained for the loan rate and for the quantity of issued deposits. We analyze the determinants of bank interest margins in a coherent and encompassing framework in order to assess the importance of micro- and macroeconomic versus regulatory determinants. The variables under consideration are of four types in our regressions: (1) country-specific bank market characteristics, such as the degree of concentration, (2) country-specific macroeconomic conditions, such as inflation, real economic growth and the real short term interest rate, (3) bank-specific characteristics, such as the degree of operational efficiency, capital adequacy, market share, the proportion of loans in total assets and the proportion of demand and savings deposits in total deposits and (4) regulatory features, such as the (time-varying) degree of bank and enterprise reform in the country. We estimate equation of the following form which follows Ho and Saunders (1981), Saunders and Schumacher (2000), Brock and Suarez (2000) and Drakos (2003), a general class of regressions for interest rate margins:

$$NIM_{it} = \alpha + \beta B_{it} + \eta I_{bt} + \pi M_t + \mu_{it} \quad \text{..... (3.1)}$$

Where: ***it*** indicate bank i at time ***t***, and ***b*** represents the bank industry (all other variable except for $\alpha$ vary with time).

$NIM_{it}$= represent the narrow interest margin *i* at year or time *t*

$\alpha$ = represent the constant term

$B_{it}$ = represent a vector of bank-specific variables for bank *i* at time *t*

$I_{bt}$ = represent industry- specific variables (the banking industry)

$M_t$ = vector for macroeconomic variables over time

$\mu_{it}$ = residual

The bank specific variables used in this study are the degree of operational efficiency (OC), capital adequacy (ER), market share (MSD), liquid assets over deposits/liquidity (LIQ), inefficiency measured by loan loss provision (INEFF) as well as intermediation measured by total loans over total liabilities (INT). The industry or market characteristics are the bank concentration or competition measured by Herfindahl-Hirschman Index (HHI). With respect to macroeconomic variables used in this study, focus is on tax (TAX), exchange rate volatility (EXCR) and inflation (DOMINF).

Thus the models to be estimated are;

$$NIM = \beta_0 + \beta_1 OC + \beta_2 ER + \beta_3 MSD + \beta_4 LIQ + \beta_5 INEFF \cdot \beta_6 INT + \beta_7 HHI + \beta_8 TAX + \beta_9 EXCR + \beta_{10} DOMINF + \alpha \quad (3.2)$$

$$NAIM = \beta_0 + \beta_1 OC + \beta_2 ER + \beta_3 MSD + \beta_4 LIQ + \beta_5 INEFF\ \beta_6 INT + \beta_7 HHI + \beta_8 TAX + \beta_9 EXCR + \beta_{10} DOMINF + \alpha \quad (3.3)$$

where:

$NIM_{it}$= represent the narrow interest margin *i* at year or time *t* and $NAIM_{it}$= represent the net interest margin *i* at year or time *t*.

**3.4 Measurement of variables**

The empirical test is concerned with the determinants of interest rate margins in Liberia's commercial banks. The variables under consideration are in these categories namely: country-specific bank market characteristics, country-specific macroeconomic conditions, bank-specific characteristics, and regulatory features.

### 3.4.1 Dependent Variables

This study uses two dependent variables to get quality results, the net and the narrow interest rate margins (NIM and NAIM).

The ***Net Interest Margin (NIM)*** is one of the dependent variables. It is defined as the difference between interest income generated by banks or other financial institutions by their lending and interest paid on borrowing (for example, deposits). NIM is expressed as net interest income (interest earned minus interest paid on borrowed funds) as a percentage of earning assets (any asset, such as a loan, that generates income).

$$Net\ Interest\ Margin = \frac{Net\ Interest\ Income}{Average\ Total\ Earning\ Assets} \qquad 1a$$

Another dependent variable is the ***Narrow Interest Margin (NAIM)*** which is defined as the difference between income received on loans (divided by total loans) and interest paid on deposits (divided by total deposits).

$$Narrow\ Interest\ Margin = \frac{Interest\ Income}{Total\ Earning\ Assets} - \frac{Interest\ Paid}{Total\ Deposits} \qquad 1b$$

### 3.4.2 Explanatory Variables

#### 3.4.2.1Bank-specific variables

**(i)** In this section, we have *overhead costs* as operating costs. Overhead costs refer to on-going expenses of operating banks. That is, overhead refers to the ratio of overhead costs to total assets. It is expected that high overhead costs in the banking sector are associated with higher spreads since higher spreads would be required to cover the additional costs as banks pass on these added costs to borrowers. Overhead costs can be measured as a ratio of bank's operating expenses to total assets.

$$Ovehead\ cost = \frac{Bank's\ Operating\ Expenses}{Total\ Assets} \qquad 1c$$

**(ii)** Equity ratio is equity over assets (equity/assets). It is expected to have a positive relationship with interest rate margins. According to Peria and Mody (2004), high equity or

capital holdings due to either banks voluntary decisions or regulation could be costly for banks so a positive relationship is expected. In general, this ratio measures the impact of financial leverage. The business of financial intermediation is exposed to various forms of risk such as interest rate risk and credit risk. In this context, the profitability of a bank would be dependent on the management's attitude towards risk. To this extent, the risk inherent in a bank and the management's attitude towards risk can be analyzed by examining the capital and reserves a bank chooses to hold and its liquidity management policies. Banks with high capital–asset ratio would be considered relatively safer in the event of loss or liquidation. Thus, high capital–asset ratios are assumed as an indicator of low leverage and hence low risk, as predicted by the conventional risk-return hypothesis. Thus, a negative relationship between capital ratio and profitability is implied. However, Koehn and Santomero (1980) pointed out that regulation, which increase the capital adequacy requirements, would increase the capital– assets ratio and thus reduce risk. This may induce the banks to absorb greater risk in their asset portfolios in the hope of maximizing the expected returns. Thus, there is also the possibility of a positive association between capital-assets ratio and bank profitability.

$$Equity\ ratio = \frac{\text{Total assets} - \text{Total Liabilities}}{\text{Total Assets}} \qquad 1d$$

**(iii)** Taxes on financial operations that is, taxes on gross revenues that are considered in this study. Taxes are expected to have a positive influence on interest margins the same as overhead costs.

$$Taxes\ on\ Fin.Operation = \frac{Taxes}{Gross\ Revenues} \qquad 1e$$

**(iv)** Liquidity is an asset's ability to be sold without causing a significant movement in the price and with minimum loss of value. Money, or cash at hand, is the most liquid asset. We expect a negative correlation between liquidity and interest rate margins since banks with holdings of liquid assets bear higher opportunity costs, and they pass on these extra costs to borrowers. Under banking, it is defined as liquid assets over deposits.

$$Liquidity = \frac{\text{Liquid Assets}}{\text{Deposits}} \qquad 1f$$

**(v)** Inefficiency in the banking sector could be shown by the Loan loss provision. Since both interest rate income and expenses are ex-post items on the banks' revenue statements, the expectation is that higher loan loss provisions should reduce the implicitly calculated margins. It is measured as total bad debts over total loans.

$$Loan\ loss\ provision = \frac{\text{Bad Debt}}{\text{Total Loans}} \qquad 1g$$

**(vi)** Intermediation involves the "matching" of lenders with savings to borrowers who need money by an agent or third party, such as a bank. If this matching is successful, the lender obtains a positive rate of return, the borrower receives a return for risk taking and entrepreneurship and the banker receives a marginal return for making the successful match. Banks that are more involved in intermediation of loans should be better prepared for competition and charge lower spreads hence a negative relationship between intermediation and interest margins is expected. It is measured as total loans over total liabilities.

$$Intermediation = \frac{\text{Total Loans}}{\text{Total Liabilities}} \qquad 1h$$

### 3.4.2.2 Industry Variables

*i) Market share of deposits and loans* (each bank's market shares in the deposit and loan market segments) - Different studies have led to various results. If the relationship results are positive, it implies that a bank with a huge market share of deposits or loans has more influence hence it might enforce higher margins. For both market shares in the deposit and loan segments, a positive correlation with the dependent variables is anticipated.

ii) We measure the market structure in the banking industry by means of the ***Herfindahl Hirschman-Index (HHI)***, which is defined as the sum of the squares of the market shares of all banks within the industry. As the lending business of commercial banks in our sample is locally oriented, market structure and competition also vary by region. Therefore, we compute the Herfindahl index by region, measuring the market shares in the mortgage business of all commercial banks acting in our analyzed region (see Piazza, 2008). According to the structure conduct-performance hypothesis, banks in highly concentrated markets earn monopoly rents, as they tend to collude (e.g. Gilbert, 1984). As collusion may result in higher

rates being charged on loans and lower interest rates being paid on deposits, we expect that a higher bank concentration has a statistically positive influence on the mortgage loan margins. The HHI ranges from 0 to 10, 000 moving from a very large quantity of very small firms to a single monopolistic producer. The HHI is computed for both the deposits and loans markets. Demirguc-Kunt and Huizinga (1999), found several variables to be correlated with higher margins, including higher inflation, higher real interest rates, and lack of banking sector competition. Concentration of the banking sector would be expected to increase margins by reducing competition. In other words, the herfindahl index for both the loan and deposit market would be expected to bear a positive relationship with the interest margins.

### 3.4.2.3 Macroeconomic Variables

iii) We include annual inflation in this section. This may affect both costs and revenues of most organizations including the banking institutions. This factor represents the changes in the general price level or inflationary conditions in the economy. The impact of inflation rates on bank margin will depend on its effect on bank costs and revenues. Perry (1992) undertook a study on banks gains and losses from inflation, and he asserted that the effect of inflation on bank performance depends on whether the inflation is anticipated or unanticipated. If the inflation is fully anticipated and interest rates are adjusted accordingly resulting in revenues, which increase faster than costs, then it may have a positive impact on margin. However, if the inflation is not anticipated and the banks are lethargic in adjusting their interest rates then there is a possibility that bank costs may increase faster than bank revenues and hence adversely affect bank margin.

A key insight of the recent theories is that inflation exacerbates so-called frictions in credit markets. In smoothly operating credit markets, banks can easily adjust nominal interest rates when they need to, but frictions create obstacles that make this adjustment difficult. Government ceilings on interest rates are an example of such an obstacle. Obstacles can also arise from the actions of banks themselves, when they respond in the best possible way to the incentives and risks that are created by existing laws, regulations, policies, and economic conditions. Since empirical studies have shown that credit market frictions are more severe in developing countries than developed countries, these frictions may play an important role in explaining the impact inflation has on economic growth in these countries.

One way inflation might affect economic growth through the banking sector is by reducing the overall amount of credit that is available to businesses. The story goes something like this. Higher inflation can decrease the real rate of return on assets. Lower real rates of return discourage saving but encourage borrowing. At this point, new borrowers entering the market are likely to be of lesser quality and are more likely to default on their loans. Banks may react to the combined effects of lower real returns on their loans and the influx of riskier borrowers by rationing credit. That is, if banks find it difficult to differentiate between good and bad borrowers, they may refuse to make loans, or they may at least restrict the quantity of loans made. Simply charging a higher nominal interest rate on loans merely makes the problem worse because it causes low risk borrowers to exit the market. And in those countries with government imposed usury laws or interest rate ceilings, increasing the nominal interest rate may not be possible. When financial intermediaries ration credit in this way, the result is lower investment in the economy. With lower investment, the present and future productivity of the economy tends to suffer. This, in turn, lowers real economic activity.

iv) Also included is the *exchange rate volatility* or changes in exchange rates (proxy by its annual growth rate). Banks balance sheets are affected by movements in the exchange rates. Ho and Saunders (1981) found that interest rate volatility leads to larger spreads while variability of the exchange rate could also be a source of uncertainty. Therefore, a positive correlation between interest margins and exchange rate volatility is expected.

Table 3.1 gives the description of the variables and also indicates the expected signs from each of the variables used in this study.

**Table 3.1: Variable Definitions and their Expected Signs**

| *Variable* | *Notation* | *Description* | *Expected sign* |
|---|---|---|---|
| **DEPENDENT VARIABLES** | | | |
| Net Interest Margin | NIM | Net interest income as a percentage of earning assets | |
| Narrow Interest Margin | NAIM | Difference between income received on loans (divided by total loans) and interest paid on deposits (divided by total deposits). | |
| **BANK- SPECIFIC DETERMINANTS** | | | |
| Overhead Costs | OC | Operating Expenses / Total Assets | **Positive** |
| Equity Ratio | ER | Total Assets - Total Liabilities / Total Assets | **Positive** |
| Tax | TAX | taxes gross revenues (ratio) | **Positive** |
| Liquidity | LIQ | Liquid assets over deposits | **Negative** |
| Inefficiency | INEFF | Provision for bad debts, relative to recoveries over total loans | **Negative** |
| Intermediation | INT | Total loans over total liabilities | **Negative** |
| **INDUSTRY- SPECIFIC DETERMINANTS** | | | |
| Market Share | MSD | Total deposits for each bank divided by total deposits of the banking system | **Positive** |
| Herfindahl Index for Market Share | HHI | Measure of market or bank concentration, calculated as the sum of squared market shares in the loan/deposit market scaled by 10,000. The Herfindahl ranges from 0 to 1. | **Positive** |
| **MACROECONOMIC DETERMINANTS** | | | |
| Domestic Inflation | DOMINF | Annualized quarterly change of the CPI | **Positive** |
| Changes in Exchange Rates | EXCR | Quarterly change in Liberian dollar per US dollar | **Positive** |
| | | | |

### 3.5 Techniques for Data Analysis

This study estimates the NIM and NAIM equations using fixed effects model in which bank-specific effects are controlled for. Assuming that the explanatory variables are exogenous and that the error term follows classical linear regression assumptions meaning that (i) error terms follow a normal distribution (Gujarati, 2003); (ii) there is no relationship between the error term and the corresponding independent variable, (iii) the error terms have a mean of zero, (iv) there is no serial correlation; and (v) that variance is constant and finite for all independent variables. It must be noted that the assessment made concerning the NIM and

NAIM equations depend on the assumptions about the intercept and slope coefficients. It is assumed here that the intercept and slope coefficients are constant over time and that the error term captures differences over time in individual banks.

For estimation purposes, STATA software was used. Panel data is ideal for this study since it will give more information and variability, more degrees of freedom and more efficiency (Gujarati, 2003).

### 3.6 Type and Sources of Data

A panel of secondary data was collected for the period 2004-2010 for which data could be available on bank specific, industry specific and macroeconomic variables. Unique bank-by-bank annual balance sheet, income statements and central bank annual reports were the main sources for data. The data on macroeconomic variables (exchange rate, inflation) were sourced from the Central Bank of Liberia and International Financial Statistics as well as African Development Indicator reports. The bank-specific data on variables such as taxes, loan loss provision, liquidity, equity ratio, equity, overhead costs, and intermediation were sourced from individual banks' statements and balance sheets. The Herfindahl-Hirschman Index (HHI) was computed for both the deposits and loans market and the data were taken from the commercial bank's annual reports.

# CHAPTER FOUR:

# DATA, ANALYSIS, INTERPRETATION AND PRESENTATION

## 4.1. Introduction

The researcher used various variables in order to determine the determinants of interest margins in post-conflict Liberia. The research used data from 8 commercial banks in Liberia where only one of the commercial banks is locally owned, the variables under consideration were in various categories which included; country-specific bank market characteristics, country-specific macroeconomic conditions, bank-specific characteristics, and regulatory features. Descriptive statistics and inferential statistic were used to analyze the data obtained from the various commercial banks in Liberia.

## 4.2. Descriptive Analysis

Before proceeding to regressions, data is explored to establish measures of central tendency and also to have an initial indication of distribution forms. Descriptive summary statistics also become useful in enabling the researcher to know whether data requires transformation before undertaking intense analysis. Details of the results are displayed in Table 4.1.

**Table 4.1: Summary Statistics**

| Variable | Mean (%) | Std. Deviation | CV |
|---|---|---|---|
| | (a) | (b) | (b/a) |
| Net Interest Margin | 14.90 | 2.518 | 0.17 |
| Narrow Interest Margin | 12.12 | 1.328 | 0.11 |
| Overhead Cost | 71 | .285 | 0.40 |
| Equity Ratio | 77 | .180 | 0.23 |
| Taxes On Financial Operations | 3.00 | .000 | 0.00 |
| Liquidity | 2.00 | .000 | 0.00 |
| Inefficiency | 3.56 | .687 | 0.19 |
| Intermediation | 4.56 | .957 | 0.21 |
| Market Share | 21.11 | .823 | 0.04 |
| Herfindahl Hirschman-Index | 0.88 | .705 | 0.80 |
| Domestic Inflation | 13.43 | .701 | 0.05 |
| Exchange Rate | 7.10 | .883 | 0.12 |

The study finds that both net interest margin and narrow interest margin are relatively high as shown by 14.90% and 12.12% respectively, which is an indication that Liberia is yet to have economic strength and lower their interest margin, there is high standard deviation indicating that there has been considerable variation in data from 2004 to 2010. The overhead cost of the bank was found to be 0.71 which shows that bank operating expense were represented by 71% of the total assets. From the mean of equity ratio of 77%, the study found that banks had high valued assets compared to their liabilities.

The banks were found to be liquid which means that they were holding more of cash and therefore they were not in risk of lack of liquidity. The Herfindahl index was found to be 0.88 with a standard deviation of 0.701; the inefficiency measure exhibits higher values on average which was found to be close to 4 with no major deviation from the average. Further, bank markets in the country are characterized by higher and more volatile levels of inflation and exchange rates.

The coefficient of variation measures variability in relation to the mean and is used to compare the relative dispersion in one type of data with the relative dispersion in another type of data. It is established that dispersion in NIM of 17% is close to the dispersion of NAIM of 11%.

### 4.3. Specification tests

The study carries out Hausman test to confirm the right model for the data set. Husman test has a null hypothesis that favors a fixed effects model (in which case errors are correlated with regressors) whereas the alternative hypothesis favors the random effects (whereby errors are uncorrelated with regressors). See Appendix Tables for Raw outputs. There is joint significance of predictors of NIM and NAIM since F statistics of 7.29 and 1.80 have p-values<0.1; Correlation exists between the errors and regressors in the fixed effects model above) but none in the random effects model. This was confirmed by Hausman test.

From Green (2008, chapter 9), if the Chi-square statistic is significant at 5% ($p<=0.05$) or 10% ($p<=0.1$) level, we use fixed effects (FE) model. We noticed that our test statistic is significant at 10% level, therefore we could employ a fixed effects model. A post-test diagnostic to see if time fixed effects were needed while running a fixed effects (FE) model was done to test joint test of relevance of dummies (whose null hypothesis claims dummies

are jointly equal to zero). A significant F-test statistic of 3.44 verified all dummies were not different from zero, hence no time fixed effects were needed. It was also revealed from correlation corr(u_i, Xb) = -0.1862 that the errors were correlated with regressors in the fixed effects model and that 30.2% and 57% of variance in NIM and NAIM respectively is attributed to differences across panels (banks) hence we had to control for these differences (see rho=0.302 and 0.577 which captures intra-class correlation). This provides a strong case for fixed effects panel analysis verified by the Hausman test. As a result, more weight is given to the fixed effects models than pooled effects models during analysis.

### 4.4. Rationale for Panel Data analysis Technique

Panel fixed-effects (FE) regression is usually carried out on time-series cross-sectional data, that is, data that has observations over time for several different units or 'cross-sections'. Panel data defines the combination of time series and cross sectional data to capture time and individual effects for effective micro and macroeconomic estimation.

Estimation of economic models using either cross sectional or time series data provides results helpful for analysis and policy, however, using time series alone has a shortcoming of not accounting for individual effect while cross sectional lacks time effect. In other words, one or combination of the problems such as autocorrelation, heteroscedasticity and heterogeneity are most likely to exist, thereby affecting the results. Thus, it is important to design a mechanism through which time series and cross sectional data can both be integrated for estimation. Panel data therefore serves a relevant remedy for addressing many short-comings such as inconsistency and unreliable estimates associated with time series and cross sectional data.

### 4.5. EMPIRICAL RESULTS

In order to determine the determinants of bank interest margins the following regression equations were used;

$$NIM = \beta_0 + \beta_1 OC_{it} + \beta_2 ER_{it} + \beta_3 MSD_{it} + \beta_4 LIQ_{it} + \beta_5 INEFF_{it} + \beta_6 INT_{it} + \beta_7 HHI_{it} + \beta_8 TAX_{it} + \beta_9 EXCR_{it} + \beta_{10} DOMINF_{it} + \alpha$$

and

$NAIM_{it} = \beta 0 + \beta 1\ OC_{it} + \beta 2\ ER_{it} + \beta 3\ MSD_{it} + \beta 4\ LIQ_{it} + \beta 5\ INEFF_{it} + \beta 6\ INT_{it} + \beta 7\ TAX_{it} + \beta 8\ HHI_{it} + \beta 9\ DOMINF_{it} + \beta 10\ EXCR_{it} + \alpha$

The two different measures of interest margins were used for comparison purposes. Using Stata 10 analysis software, the results for the pooled and fixed effect models using the two measures of interest margins are as reported in Tables 1 to 6 of the Appendix.

The model fit for pooled regression was such that, the NIM equation had R-squared of 0.4214: this implies that there is 42% variation in the NIM due to changes in the various determinants of net interest rate margin. Similarly, the NAIM equation had R-squared of 0.3068 which implies there is 31% variation of NAIM explained by the variables included in the model.

**Table 4.2: Pooled and Fixed Effects regression results**

| | Net Interest Margin (NIM) | | | | | | Narrow Interest Margin (NAIM) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pooled | | | Fixed | | | Pooled | | | Fixed | | |
| **Variables** | **Coef.** | **t** | **p>t** | **Coef.** | **t** | **p>t** | **Coef.** | **t** | **p>t** | **Coef.** | **t** | **p>t** |
| OC | 52.81657 | 4.79 | 0.000 | 61.32726 | 4.51 | 0.000 | -30.37567 | -2.63 | 0.010 | 30.50544 | -2.87 | 0.005 |
| ER | 1.722649 | 1.25 | 0.213 | 4.716086 | 2.29 | 0.024 | 11.61234 | 4.70 | 0.000 | 1.264881 | 0.49 | 0.627 |
| MSD | -10.09151 | -1.97 | 0.051 | -1.827993 | -0.17 | 0.866 | -23.39684 | -3.57 | 0.001 | 3.844096 | 0.37 | 0.713 |
| LIQ | 1.248453 | 0.84 | 0.402 | -2.222695 | -1.13 | 0.260 | -7.4174 | -3.04 | 0.003 | 1.015865 | 0.39 | 0.698 |
| INEFF | .0000208 | 3.82 | 0.000 | .0000167 | 2.56 | 0.012 | .0000154 | 1.41 | 0.162 | .0000137 | 1.39 | 0.167 |
| INTER | -3.681465 | -1.16 | 0.250 | -3.68241 | -1.11 | 0.270 | -5.546981 | -1.49 | 0.139 | -7.066929 | -2.09 | 0.039 |
| **Industry factors** | | | | | | | | | | | | |
| HHI | 173.8713 | 3.89 | 0.000 | 161.3346 | 3.82 | 0.000 | 205.703 | 3.55 | 0.001 | 116.3487 | 2.24 | 0.027 |
| **Macro Economic factors** | | | | | | | | | | | | |
| TAX | .0000638 | 2.19 | 0.031 | .000046 | 1.87 | 0.064 | .0000957 | 2.37 | 0.020 | .0000828 | 2.34 | 0.021 |
| EXCR | -.2256296 | -1.68 | 0.095 | -.2381314 | -1.71 | 0.091 | -.3217708 | -1.94 | 0.055 | -.1623484 | -1.18 | 0.241 |
| DOMINF | .1348687 | 1.96 | 0.053 | .0897114 | 1.30 | 0.197 | -.0233965 | -0.29 | 0.770 | .0722127 | 1.05 | 0.298 |

| **Controls:** ***Bank Type/ Name***[2] | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *EBLL* | - | - | - | *-4.007069* | *-1.62* | *0.109* | - | - | - | *-1.018168* | *-0.68* | *0.495* |
| *IBLL* | - | - | - | *.8569676* | *0.89* | *0.377* | - | - | - | *-4.889884* | *-5.52* | *0.000* |
| *GBLL* | - | - | - | *-1.56564* | *-1.45* | *0.151* | - | - | - | *3.674687* | *4.70* | *0.000* |
| Constant (FE) | -11.36459 | -2.12 | 0.037 | -9.028006 | -1.72 | 0.089 | -8.996773 | -1.30 | 0.196 | 1.237236 | 0.16 | 0.874 |
| Number of obs = 111<br>F(10, 100) = 5.99;<br>Prob > F = 0.0000<br>R-square = 0.4214; .<br>Root MSE = 3.264 | | | | Number of obs = 111<br>F(13, 97) = 5.45;<br>Prob > F = 0.0000<br>R-square = 0.444<br>Root MSE = 3.2486 | | | Number of obs = 111<br>F(10, 100) = 4.43;<br>Prob > F = 0.0000<br>R-square = 0.3068;<br>Root MSE = 3.6944 | | | Number of obs = 111<br>F(13, 97) = 29.25;<br>Prob > F = 0.0000<br>R-square = 0.5517;<br>Root MSE = 3.0167 | | |

The total number of cases used in the analysis was 111 split into four banks: Liberia Bank for Development & Investment (LBDI), Ecobank Liberia Limited (EBLL), International Bank Liberia Limited (IBLL) and Global Bank Liberia Limited (GBLL). The above table has summary results of the estimated coefficients of predictors of net interest rate margin and narrow interest rate margin.

[2] **Notes:** LBDI is the reference category and was omitted in the regression; estimations based on 30 quarters for time period 2004-2010 respectively; FE means Fixed Effects.

A look at the intercepts in the pooled effect models reveal that when the effect of determinants of net interest margin and narrow interest margin is held constant, NIM and NAIM of commercial banks in Liberia would be at -9.03 and 1.23 respectively. This indicates that the Liberian economy is yet to achieve desired growth. NIM of commercial banks in Liberia had significant relationship with overhead cost, market share deposits, inefficiency, Herfindahl Hirschman index, tax on financial operations, exchange rate volatility and domestic inflation. For NAIM, the following determinants were significant: overhead cost, equity ratio, market share deposit, liquidity, HHI, tax and exchange rate.

Thus, holding other factors constant, a 1% increase in overhead costs leads to 52% increase in NIM but a 30% decrease in NAIM; a 1% increase in equity ratio causes 11% increase in NAIM; a 1% increase in market share deposits decreases NIM and NAIM by 10% and 23% respectively. Holding all other covariates constant, a 1% increase in liquidity leads to 7% decrease in NAIM; a 1% increase in inefficiency causes a 0.002% increase in NIM; a 1% increase in bank concentration (HHI measured from 0 to 1) leads to 173% and 205% increase in NIM and NAIM respectively. A L$ 1million increase in tax leads to 0.006% increase in NIM and 0.01% increase in NAIM; a 1% increase in inflation leads to 13.5% increase in NIM; finally, a 1% depreciation in exchange rate leads to 23% and 32% decrease in NIM and NAIM respectively. Following significance of relationships, the most important determinants of NIM are overhead cost, inefficiency and HHI while those of NAIM are equity ratio, market share deposit and HHI.

The FE model fit is good with a significant F=5.45 and 44% of variance in NIM is explained for by all predictors whereas F=29.25 and 55% of variance in NAIM is explained for by all predictors. The FE estimation results shown in Table 4.2, shows that there is evidence that higher overhead costs lead to both higher net and narrow interest margins (the effect is highly significant at 1% level) as banks pass on these additional costs to borrowers. A unit increase in OC leads to 30% increase in NAIM and a double increase in NIM. Equity significantly influences net interest margin but is insignificant for narrow interest margin. The signs are predominantly positive. Looking at bank concentration, a percentage increase in both the deposit and loan markets as measured by the HHI causes a 161 percent increase in NIM and doubles NAIM, with both effects being significant at 5 percent. Taxes, whether implicit or explicit, only widen narrow interest margins through increasing the intermediation costs. These include:

reserve requirements, withholding taxes, stamp duties, transaction taxes, value added taxes, profit taxes and license fees. Overall, taxes (levy on gross earnings) have a 0.0000828 increase on NAIM.

## 4.6. Comparison of Results with Other Empirical Studies

Estimations on both dependent variables in relation to the different independent variables, shows overhead costs, equity ratio, inefficiency, intermediation, bank concentration, tax and changes in exchange rates appear to be significant in explaining interest rate margins (NIM and NAIM) in Liberia even though there are differences in coefficient signs between the variables. The other variables which include: loan loss provision, domestic inflation and market share deposit loans are all statistically insignificant, also with variations in the signs of the coefficients. However, their impacts on interest rate margins cannot be ignored.

There are many empirical studies that have been conducted to identify the determinant factors of net interest margins, for groups of countries, for specific economies, as well as for individual banks or for aggregated data at systemic levels. A range of results were derived from studies conducted (in some instances conflicting ones) concerning the relation of net interest margin with diverse factors that impact it. It is therefore important to assess whether the determinants of Liberia's banks' interest margins behave comparably to those of other studies done in Europe and other African countries and to see whether they show significant differences with what other researchers have found. The determinant factors of interest margin that have resulted from the econometric analyses of this study are as follows:

### 4.6.1. Discussion of bank- specific factors

Overhead costs (OC), which are also the operating expenses of a bank, are associated with higher margins since higher margins would be required to cover the additional costs (this is except for the pooled NAIM equation). Overhead costs appear to be an important determinant of interest rate margins in Liberia. This means that an increase in operating expenses lead to an increase in the net and narrow interest margins to cover the extra costs, meaning that Liberia's banks transfer a portion of their operating costs to their borrowers and depositors. Hence, a decline in the bank's net interest margins must be preceded by the reduction in the level of bank operating expenses. Liebeg and Schwaiger (2006), Estrada et.al (2006), Naceur (2003), Affanasief et al.

(2002), Maudos and Fernández de Guevara (2004) have all found a positive relationship between the interest margin and the operating costs. Researchers have discovered that the higher the operating costs, the higher the margins that banks set out to cover these costs. In the absence of market power and of any type of risk, banks require a positive margin to cover operating expenditures.

Equity ratio (ER) has a positive relationship with net interest rate margin. Similarly, Peria and Mody (2004), found a positive relationship between equity and spreads as a large amount capital assets can be expensive for banks and so a positive association should be regularly anticipated. With respect to the narrow interest margin, we notice that equity ratio increases the narrow interest margin when taxes, intermediation and bank concentration have been introduced in the model. This is true in the case of taxes which eat more on equity finance unlike debt finance which has an advantage of a tax shield. It is worth noting that equity ratio is significant for fixed effects NIM model and pooled NAIM models out of the four.

Market share deposit (MSD) is statistically significant only for the pooled models of both interest margins. A negative relationship is established hence banks with larger market share illustrate low levels of net and narrow interest margins.

The liquidity (LIQ) of banks which is defined as the ratio of total operational assets to total bank liabilities was expected to be negatively related to interest margins. A rise in liquidity will limit the bank's liquidity risk, which lessens the interest margin due to a lower liquidity premium charged on loans. Empirical results of this study showed that only pooled NAIM had a significant negative relationship with LIQ. In other words, liquidity reduces narrow interest margin. A study carried out by Peria and Mody (2004) found a positive relationship between liquidity and margins due to banks foregone interest income that is recovered from borrowers in the form of higher margins. However holding liquid assets reduces the risk that banks may not have adequate cash to meet deposit withdrawals or new loan demand (i.e. liquidity risk), in that way forcing them to borrow at excessive costs. Consequently, as the proportion of liquid assets increases, a bank's liquidity risk decreases, leading to a lower liquidity premium component of the net interest margin (Angbazo, 1997 and Drakos, 2003).

Inefficiency (INEFF) was found to have a positive relationship with pooled net interest rate margin meaning that higher financial inefficiency on the part of commercial banks leads to higher NIM. Hence, banks whose costs are higher will more likely operate with higher margins (Altunbas, *et al.* 2001). Inefficiency or loan loss provisions which is provision for bad debt relative to recoveries over total loans, since costs and interest revenue are ex-post items on the banks' income statements. A decline in the quality of loans may result in an increase of non-performing loans and advances thus resulting to a decline in interest income (Central Bank Report, 2010). Financing and loan loss provisioning affects a banking firm in several ways. The instant result of an increase in financing and loan loss provision is anticipated to decrease reported net income; thus, bank's retained profit.

Intermediation had a negative but insignificant relationship with both net and narrow interest rate margins. This means as much as we may claim that intermediation reduces interest margins, the relationship so established is not of statistical relevance.

### 4.6.2. Industry- specific factors

Bank concentration was expected to have a positive influence on the interest margins. Concentration of the banking sector (measured by Herfindahl index for both loan and deposit markets) – the concentration of the banking sector would be expected to increase margins by reducing competition. The results show that concentration of the banking sector positively affects the net interest rate margins and this effect is significant: an increase in market concentration has a positive effect on bank margins which is indicative of collusion. Put differently, an increase in competition raises the HHI instead of lowering it. Thus when controlling for macroeconomic variables, the herfindahl index becomes significant determinant of interest margins.

Interest rate margins have been found to be positively related to the level of market concentration in European banking sectors by (Saunders and Schumacher, 2000; Maudos and Fernandez de Guevara, 2004), the US (Angbanzo, 1997) and Australia (McShane and Sharpe, 1985). In small countries, the concentration ratio is likely to be higher, specifically because the economy is small. In the case of Liberia's economy, concentration is also an important factor in determining net interest margins but not narrow interest rates margins.

### 4.6.3. Macroeconomic variables

In agreement with findings of this study, higher rates of taxation are seen to amplify interest rate margins as observed by Demirguc-Kunt and Huizinga (1999) and Claessens et al (2004). Other studies that have established a similar finding include Hanson and Rocha (1986), Barajas et al. (1998) and Brock and Suarez (2000) who argue that high interest margins are attributed to high financial taxation alongside operation costs, inflation and lack of competition.

The variability of the exchange rate (Liberian dollar to US dollar) -banks' balance sheets are also affected by changes in the exchange rates. Contrary to expectation, this variable has a negative and significant association with both net and narrow interest rate margins. Exchange rate volatility increases risk in cross-border bank activity and losses can occur in foreign exchange transactions. However, it must be noted that the size of the sample is quite small, so it is not surprising that some of the variables are insignificant in explaining the determinants of interest rate margins in Liberia's commercial banks.

We found a negative relation (pooled) between inflation and interest margins contrary to other findings. A higher inflation is frequently found to be positively related to margins and spreads especially in developing countries with high and unstable inflation rates as observed by Demirguc-Kunt and Huizinga (1999) and Claessens et al (2004). A possible justification for this relationship would be found in the link to monetary policy. Lending rates typically differ more than deposit rates, so looser monetary policy- which would lead to higher inflation would be associated with lower lending rates and therefore lower margins. Likewise, if banks charge lesser margins this would be linked with lower lending rates, faster credit expansion, and higher inflation.

Inflation would also be linked with the presence of large dominant banks that lend irresponsibly, and which have low margins because they are not fully responsible to their shareholders. The association could even be affected simply by the state's interference in the banking sector, by a willingness of the authorities to overcome sound economic management to political considerations, including by pressuring banks to lend at low rates to support the economy.

## CHAPTER FIVE:

## SUMMARY, CONCLUSION AND RECOMMENDATIONS

### 5.1 Introduction

The objective of this study was to identify the determinants of interest rate margins in Liberia; to analyze the implications of interest rate margins on key economic indicators in Liberia and to make policy recommendations on how they can be reduced. From the analysis and data collected, the following discussions, conclusion and recommendations are made.

### 5.2 Summary of Findings

The findings of the study are summarized with strong regard to the fixed effects models rather than pooled effects models. The coefficient on the inefficiency ratio was positively significant for commercial banks, supporting the efficient structure hypothesis. Similarly, Gondat-Larralde and Lepetit (2001) find that higher levels of efficiency improve bank profitability but Vander Vennet (2002) suggested higher efficiency reduces interest margins. In accordance with theory, a higher operational efficiency induces banks to pass the lower costs on to their customers in the form of lower loan rates and/or higher deposit rates, thereby lowering the interest margin.

Concerning bank-specific and macroeconomic control variables, equity ratio was found to increase interest margins parallel to findings of Brock and Suarez (2000), Saunders and Schumacher (2000) and Demirguc and Levine (2004). This finding is consistent with the interpretation that capital/equity serve as a signal of the banks' creditworthiness in bank markets. The higher sensitivity of margins with respect to equity ratio can be explained by the existence of depositor discipline in banking. This may decrease the deposit cost of well capitalized banks, leading to higher interest margins. Holding capital in excess of what is required is then often the only solution to signal solvency and inspire depositor trust. Once the legal environment improves, depositor confidence grows and the 'credible amount' of capital needed to signal creditworthiness can be reduced.

These findings seem unexpected since it is usually assumed that commercial banks markets are competitive, due to extensive efforts of financial deregulation, regulatory harmonization and the

convergence of the monetary and macroeconomic environment in the country. Our findings only corroborate previous results. De Bandt and Davis (2000) in his study concluded that bank markets were characterized by monopolistic competition, while Corvoisier and Gropp (2002) find that for loans and demand deposits, increased concentration due to consolidation in banking may have resulted in less competitive pricing by banks. Saunders and Schumacher (2000) also find evidence of a non-competitive market structure which materializes in an extra rent above the intermediation spread.

The negative coefficient on inflation supports the hypothesis that inflation has a negative effect on net and narrow interest margins. Bearing in mind that inflation increases costs of holding money, perhaps less people are willing to borrow leading to commercial banks reducing lending rates thus interest margins go down. This confirms the hypothesis that lower inflation (and decreasing inflation expectations) has a more pronounced downward effect on long-term compared to short-term interest rates, leading to declining intermediation margins. In the two regressions, the overhead cost variable is positive and highly significant. Hence, the sensitivity of the interest margins with respect to cost-efficiency decreases with reform in the corporate sector.

**5.3 Conclusion**

This study aimed to investigate determinants of interest margins among banks in Liberia in which both public and private owned banks were investigated. To achieve in depth analysis, we split interest margin into two: net interest margin and narrow interest margin. Literature by Wong (1997), Dziobek and Pazarbasioglu (1998), Brock and Suarez (2000), Sinkey (2002), Jayaraman and Sharma (2003) and Chirwa and Mlachila (2004), among others, revealed the following as key determinants of interest rate margins: market power, ownership and management, operation costs, inflation, institutional factors, taxation, competition and concentration. We borrowed from Dealer Model based on Ho and Saunders (1981) and Drakos (2003) to estimate the effect of bank specific, industry related factors and macro-economic environment on NIM and NAIM using secondary time series data. The bank specific variables used in this study were operational efficiency, capital adequacy, market share deposit, liquidity, inefficiency and intermediation. Industry characteristics were captured by bank concentration measured by Herfindahl-Hirschman Index. Macroeconomic variables included tax, exchange rate

volatility and domestic inflation rate. A theoretical framework and the model of the study helped to facilitate empirical analysis to achieve the objectives of the study.

The study found that overhead costs and equity ratio are very important bank specific determinants of high margins in the Liberia bank market, bank concentration plays an important role in interest margins in the industry and taxation as a macro-economic indicator stood out as a strong determinant. The study revealed that it was more difficult for banks to maintain their market power to impose low deposit rates and high loan rates once the corporate sector becomes more competitive and transparent. This is possibly due to an improving operating environment after many years of civil crisis. Fries et al. (2002) find that in countries with a significant progress in bank and enterprise reform, there is no evidence of reduced interest margins by banks.

Concerning overhead cost, a positive relationship with interest rate margins implies that the country's banks transfer a fraction of their operating costs to their borrowers and depositors. As such, reducing the country's bank interest margins must be preceded by the reduction in the level of bank operating expenses. Increases in equity ratio and inefficiency will also widen both the net and narrow interest rate margins. Concentration of the banking sector was expected to increase margins by reducing competition. If a sufficient degree of competition in the banking markets can be maintained, interest margins will probably converge.

Concentration can result in higher margins if banks achieve more market power through diversification. The number of banks operating in the market can have an impact, perhaps because it best captures diversification or else deepening of the monetary sector, which would bring numerous benefits. Taxation and exchange rate were significant macroeconomic variables. Higher taxes and depreciations in domestic currency could significantly broaden interest rate margins of commercial banks. Finally, the other variables were not significant in statistical terms perhaps due to the fact that this study used a small sample. Nevertheless, their effects on both NIM and NAIM cannot be ignored.

### 5.4 Recommendation and implication of the study to policy markers

The greatest and most recent financial sector revolution happened in 1999 when the Central Bank of Liberia was established as a measure of bringing reforms in the banking sector. Various

efforts to try and liberalize the industry are still being formalized that have made more privately owned banks to venture in the economy. But the sector is not fully competitive meaning gains can be realized through policy initiatives. Arising from factors found to be of policy significance in this study, we note the following.

Policies that aim to reduce overhead costs and equity ratio for banks need to be prioritized if they are to offer their products at competitive rates. Since high concentration is seen to increase margins and reduce competition, the financial sector in Liberia needs policies that reduce HHI in the industry. Liquidity among banks needs to be enhanced since it was found to have caused collapse of some banks in the country in the late 1990's and the early 2000. This can be done through central bank properly monitoring the banks so as not to incur unnecessary liabilities through "insider" loans that are sub-prime for recovery.

From the findings and conclusion, the study recommends Central Bank of Liberia should enhance various financial regulations and financial supervisors while fostering reform in the corporate sector in order to reduce asymmetric information since commercial banks in Liberia will be able and more willing to screen, lend and monitor, leading to increased credit availability. The study further recommends that there should be fair competition in the banking sector in Liberia as interest margins will probably converge.

**5.5 Limitations and Areas of Further Study**

One of the limitations experienced was that the series of data used was too short (2004-2010) to establish long-run and short run dynamics. Future studies need to establish determinants using a longer series and investigate if and why there may be changes in estimated parameters.

Some of the reviewed studies revealed other factors beyond the scope of variables that we did not include in this study. These are: degree of bank management/risk aversion, size of operations, opportunity cost of bank reserves, quality of management and the size of the bank. Further studies need to find out how these additional factors impart on interest rate margins of commercial banks.

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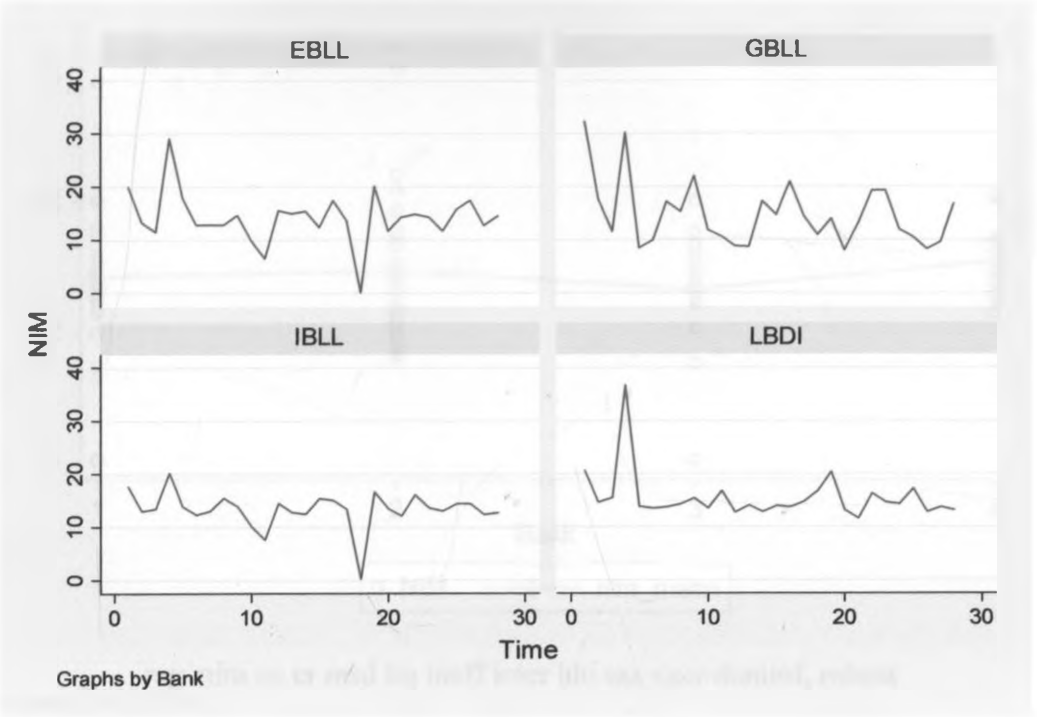
## APPENDICES: RAW ANALYSIS OUTPUTS

### A - Raw Outputs for NIM

**Figure1(a) and (b): NIM Trends by Quarters**



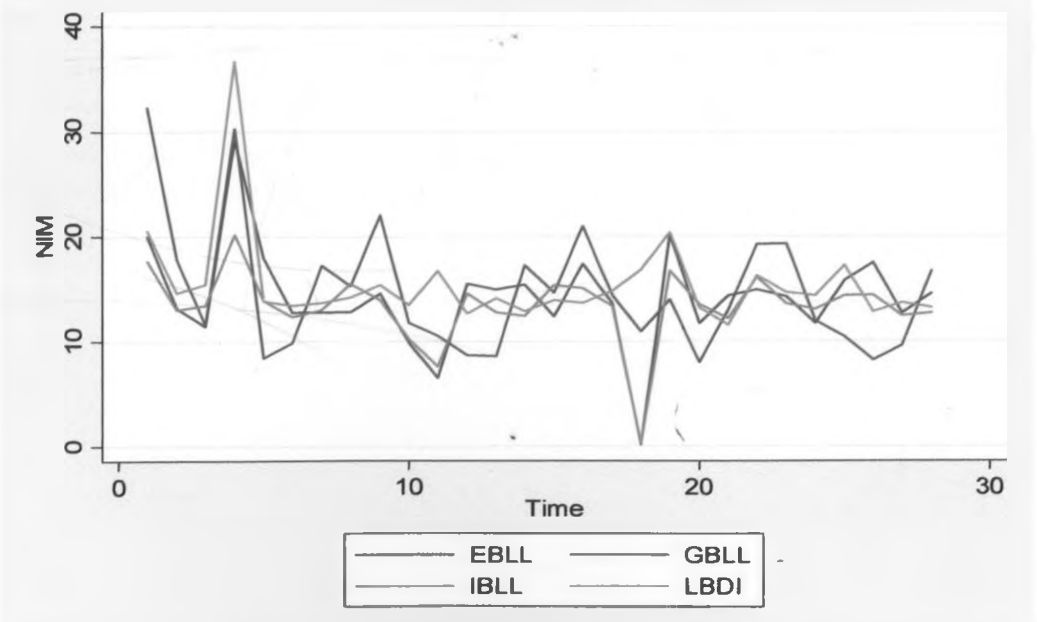
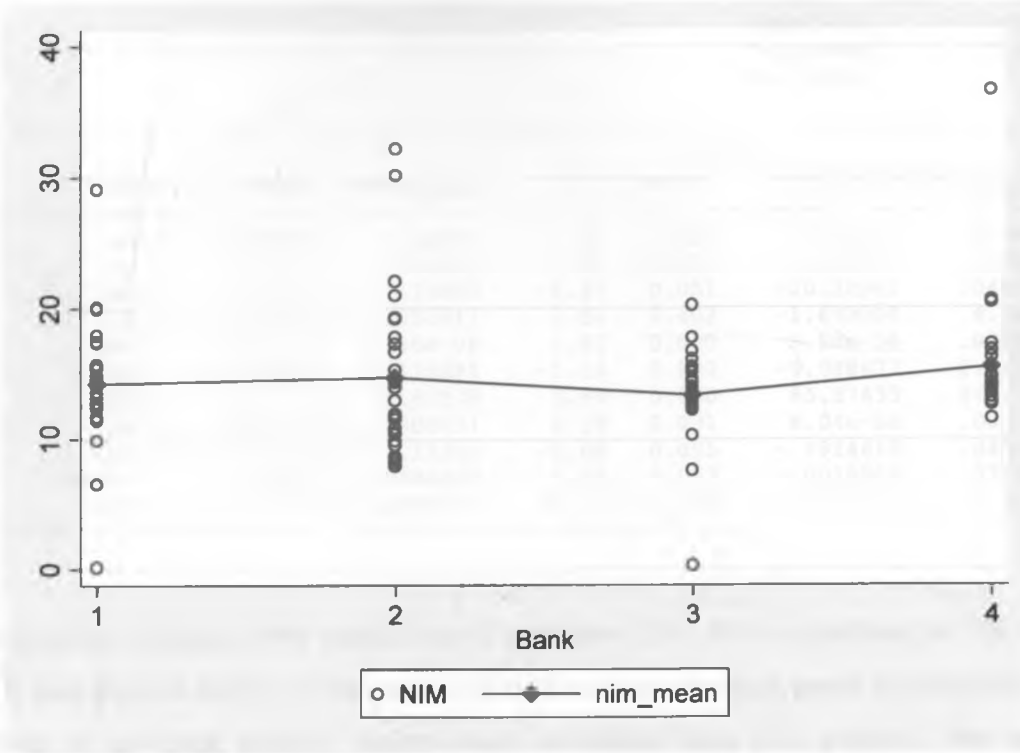



**Figure 2: Heretogeneity of NIM across Banks**




reg nim oc er msd liq ineff inter hhi tax excr dominf, robust

**Table 1: Pooled Regression NIM**

```
Linear regression                               Number of obs =     111
                                                F( 10,   100) =    5.99
                                                Prob > F      =  0.0000
                                                R-squared     =  0.4214
                                                Root MSE      =   3.264

------------------------------------------------------------------------------
                                               Robust
         nim |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          oc |   52.81657    11.0299     4.79   0.000     30.93357    74.69957
          er |   1.722649   1.374885     1.25   0.213    -1.005083    4.450381
         msd |  -10.09151   5.110003    -1.97   0.051    -20.22961    .0465868
         liq |   1.248453   1.482611     0.84   0.402    -1.693004     4.18991
       ineff |   .0000208   5.45e-06     3.82   0.000     9.98e-06    .0000316
       inter |  -3.681465   3.179084    -1.16   0.250    -9.988677    2.625746
         hhi |   173.8713   44.65538     3.89   0.000     85.27633    262.4663
         tax |   .0000638   .0000291     2.19   0.031     6.04e-06    .0001215
        excr |  -.2256296     .13399    -1.68   0.095    -.4914619    .0402027
      dominf |   .1348687   .0689623     1.96   0.053    -.0019506    .2716881
       _cons |  -11.36459   5.368539    -2.12   0.037    -22.01562   -.7135588
------------------------------------------------------------------------------
```

OLS regression indicates joint significant of predictors (F=5.99 is significant at 1% level, R-square is also good at 42%), yet we must subject the analysis through panel techniques to control for effects of any bank specific factors (such as culture, bank size, policies) that contribute individual heterogeneity.

**The Hausman Test**

To decide whether to apply fixed effects or random effects approach, we ran a Hausaman test whose null hypothesis favors a fixed effects model (in which case errors are correlated with regressors) whereas the alternative hypothesis favors the random effects (whereby errors are uncorrelated with regressors). Table 2 below has findings.

**Table 2: Fixed-effects (within) regression**

xtreg nim oc er msd liq ineff inter hhi tax excr dominf, fe

```
Fixed-effects (within) regression               Number of obs      =       111
Group variable: bank2                           Number of groups   =         4

R-sq:  within  = 0.4292                         Obs per group: min =        27
       between = 0.6272                                        avg =      27.8
       overall = 0.3235                                        max =        28

                                                F(10,97)           =      7.29
corr(u_i, Xb)  = -0.6471                        Prob > F           =    0.0000

------------------------------------------------------------------------------
         nim |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
```

| | | | | | | |
|---|---|---|---|---|---|---|
| oc | 61.32726 | 11.44877 | 5.36 | 0.000 | 38.60461 | 84.04991 |
| er | 4.716086 | 2.791507 | 1.69 | 0.094 | -.8242821 | 10.25645 |
| msd | -1.827993 | 11.24172 | -0.16 | 0.871 | -24.13969 | 20.4837 |
| liq | -2.222695 | 2.807581 | -0.79 | 0.430 | -7.794967 | 3.349576 |
| ineff | .0000167 | .0000106 | 1.58 | 0.118 | -4.29e-06 | .0000377 |
| inter | -3.68241 | 3.283184 | -1.12 | 0.265 | -10.19862 | 2.833801 |
| hhi | 161.3346 | 55.93196 | 2.88 | 0.005 | 50.3251 | 272.344 |
| tax | .000046 | .0000381 | 1.21 | 0.230 | -.0000296 | .0001217 |
| excr | -.2381314 | .1481414 | -1.61 | 0.111 | -.5321511 | .0558883 |
| dominf | .0897114 | .0742957 | 1.21 | 0.230 | -.057745 | .2371677 |
| _cons | -10.21756 | 6.591023 | -1.55 | 0.124 | -23.29892 | 2.863795 |

| | | |
|---|---|---|
| sigma_u | 2.135624 | |
| sigma_e | 3.2486299 | |
| rho | .30175619 | (fraction of variance due to u_i) |

F test that all u_i=0: F(3, 97) = 1.32 Prob > F = 0.2737

There is joint significance of predictors of NAIM since F=7.29 has a p-value<0.01; Correlkation exists between the errors and regressors in the fixed effects model above) but none in the random effectsmodel below. This will be confirmed by Hausman test.

**Table 3: Random-effects (GLS) regression**

```
. est store reg

. xtreg nim oc er msd liq ineff inter hhi tax excr dominf, re

Random-effects GLS regression                   Number of obs      =       111
Group variable: bank2                           Number of groups   =         4

R-sq:  within  = 0.4111                         Obs per group: min =        27
       between = 0.9962                                        avg =      27.8
       overall = 0.4214                                        max =        28

Random effects u_i ~ Gaussian                   Wald chi2(10)      =     72.82
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
```

| nim | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| oc | 52.81657 | 10.20488 | 5.18 | 0.000 | 32.81538 | 72.81777 |
| er | 1.722649 | 2.183238 | 0.79 | 0.430 | -2.556418 | 6.001717 |
| msd | -10.09151 | 5.791119 | -1.74 | 0.081 | -21.4419 | 1.258871 |
| liq | 1.248453 | 2.157436 | 0.58 | 0.563 | -2.980044 | 5.47695 |
| ineff | .0000208 | 9.67e-06 | 2.15 | 0.032 | 1.84e-06 | .0000397 |
| inter | -3.681465 | 3.283373 | -1.12 | 0.262 | -10.11676 | 2.753828 |
| hhi | 173.8713 | 51.14145 | 3.40 | 0.001 | 73.63592 | 274.1067 |
| tax | .0000638 | .0000357 | 1.79 | 0.074 | -6.16e-06 | .0001337 |
| excr | -.2256296 | .1466146 | -1.54 | 0.124 | -.512989 | .0617298 |
| dominf | .1348687 | .0705734 | 1.91 | 0.056 | -.0034527 | .2731901 |
| _cons | -11.36459 | 6.108257 | -1.86 | 0.063 | -23.33655 | .6073776 |

| | | |
|---|---|---|
| sigma_u | 0 | |
| sigma_e | 3.2486299 | |
| rho | 0 | (fraction of variance due to u_i) |

```
. hausman reg

Note: the rank of the differenced variance matrix (8) does not equal the number of
                coefficients being tested (10); be sure this
      is what you expect, or there may be problems computing the test.  Examine the
                output of your estimators for anything
          unexpected and possibly consider scaling your variables so that the
                coefficients are on a similar scale.
```

**Table 4: Hausman Test Results**

| | ---- Coefficients ---- | | | |
|---|---|---|---|---|
| | (b) reg | (B) . | (b-B) Difference | sqrt(diag(V_b-V_B)) S.E. |
| oc | 61.32726 | 52.81657 | 8.510687 | 5.189884 |
| er | 4.716086 | 1.722649 | 2.993437 | 1.739535 |
| msd | -1.827993 | -10.09151 | 8.263521 | 9.635308 |
| liq | -2.222695 | 1.248453 | -3.471149 | 1.796659 |
| ineff | .0000167 | .0000208 | -4.09e-06 | 4.28e-06 |
| inter | -3.68241 | -3.681465 | -.0009443 | . |
| hhi | 161.3346 | 173.8713 | -12.53678 | 22.64809 |
| tax | .000046 | .0000638 | -.0000177 | .0000134 |
| excr | -.2381314 | -.2256296 | -.0125018 | .0212138 |
| dominf | .0897114 | .1348687 | -.0451574 | .0232214 |

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

     Test:  Ho:  difference in coefficients not systematic

                   chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                           =         3.96
                 Prob>chi2 =       0.0604
                (V_b-V_B is not positive definite)
```

From Green (2008, chapter 9), if the Chi-square statistic is significant at 5% (p<=0.05) or 10% (p<=0.1) level, we use fixed effects (FE) model. WE notice that our test statistic is significant at 10%[3], therefore we can work with a fixed effects model.

**Post-test diagnostic**

To see if time fixed effects are needed while running a fixed effects (FE) model, we conducted a joint test of relevance of dummies (whose null hypothesis claims dummies are jointly equal to zero). If they are, no time-fixed effects are needed. Table 5 has results.

**Table 5: Diagnostic Rho-Test**

```
. xi: xtreg nim oc er msd liq ineff inter hhi tax exor dominf i.time2, fe
      i.time2           _Itime2_1-28        (naturally coded; _Itime2_1 omitted)

Fixed-effects (within) regression               Number of obs      =       111
Group variable: bank2                           Number of groups   =         4

R-sq:  within  = 0.7155                         Obs per group: min =        27
```

[3] Our test level has been maintained at 90% confidence in this study

```
       between = 0.7632                                        avg =      27.8
       overall = 0.6591                                        max =        28

                                                   F(34,73)          =      5.40
corr(u_i, Xb)  = -0.4214                           Prob > F          =    0.0000
```

| nim | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| oc | 26.20739 | 14.83662 | 1.77 | 0.082 | -3.361953 | 55.77673 |
| er | 5.189435 | 3.391029 | 1.53 | 0.130 | -1.568877 | 11.94775 |
| msd | -.4897652 | 10.50639 | -0.05 | 0.963 | -21.42896 | 20.44943 |
| liq | -2.868053 | 2.845985 | -1.01 | 0.317 | -8.540094 | 2.803987 |
| ineff | 8.66e-06 | .0000124 | 0.70 | 0.486 | -.000016 | .0000333 |
| inter | 1.800095 | 3.0308 | 0.59 | 0.554 | -4.24028 | 7.84047 |
| hhi | (dropped) | | | | | |
| tax | .0000666 | .0000522 | 1.28 | 0.206 | -.0000375 | .0001706 |
| excr | -1.640364 | .3150087 | -5.21 | 0.000 | -2.268176 | -1.012553 |
| dominf | -.4070221 | .1619378 | -2.51 | 0.014 | -.7297637 | -.0842805 |
| _Itime2_2 | -8.285524 | 2.333826 | -3.55 | 0.001 | -12.93683 | -3.634215 |
| _Itime2_3 | -11.7446 | 2.541673 | -4.62 | 0.000 | -16.81015 | -6.679052 |
| _Itime2_4 | -1.507412 | 2.790006 | -0.54 | 0.591 | -7.067887 | 4.053063 |
| _Itime2_5 | 1.143642 | 1.938021 | 0.59 | 0.557 | -2.718828 | 5.006112 |
| _Itime2_6 | -12.77549 | 3.193185 | -4.00 | 0.000 | -19.1395 | -6.41148 |
| _Itime2_7 | -14.04797 | 3.714319 | -3.78 | 0.000 | -21.4506 | -6.645348 |
| _Itime2_8 | -10.74569 | 3.120961 | -3.44 | 0.001 | -16.96575 | -4.52562 |
| _Itime2_9 | -.8868196 | 1.654534 | -0.54 | 0.594 | -4.184301 | 2.410662 |
| _Itime2_10 | -14.66613 | 2.72288 | -5.39 | 0.000 | -20.09282 | -9.23944 |
| _Itime2_11 | -11.55545 | 2.197088 | -5.26 | 0.000 | -15.93424 | -7.176662 |
| _Itime2_12 | -5.919221 | 1.7984 | -3.29 | 0.002 | -9.503426 | -2.335015 |
| _Itime2_13 | -7.192619 | 2.694782 | -2.67 | 0.009 | -12.56331 | -1.821926 |
| _Itime2_14 | -10.01666 | 2.885314 | -3.47 | 0.001 | -15.76709 | -4.266242 |
| _Itime2_15 | -6.839055 | 2.621088 | -2.61 | 0.011 | -12.06287 | -1.615235 |
| _Itime2_16 | -4.066181 | 1.922125 | -2.12 | 0.038 | -7.89697 | -.2353913 |
| _Itime2_17 | -11.93295 | 2.718813 | -4.39 | 0.000 | -17.35154 | -6.514365 |
| _Itime2_18 | -13.56456 | 2.126974 | -6.38 | 0.000 | -17.80361 | -9.325505 |
| _Itime2_19 | -6.832086 | 2.132624 | -3.20 | 0.002 | -11.0824 | -2.581772 |
| _Itime2_20 | (dropped) | | | | | |
| _Itime2_21 | -11.446 | 2.79321 | -4.10 | 0.000 | -17.01286 | -5.879139 |
| _Itime2_22 | -5.952989 | 2.137009 | -2.79 | 0.007 | -10.21204 | -1.693937 |
| _Itime2_23 | -8.157087 | 2.499576 | -3.26 | 0.002 | -13.13874 | -3.175439 |
| _Itime2_24 | -12.08867 | 2.58309 | -4.68 | 0.000 | -17.23676 | -6.940576 |
| _Itime2_25 | -11.21732 | 2.466703 | -4.55 | 0.000 | -16.13345 | -6.301185 |
| _Itime2_26 | (dropped) | | | | | |
| _Itime2_27 | -4.984132 | 2.69294 | -1.85 | 0.068 | -10.35115 | .3828908 |
| _Itime2_28 | -11.76883 | 3.51716 | -3.35 | 0.001 | -18.77852 | -4.759136 |
| _cons | 24.07243 | 4.200625 | 5.73 | 0.000 | 15.7006 | 32.44427 |

```
                             sigma_u |   1.305378
                             sigma_e |  2.6437192
                         rho |  .19601521   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(3, 73) =     0.67                 Prob > F = 0.5717
```

```
. testparm _Itime2*

 ( 1)  _Itime2_2 = 0
 ( 2)  _Itime2_3 = 0
 ( 3)  _Itime2_4 = 0
 ( 4)  _Itime2_5 = 0
 ( 5)  _Itime2_6 = 0
 ( 6)  _Itime2_7 = 0
```

```
 ( 7)  _Itime2_8 = 0
 ( 8)  _Itime2_9 = 0
 ( 9)  _Itime2_10 = 0
 (10)  _Itime2_11 = 0
 (11)  _Itime2_12 = 0
 (12)  _Itime2_13 = 0
 (13)  _Itime2_14 = 0
 (14)  _Itime2_15 = 0
 (15)  _Itime2_16 = 0
 (16)  _Itime2_17 = 0
 (17)  _Itime2_18 = 0
 (18)  _Itime2_19 = 0
 (19)  _Itime2_20 = 0
 (20)  _Itime2_21 = 0
 (21)  _Itime2_22 = 0
 (22)  _Itime2_23 = 0
 (23)  _Itime2_24 = 0
 (24)  _Itime2_25 = 0
 (25)  _Itime2_26 = 0
 (26)  _Itime2_27 = 0
 (27)  _Itime2_28 = 0
       Constraint 19 dropped
       Constraint 25 dropped

       F( 25,     73) =    3.44
            Prob > F =    0.0000
```

The significant F-test statistic of 3.44 tells us that all dummies were not different from zero, hence no time fixed effects were needed.

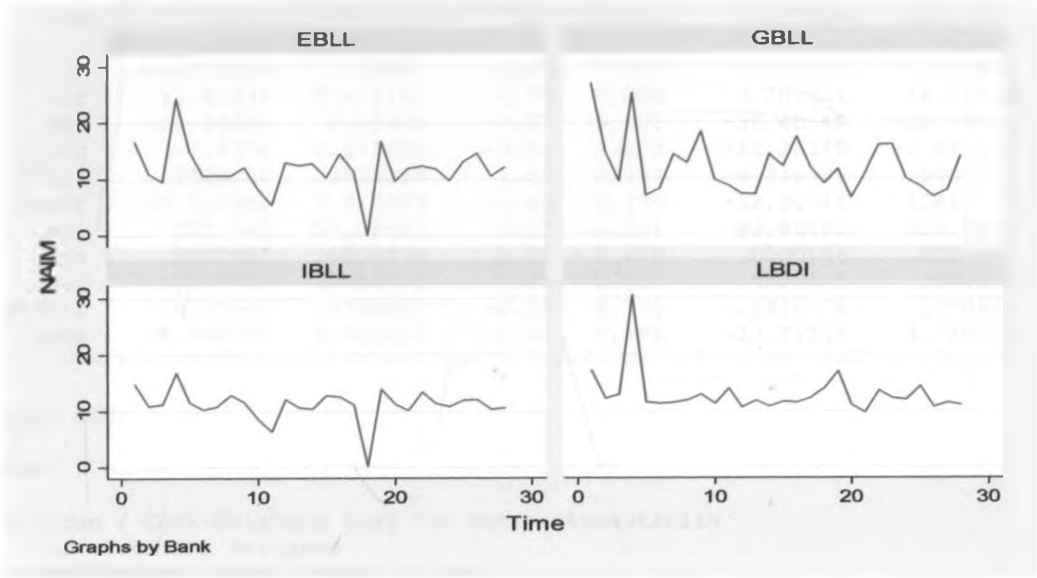
**Table 6: Fixed Effects Panel Regression NIM**

```
. xi: reg nim oc er msd liq ineff inter hhi tax excr dominf i.bank2, robust
i.bank2           _Ibank2_1-4         (naturally coded; _Ibank2_1 omitted)

Linear regression                               Number of obs =       111
                                                F( 13,     97) =      5.45
                                                Prob > F      =    0.0000
                                                R-squared     =    0.4440
                                                Root MSE      =    3.2486
------------------------------------------------------------------------------
             |               Robust
         nim |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          oc |   61.32726   13.59697     4.51   0.000     34.34104    88.31348
          er |   4.716086   2.057338     2.29   0.024      .6328404   8.799332
         msd |  -1.827993   10.83195    -0.17   0.866    -23.32641    19.67043
         liq |  -2.222695   1.959862    -1.13   0.260     -6.11248    1.667089
       ineff |   .0000167   6.52e-06     2.56   0.012     3.75e-06    .0000296
       inter |   -3.68241    3.32058    -1.11   0.270    -10.27284    2.908022
         hhi |   161.3346   42.28038     3.82   0.000     77.41969    245.2494
         tax |    .000046   .0000246     1.87   0.064    -2.82e-06    .0000949
        excr |  -.2381314   .1392801    -1.71   0.091    -.5145639     .038301
      dominf |   .0897114    .069102     1.30   0.197    -.0474371    .2268598
    _Ibank2_2 |  -4.007069   2.476558    -1.62   0.109    -8.922352    .9082139
    _Ibank2_3 |   .8569676   .9660726     0.89   0.377    -1.060419    2.774354
    _Ibank2_4 |   -1.56564    1.08116    -1.45   0.151    -3.711444    .5801635
        _cons |  -9.028006   5.25291     -1.72   0.089    -19.45358    1.397567
------------------------------------------------------------------------------
```

**B - Raw Outputs for NAIM**

**Figure1(a) and (b): NAIM Trends by Quarters**



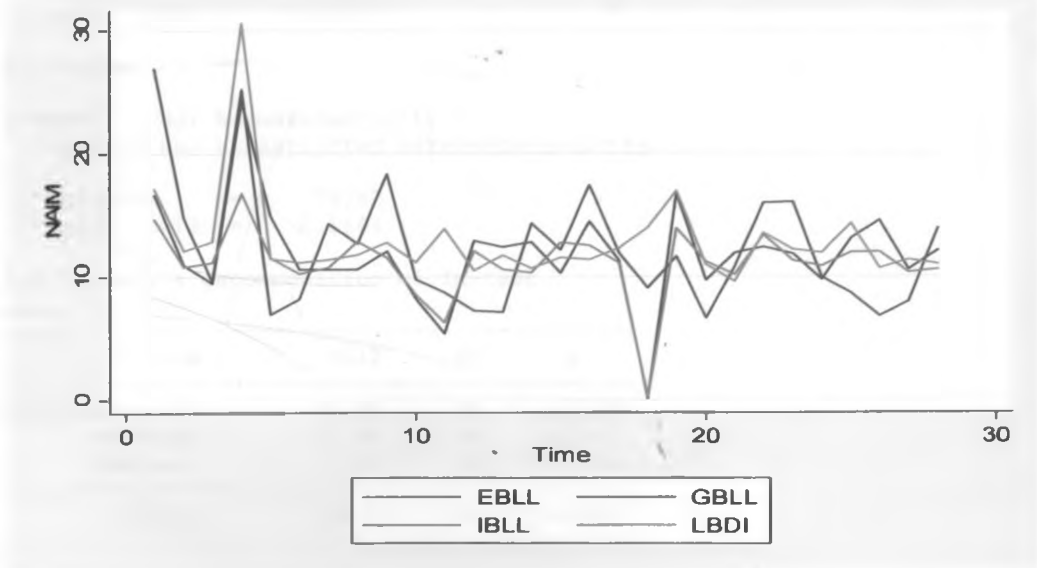



**Table 1: Pooled Regression NAIM**

```
. reg naim oc er msd liq ineff inter hhi tax excr dominf;
reg naim oc er msd liq ineff inter hhi tax excr dominf;

      Source |       SS       df       MS              Number of obs =     111
-------------+------------------------------           F( 10,   100) =    4.43
       Model |  604.063765     10  60.4063765           Prob > F      =  0.0000
    Residual |  1364.88263    100  13.6488263           R-squared     =  0.3068
-------------+------------------------------           Adj R-squared =  0.2375
       Total |  1968.94639    110  17.8995127           Root MSE      =  3.6944

------------------------------------------------------------------------------
        naim |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          oc |  -30.37567   11.55069    -2.63   0.010    -53.29192   -7.459428
          er |   11.61234   2.471162     4.70   0.000     6.709621    16.51505
         msd |  -23.39684    6.55485    -3.57   0.001    -36.40148   -10.39221
         liq |    -7.4174   2.441958    -3.04   0.003    -12.26218   -2.572625
       ineff |   .0000154   .0000109     1.41   0.162    -6.31e-06    .0000371
       inter |  -5.546981   3.716383    -1.49   0.139    -12.92018    1.826217
         hhi |    205.703   57.88597     3.55   0.001     90.85892    320.5472
         tax |   .0000957   .0000404     2.37   0.020     .0000156    .0001758
        excr |  -.3217708   .1659501    -1.94   0.055    -.6510112    .0074695
      dominf |  -.0233965   .0798807    -0.29   0.770    -.1818774    .1350844
       _cons |  -8.996773   6.913813    -1.30   0.196    -22.71358    4.720034
------------------------------------------------------------------------------

. set more off;

. hettest;

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of naim

         chi2(1)      =     3.12
         Prob > chi2  =   0.0774

. imtest, white;

White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(65)     =    78.82
         Prob > chi2  =   0.1164

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      78.82     65    0.1164
            Skewness |      12.76     10    0.2372
            Kurtosis |       1.57      1    0.2102
---------------------+-----------------------------
               Total |      93.15     76    0.0882
---------------------------------------------------
```

OLS shows presence of Heteroskedasticity thus validating use of White consistent Robust Regression for the panels.

```
. encode bank2, gen (bank3);

. encode time1, gen (time3);

. xtset bank3 time3;
       panel variable:  bank3 (unbalanced)
        time variable:  time3, 1 to 28
                delta:  1 unit
```

**Table 2: Fixed-effects (within) regression - NAIM**

```
. xtreg naim oc er msd liq ineff inter hhi tax excr dominf, fe;

Fixed-effects (within) regression               Number of obs      =       111
Group variable: bank3                           Number of groups   =         4

R-sq:  within  = 0.1564                         Obs per group: min =        27
       between = 0.0128                                        avg =      27.8
       overall = 0.0411                                        max =        28

                                                F(10,97)           =      1.80
corr(u_i, Xb)  = -0.1862                        Prob > F           =    0.0709

------------------------------------------------------------------------------
        naim |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          oc |  -30.50544   10.63142    -2.87   0.005    -51.60587    -9.40501
          er |   1.264881   2.592215     0.49   0.627    -3.879948    6.409711
         msd |   3.844096   10.43915     0.37   0.713    -16.87473    24.56292
         liq |   1.015865   2.607143     0.39   0.698    -4.158592    6.190322
       ineff |   .0000137   9.82e-06     1.39   0.167    -5.81e-06    .0000332
       inter |  -7.066929   3.048791    -2.32   0.023    -13.11793   -1.015923
         hhi |   116.3487   51.93886     2.24   0.027     13.26445     219.433
         tax |   .0000828   .0000354     2.34   0.021     .0000126    .0001531
        excr |  -.1623484   .1375653    -1.18   0.241    -.4353774    .1106807
      dominf |   .0722127   .0689916     1.05   0.298    -.0647165    .2091418
       _cons |   .6738651   6.120477     0.11   0.913    -11.47359    12.82132
-------------+----------------------------------------------------------------
     sigma_u |  3.5215519
     sigma_e |  3.0167037
         rho |  .57675687   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(3, 97) =    17.66                 Prob > F = 0.0000
```

The total number of cases used in the analysis was 111 split into four banks: Liberia Bank for Development & Investment (LBDI), Ecobank Liberia Limited (EBLL), International Bank Liberia Limited (IBLL) and Global Bank Liberia Limited (GBLL). It is revealed from corr(u_i, Xb) = -0.1862 above that the errors are correlated with regressors in the fixed effects model) and that 57% of variance in NAIM is attributed to differences across panels (banks) hence we have to control for these differences (see rho=0.577 or intra-class correlation). This is a strong case for fixed effects path that can be verified by Hausman test.

In terms of model fit, all coefficients are jointly different from zero (F=1.8 has p<0.1), thus explanatory variables are relevant predictors of NAIM. Nevertheless, some are not statistically significant at 10 percent level.

```
. est store reg;
```

**Table 3: Random-effects (GLS) regression - NAIM**

```
. xtreg naim oc er msd liq ineff inter hhi tax excr dominf, re;

Random-effects GLS regression                   Number of obs      =       111
Group variable: bank3                           Number of groups   =         4

R-sq:  within  = 0.0532                         Obs per group: min =        27
       between = 0.9779                                        avg =      27.8
       overall = 0.3068                                        max =        28

Random effects u_i ~ Gaussian                   Wald chi2(10)      =     44.26
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
        naim |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          oc |  -30.37567   11.55069    -2.63   0.009    -53.01461   -7.736732
          er |   11.61234   2.471162     4.70   0.000     6.768948    16.45573
         msd |  -23.39684    6.55485    -3.57   0.000    -36.24411   -10.54957
         liq |    -7.4174   2.441958    -3.04   0.002    -12.20355   -2.63125
       ineff |   .0000154   .0000109     1.41   0.159    -6.05e-06    .0000369
       inter |  -5.546981   3.716383    -1.49   0.136    -12.83096    1.736996
         hhi |    205.703   57.88597     3.55   0.000     92.24862    319.1575
         tax |   .0000957   .0000404     2.37   0.018     .0000166    .0001749
        excr |  -.3217708   .1659501    -1.94   0.053    -.6470271    .0034855
      dominf |  -.0233965   .0798807    -0.29   0.770    -.1799597    .1331667
       _cons |  -8.996773   6.913813    -1.30   0.193     -22.5476    4.554051
-------------+----------------------------------------------------------------
     sigma_u |           0
     sigma_e |  3.0167037
         rho |           0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

**Table 4: Hausman Test Results - NAIM**

```
. hausman reg;

Note: the rank of the differenced variance matrix (8) does not equal the number of
coefficients being tested (10); be sure this is what you expect, or there may be
problems computing the test.  Examine the output of your estimators for anything
unexpected and possibly consider scaling your variables so that the coefficients are
on a similar scale.

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |      reg            .          Difference          S.E.
-------------+----------------------------------------------------------------
          oc |   -30.50544    -30.37567        -.129767                .
```

```
          er |    1.264881     11.61234      -10.34746       .7829024
         msd |    3.844096    -23.39684       27.24094        8.12464
         liq |    1.015865      -7.4174       8.433265       .9132543
      ineff |    .0000137     .0000154      -1.72e-06              .
      inter |   -7.066929    -5.546981      -1.519947              .
         hhi |    116.3487       205.703      -89.35434              .
         tax |    .0000828     .0000957      -.0000129              .
        excr |   -.1623484    -.3217708       .1594225              .
      dominf |    .0722127    -.0233965       .0956092              .
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       76.16
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)
```

Hausman test for NAIM equation also supports the case for Fixed effects model of analysis. This is because the chi-square statistic is significant at 1% level and 8 degrees of freedom confirming that the difference in coefficients is systematic.

**Table 5: Diagnostic Rho-Test - NAIM**

```
. xi: xtreg naim oc er msd liq ineff inter hhi tax excr dominf i.time3, fe;
i.time3           _Itime3_1-28        (naturally coded; _Itime3_1 omitted)

Fixed-effects (within) regression               Number of obs      =       111
Group variable: bank3                           Number of groups   =         4

R-sq:  within  = 0.4439                         Obs per group: min =        27
       between = 0.0011                                        avg =      27.8
       overall = 0.1968                                        max =        28

                                                F(34,73)           =      1.71
corr(u_i, Xb)  = -0.1410                        Prob > F           =    0.0279

------------------------------------------------------------------------------
        naim |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          oc |  -5.237901    15.8445    -0.33   0.742    -36.81595    26.34015
          er |   1.582072   3.621389     0.44   0.663    -5.635346     8.79949
         msd |   9.151766   11.22011     0.82   0.417    -13.20988    31.51341
         liq |  -3.313139    3.03932    -1.09   0.279    -9.370495    2.744217
      ineff |   3.81e-06   .0000132     0.29   0.774    -.0000225    .0000301
      inter |  -4.535197   3.236689    -1.40   0.165    -10.98591    1.915514
         hhi |  (dropped)
         tax |   .0000492   .0000558     0.88   0.380    -.0000619    .0001604
        excr |  -.0132078   .3040694    -0.04   0.965    -.6192173    .5928017
      dominf |  -.1764693   .1255883    -1.41   0.164    -.4267663    .0738277
    _Itime3_2 |  -1.354697   2.023471    -0.67   0.505    -5.387469    2.678076
    _Itime3_3 |   2.305277   2.198522     1.05   0.298    -2.076371    6.686925
    _Itime3_4 |  -3.241178    2.17749    -1.49   0.141    -7.580908    1.098553
    _Itime3_5 |  -.5853876   2.544031    -0.23   0.819    -5.655635     4.48486
    _Itime3_6 |  -2.090851   2.970796    -0.70   0.484    -8.011638    3.829937
```

```
   _Itime3_7 |  -.9556636    2.64025    -0.36   0.718    -6.217674    4.306347
   _Itime3_8 |   7.538317   2.572358     2.93   0.005     2.411615    12.66502
   _Itime3_9 |  -2.621583   2.510009    -1.04   0.300    -7.624023    2.380857
  _Itime3_10 |   .6025636   2.193678     0.27   0.784     -3.76943    4.974558
  _Itime3_11 |   1.197569   2.548594     0.47   0.640    -3.881772    6.276909
  _Itime3_12 |  -2.325391   2.631461    -0.88   0.380    -7.569886    2.919104
  _Itime3_13 |  -3.571407   2.377445    -1.50   0.137    -8.309649    1.166835
  _Itime3_14 |   -1.18121   2.756123    -0.43   0.669    -6.674155    4.311735
  _Itime3_15 |  -.0007433   2.641525    -0.00   1.000    -5.265296    5.263809
  _Itime3_16 |  -2.209528   2.634009    -0.84   0.404      -7.4591    3.040044
  _Itime3_17 |  -2.803044   2.742452    -1.02   0.310    -8.268742    2.662654
  _Itime3_18 |   -.842418   2.115678    -0.40   0.692    -5.058958    3.374122
  _Itime3_19 |   .1276592   2.242797     0.06   0.955    -4.342228    4.597546
  _Itime3_20 |  -1.912911   2.420783    -0.79   0.432    -6.737524    2.911701
  _Itime3_21 |  -1.838193   2.067381    -0.89   0.377    -5.958478    2.282092
  _Itime3_22 |  -.1984598   1.972744    -0.10   0.920    -4.130133    3.733213
  _Itime3_23 |   .8144665   2.227127     0.37   0.716    -3.624192    5.253125
  _Itime3_24 |  (dropped)
  _Itime3_25 |  -2.893396    2.08883    -1.39   0.170    -7.056429    1.269637
  _Itime3_26 |  -2.329584   1.990849    -1.17   0.246    -6.297339    1.638172
  _Itime3_27 |  (dropped)
  _Itime3_28 |  -2.588719   2.314817    -1.12   0.267    -7.202142    2.024704
       _cons |   16.58984   3.221157     5.15   0.000     10.17009     23.0096
-------------+----------------------------------------------------------------
     sigma_u |  3.4912362
     sigma_e |  2.8233131
         rho |   .6046049   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(3, 73) =    12.20                 Prob > F = 0.0000

. testparm _Itime3*;

 ( 1)  _Itime3_2 = 0
 ( 2)  _Itime3_3 = 0
 ( 3)  _Itime3_4 = 0
 ( 4)  _Itime3_5 = 0
 ( 5)  _Itime3_6 = 0
 ( 6)  _Itime3_7 = 0
 ( 7)  _Itime3_8 = 0
 ( 8)  _Itime3_9 = 0
 ( 9)  _Itime3_10 = 0
 (10)  _Itime3_11 = 0
 (11)  _Itime3_12 = 0
 (12)  _Itime3_13 = 0
 (13)  _Itime3_14 = 0
 (14)  _Itime3_15 = 0
 (15)  _Itime3_16 = 0
 (16)  _Itime3_17 = 0
 (17)  _Itime3_18 = 0
 (18)  _Itime3_19 = 0
 (19)  _Itime3_20 = 0
 (20)  _Itime3_21 = 0
 (21)  _Itime3_22 = 0
 (22)  _Itime3_23 = 0
 (23)  _Itime3_24 = 0
 (24)  _Itime3_25 = 0
 (25)  _Itime3_26 = 0
 (26)  _Itime3_27 = 0
 (27)  _Itime3_28 = 0
       Constraint 23 dropped
       Constraint 26 dropped
```

```
F( 25,     73) =     1.74
     Prob > F =     0.0358
```

The significant F-test statistic of 1.74 revealed that all dummies were not different from zero, hence no time fixed effects were needed.

**Table 6: FE Panel Regression Results NAIM**

```
. xi: reg naim oc er msd liq ineff inter hhi tax excr dominf i.bank3, robust;
i.bank3           _Ibank3_1-4         (naturally coded; _Ibank3_1 omitted)

Linear regression                                      Number of obs =     111
                                                       F( 13,     97) =   29.25
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.5517
                                                       Root MSE      =  3.0167

------------------------------------------------------------------------------
             |               Robust
        naim |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          oc |  30.50544   7.930709    -3.85   0.000     -46.2457   -14.76518
          er |   1.264881   1.792573     0.71   0.482     -2.29288    4.822643
         msd |   3.844096   9.416555     0.41   0.684    -14.84516    22.53335
         liq |   1.015865   2.528498     0.40   0.689    -4.002504    6.034234
       ineff |   .0000137   8.45e-06     1.62   0.109    -3.09e-06    .0000305
       inter |  -7.066929   3.380674    -2.09   0.039    -13.77663   -.3572273
         hhi |   116.3487   69.32676     1.68   0.097    -21.24572    253.9431
         tax |   .0000828   .0000434     1.91   0.059    -3.26e-06    .0001689
        excr |  -.1623484    .121169    -1.34   0.183    -.4028353    .0781386
      dominf |   .0722127   .0554799     1.30   0.196    -.0378996    .1823249
    _Ibank3_2 |  -1.018168   1.487607    -0.68   0.495    -3.970655     1.93432
    _Ibank3_3 |  -4.889884   .8858144    -5.52   0.000    -6.647981   -3.131788
    _Ibank3_4 |   3.674687    .78178     4.70   0.000     2.123071    5.226304
        _cons |   1.237236   7.770533     0.16   0.874    -14.18512    16.65959
------------------------------------------------------------------------------
```