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**ADDIS ABABA UNIVERSITY
COLLEGE OF BUSINESS AND ECONOMICS
DEPARTMENT OF ACCOUNTING AND FINANCE**

***THE EFFECT OF ASSET & LIABILITY MANAGEMENT
ON COMMERCIAL BANKS PROFITABILITY***

BY

SAMSON ABATE

**A THESIS SUBMITTED TO THE DEPARTMENT OF ACCOUNTING &
FINANCE IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR
DEGREE OF MASTER OF SCIENCE IN ACCOUNTING AND FINANCE**

ADVISOR : SEWALE ABATE (Phd.)

**January:2018
Addis Ababa, Ethiopia**

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Declaration

I, Samson Abate hereby declare that the thesis entitled “*The Effects of Asset and Liability Management on Commercial Banks Profitability*” in partial fulfillment of the requirements for the award of Master of Science in Accounting & Finance is a record of original research work done by me and supervision and guidance of Dr. Sewale Abate.

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Certification

This is to certify that the thesis prepared by Samson Abate, entitled “*The Effects of Asset and Liability Management on Commercial Banks Profitability*” and submitted in partial fulfillment for Masters of Science in Accounting & Finance complies with the regulations of the university and meets the accepted standards with respect to originality and quality.

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Abstract

The purpose of this study is to assess the effect of asset liability management along with external macro-economic factors on commercial banks profitability with an emphasis on the core business operations profitability of commercial banks in the country over a period of fourteen years from 2002-2015. The study was necessitated by the lack of documented literature on the effect of asset liability management on the financial performance of banks with an emphasis to core business operations profitability. To conduct the study quantitative research method was employed and explanatory research design was used in trying to establish the causal effect relationship between profitability and asset liability management and macro-economic variables (which were; loans & advances, deposit & placement with other banks, sum of investments, saving deposits, demand deposits, fixed deposits, market share, real GDP growth rate and Inflation rate).The profitability measure was net interest income. Seven commercial banks were selected as a sample from seventeen commercial banks operating in the country. Secondary data was utilized through structured record review of the financial statements of the bank which was obtained from the NBE and each of the banks. The study utilized panel data analysis methodology in drawing conclusions about the effect of the explanatory variables on the dependent variable. The research revealed that loans & advances and sum of investments had a statistically significant positive effect on net interest income, while saving deposit had a statistically significant negative effect on net interest income. Whereas deposit & placement with other banks from the asset part and demand deposit and fixed deposit from the liability part, don't have statistically significant effect on profitability as measured by net interest income. On the other hand market share do not have statistically significant effect on profitability while real GDP growth rate and Inflation has got a statistically significant effect on profitability as measured by net interest income.

Keywords:-Profitability,commercialbanks

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the study

The business of banking consists of borrowing and lending. Banks act as financial intermediaries between savers and investors by accepting money as deposits from large number of customers and then on lending a major portion of accumulated —pool of money to those who wish to borrow. In this process banks secure reasonable return for the savers, make funds available to the investors at a cost and earn a profit for themselves after covering the cost of funds and paying or providing for corporate taxes. These transformation activities expose banks to interest rate, liquidity and credit risks. While credit risk is only related to the asset-side of the bank's balance sheets, the interest rate and liquidity risk is associated with the liability side, which reflects the funding decision of banks, and with the asset side, which reflects the investment decision of banks.

Asset Liability management (ALM) is a tool to manage interest rate risk and liquidity risk faced by various banks, other financial services companies. It is an attempt to match: assets and liabilities in terms of: maturities and interest rates sensitivities to minimize: interest rate risk and liquidity risk. Banks manage the risks of asset liability management mismatch by matching various assets and liabilities according to the maturity pattern or the matching the duration, by hedging and by securities.

ALM can be termed as a risk management technique designed to earn an adequate return while maintaining a comfortable surplus of assets beyond liabilities. It takes into consideration interest

rates, earning power, and degree of willingness to take on debt and hence is also known as Surplus Management. It can be also defined as “the process of decision – making to control risks of existence, stability and growth of a system through the dynamic balances of its assets and liabilities.”

Various researchers have pointed out what an ALM is in their investigations. Among them, Charumathi (2008) explained assets and liabilities management as a dynamic process of planning, organizing, coordinating and controlling the assets and liabilities, their mixes, volumes, maturities, yields and costs. He noted how ALM can be employed to manipulate net interest income (NII) despite the fluctuation of interest rates (interest rate risk) in the Indian banking industry. Gup and Brooks (1993) argued that asset and liability management in banks is the simultaneous planning of all asset and liability positions on the bank's balance sheet under consideration of the different bank management objectives and legal, managerial and market constraints, for the purpose of mitigating interest rate risk, providing liquidity and enhancing the value of the bank.

The core issue of Asset-Liability Management (ALM) is the bank's balance sheet and the main question is: given a certain level of risk, government regulation, globalization, competitors, and alternative choices of investment, and liquidity and interest rate changes in the market, what should be the composition of a bank's assets and liabilities in order to maximize the bank's profit? What should be the optimal combination of ALM? These are the two questions raised by Kosmidou et al (2005) who argued that the optimal balance between these factors cannot be found without considering important interactions that exist between the structure of a bank's liability and capital and the compositions of its assets.

ALM involves a set of actions and procedures designed to control banks risks and financial positions. The ALM process rests on three pillars: ALM information systems (Management information system, Information availability, accuracy, adequacy and expediency), ALM organization (structure and responsibilities, level of top management responsibilities) and, ALM process (risk parameters, risk identification, risk measurement, risk management risk policies and tolerance) (A guideline of Banks in India, 2008).

One of the key motivators of asset-liability management worldwide was the Basel Committee. The Basel committee on banking supervision (2001) formulated broad supervisory standards and guidelines and recommended statements of best practice in banking supervision. The purpose of the committee was to encourage global convergence toward common approaches and standards. In particular, the Basel II norms (2004) were proposed as an international standard for the amount of capital that banks need to set aside to guard against the types of financial and operational risks they face. Basel II proposed setting up rigorous risk and capital management requirements designed to ensure that a bank holds capital reserves appropriate to the risk the bank exposes itself to through its lending and investment practices. Generally speaking, these rules mean that the greater risk to which the bank is exposed, the greater the amount of capital the bank needs to hold to safeguard its solvency and overall economic stability. This would ultimately help protect the international financial system from the types of problems that might arise should a major bank or a series of banks collapse. Therefore The assets and liabilities of commercial banks shall be managed in order to maximize shareholder value, to enhance profitability and increase capital, to serve customer and community needs, and to protect the institution from any disastrous financial consequences arising from different changes.

1.2 Statement of the Problem

Over the last few years the Ethiopian banking industry has witnessed wide ranging changes. This intense competition in the banking industry creates a challenging environment for banks at least in reducing their market share, among other things. Indeed, given still largely huge and still an unmet financial intermediation needs in Ethiopia, there will not be fundamental change to the high growth, high profit banking environment (Access Capital, 2010). In course of time, banks are not only prone to reduced market share due to potential increase in participants but also are to risk. To cope with the changes in the environment, banks have been forced to effectively manage their asset and liability to mitigate various risks that arise due to mismatch between their assets and liabilities that are loans and advances of the bank (Angelopoulos et al., 2001). Banks are exposed to several major risks in the course of its business -credit risk, interest rate risk, liquidity risk and operational risk. Risk is inherent to any business, but it can be controlled to mitigate its impact on profitability. According to Oguzsoy and Guven (1997) asset liability management (ALM) is an essential tool for monitoring, measuring and managing the market risk of a bank. Therefore, profitability is not only attributable to unmet intermediation. If uninterrupted profitability is sought, risks that a bank could encounter should be managed. Risks, if not managed, would lead the bank to loss a portion of possible revenue that might have been realized as those risks were managed well. Therefore, extent of profitability of a bank depends on the effective management of balance sheet contents – assets and liabilities. This is assured via Asset Liability Management (ALM).

In banking institutions, asset and liability management is the practice of managing various risks that arise due to mismatches between the assets and liabilities (loans and advances) of the bank. ALM is the integral part of the financial management process of the bank. It is concerned

with strategic balance sheet management involving risks caused by changes in the interest rates, exchange rates and the liquidity position of the bank. While managing these three risks forms the root of ALM, credit risk and contingency risk also form a part of the ALM.

It is a mechanism to address the risk faced by a bank due to a mismatch between assets and liabilities either due to liquidity or changes in interest rates. Liquidity is an institution's ability to meet its liabilities either by borrowing or converting assets. Apart from liquidity, a bank may also have a mismatch due to changes in interest rates as banks typically tend to borrow short term (fixed or floating) and lend long term (fixed or floating).

A comprehensive ALM policy framework focuses on bank profitability and long-term viability by targeting the net interest margin (NIM) ratio and Net Economic Value (NEV), subject to balance sheet constraints. Significant among these constraints are maintaining credit quality, meeting liquidity needs and obtaining sufficient capital. An insightful view of ALM is that it simply combines portfolio management techniques (that is, asset, liability and spread management) into a coordinated process. Thus, the central theme of ALM is the coordinated – and not piecemeal – management of a bank's entire balance sheet. Although ALM is not a relatively new planning tool, it has evolved from the simple idea of maturity-matching of assets and liabilities across various time horizons into a framework that includes sophisticated concepts such as duration matching, variable rate pricing, and the use of static and dynamic simulation(Oracle,2008)

So many researchers have empirically explored various factors of banks profitability even though the definition & measures of profitability varies among the researchers. Disregarding the profitability measures, most of the banking studies have noticed that both the internal

environment of the organization and external environment are important drivers of high profitability. Internal drivers of bank performance or profitability can be defined as factors that are influenced by a bank's management decisions which encompass the ALM culture of the bank. Such management effects will definitely affect the operating results of banks. Although a quality management leads to a good bank performance, it is difficult, if not impossible, to assess management quality directly. In fact, it is implicitly assumed that such a quality will be reflected in the operating performance. As such, it is not uncommon to examine a bank's performance in terms of those financial variables found in financial statements, such as the balance sheet and income statement Krakah and Ameyaw (2010). External determinants of bank profitability are factors that are beyond the control of a bank's management. They represent events outside the influence of the bank. However, the management can anticipate changes in the external environment and try to position the institution to take advantage of anticipated developments. The two major components of the external determinants are macroeconomic factors and financial structure factors Krakah and Ameyaw (2010). The common macroeconomic factors that determine the profitability of banks in general and commercial banks in particular are GDP, inflation rate, market interest rates, and ownership.

Hester & Zoellner (1966) tried to investigate the relationship between ALM and profitability and found out that there is statistically significant relationship between ALM and profitability and they disregard the null hypothesis that there is no relationship between them. On the other hand, Kosmidou *et al.* (2004) found that liability management plays its own pivotal role in contributing profitability difference among commercial banks. However, before this study Vasiliou (1996) suggested that asset management rather than liability management play the key role in explaining the differences in banks profitability. Apart from these, In a study conducted by Asiri (2007) it is

mentioned that assets management positively and liabilities management negatively related to the profitability of Kuwaiti banks.

In the contexts of Ethiopia there is one research made in the area by Tamiru belete (2013).He used return on asset as a measure of profitability and found out that the rate of return on earning assets is positive and varies across assets, and the rate of cost on liabilities is negative and varies across liabilities. The regression analysis result showed that all assets, except fixed assets, mainly loans and advances affect profitability positively, while all liabilities mainly saving and fixed deposits and other liabilities and credit balances have significant and negative effect on commercial banks profitability.

The assets and liabilities of commercial banks shall be managed in order to maximize shareholder value, to enhance profitability and increase capital, to serve customer and community needs, and to protect the institution from any disastrous financial consequences arising from different changes. These objectives shall be pursued within the framework of written credit, capital, and investment policies. The Asset/Liability Management Policy of the Bank falls under the authority of the Board of Directors, who in turn assigns authority for its formulation, revision and administration to the Asset/Liability Management Committee (ALCO). The degree of managing assets and liabilities affects a profitability of banks through reducing loss of revenue due to potential risks banks may face (Muhammad and Mohammad,2009). In addition, different market and macroeconomic factors also influence the ability of the banks to make profits (Short, 1979; Molyneux and Thornton, 1992; Athanasoglou et al, 2008). In a capsule, the Bank intends, through sound and dynamic funds management, to realize solid operating results produced against a background of a quality balance sheet.

Most of previous studies attempted to test the relationship between Asset Liability Management and profitability using comprehensive measures of profitability return on asset (ROA) and return on equity (ROE), no one was emphasized on the core business operations profitability of banks. For the purpose of this study core business operations of commercial banks was defined as ‘the banks’ operations of deposit mobilization and providing loans to customers’. Hence, didn’t take into account other measures of profitability particularly the measure of profitability for core business operations of banking sector, net interest income.

As to the knowledge of the researcher there were no studies related to this title “The Effect of Asset & Liability Management on Commercial Banks profitability” with an emphasis on the core business operations profitability of commercial banks in the country.

Knowledge of the effect of ALM on profitability of banks would help financial managers to predict and mitigate potential risks associated with their operational decisions. Particularly, acquiring knowledge of the effect of Asset Liability Management on profitability of banks’ core business operations will have significant benefit to manage risks associated to the industry in a way that meets the goal of firms; shareholders’ wealth maximization.

Therefore, given the unique features of banks’ financial structure and the environment in which they operate, there are strong grounds for a separate study on the effect of Asset Liability Management on profitability of commercial banks in Ethiopia by emphasizing on banks’ core business operations profitability.

1.3 Objectives and Hypothesis of the study

1.3.1 General Objective

The general objective of the paper is to find out the effects of asset liability management on profitability of commercial banks listed in the National Bank of Ethiopia.

1.3.2 Specific Objectives

The specific objectives of this study are;

- ✓ Examining the relationship between assets management and profitability of Ethiopian Commercial Banks;
- ✓ Examining the relationship between liability management and profitability of Ethiopian Commercial Banks;
- ✓ Examining the effects of economic growth, market share and inflation on Ethiopian commercial banks profitability;

1.4 Hypothesis of the study

In line with the broad purpose statement the following hypotheses were also formulated for investigation. Hypotheses of the study stands on the theories and past empirical studies related to profitability and Asset Liability Management. The results from the literature review were used to establish expectations for the relationship of the different determinants. Hence, based on the objective, the present study seeks to test the following hypotheses:

HP1: There is a significant positive relationship between assets of a bank and the bank's profitability.

HP2: There is a significant negative relationship between liabilities of a bank and the bank's profitability.

HP3: There is a significant positive relationship between real gross domestic product growth and bank profitability.

HP4: There is a significant negative relationship between inflation and bank profitability.

HP5: There is a significant positive relationship between market share and the bank's profitability.

1.4 Significance of the Study

Asset liability management is the set of actions and procedures designed to control the risks and financial conditions. Without proper management of risks and financial condition there won't be any manner where by banks could strive for a maximum profit. So through usage of advanced valuation model this research paper will assist the commercial banks in determining the appropriate composition of Asset and Liability in order to maximize their profit and it's expected to provide empirical evidence on the effect of ALM along with other macro-economic variables on commercial banks profitability in Ethiopia. Thus, it gives signal to the management of the banks and policy makers to take remedial action.

Furthermore, many parties would benefit from the results that will emanate from the outcome of the study and these parties are:

Management: Will assist the management in identifying indicators of success and failure in relation to the bank's asset and liability management strategy to take the necessary actions to improve the performance of the company and choose the right decisions.

Government: Government interested in knowing which companies are operating successfully or failing to take the necessary measures to avoid crises of the bankruptcy in these companies.

Investors: Will assist investors by providing feedback about the company they are investing to protect their investment, and directing their money to the best investment.

Customers: Customers interested in knowing the capacity of Commercial bank, this study will help them to know better which companies are in the right direction and can satisfy their needs.

This research does have significant role to play in shading light on how to better understand ALM and its effects on banks profitability. Furthermore, this study does have a paramount importance in providing a better ground for bank managers, business professionals, business initiatives and policy makers as a crucial part of committing strategy planning and management towards ALM thereby reducing the gap in information prevalence on the topic.

1.5 Scope and Limitation of the study

Although It is evident that there are many factors that affect banks profitability it is impossible to force the researcher to measure the dependent variable as well as the proxies of the cover all factors in one study, therefore the scope of the study is restricted up to examining how asset and liability management together with external variables such as GDP growth rate, market share in the industry and inflation affecting bank profitability of all commercial banks registered by the NBE and that have at least ten years data i.e., 2002-2015. As a result, it includes the largest

governments owned commercial bank i.e Commercial Bank of Ethiopia. The scope of the study also includes the six leading private commercial banks in the country in terms of both branch network and market share namely, Awash International Bank, Dashen Bank, Bank of Abyssinia, Wegagen Bank, United Bank and Nib International Bank. To meet its objectives, the study was limited to examining the effect of asset & liability management on profitability of core business operation of banks using independent variables: loans & advances to asset, deposits & placement with other banks to asset & short term investment to asset, saving deposit to asset, demand deposit, fixed deposit to asset, market share ,inflation and GDP and the dependent variable was Net interest Income (as a measure of profitability of core business operations of banks).

1.6 Organization of the Paper

The remaining chapters of this paper will be organized as follows: chapter two will review some of the theoretical and empirical literatures; chapter three will demonstrate the research methodology; chapter four will report the findings and discussion; finally, the fifth chapter will demonstrate the conclusions and recommendations reached at from findings.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Introduction

This chapter reviews the theoretical and empirical literatures on ALM in banks. We start with an overview of the Ethiopia banking system, section 2.3 covers the theoretical Reviews on ALM, Then, it demonstrates (in section 2.4) review of empirical studies related to the impact of ALM on profitability of banks. Section 2.5, discusses summary of the variable and the relationship between dependent & independent variables. Finally, knowledge gap and conclusions on literature review are presented (section 2.6).

2.2 Overview of the Ethiopian banking system

Banking system in Ethiopia was started in 1905 with the establishment of Abyssinian Bank. Its establishment was based on a fifty year agreement with the Anglo-Egyptian National Bank. A new development bank and two other foreign banks were also established in 1908 (Degefe, 1995 cited in Geda, 2006). However, in 1931 the Ethiopian government purchased the Abyssinian Bank and renamed it as the Bank of Ethiopia.

Generally, in its short period of existence, Bank of Abyssinia had been carrying out limited business such as keeping government accounts, some export financing and undertaking various tasks for the government. Moreover, the Bank faced enormous pressure for being inefficient and purely profit motivated and reached an agreement to abandon its operation and be liquidated in order to disengage banking from foreign control and to make the institution responsible to

Ethiopia's credit needs. Thus by 1931 Bank of Abyssinia was legally replaced by Bank of Ethiopia shortly after Emperor Haile Selassie came to power.

As stated in Degefe (1995) cited in Geda (2006), banking activity of the country was relatively expanded during the five-years of Italian occupation. During that time, the Italian banks were particularly active. As a result, most of the banks operating during this period were Italian banks. After independence from Italy's occupation, due to the paramount role of British in its strategic planning during the Second World War, Barclays Bank was established and it remained in operation in Ethiopia in the period of 1941 to 1943.

The new Bank, Bank of Ethiopia, was a purely Ethiopian institution and was the first indigenous bank in Africa (NBE 2009/2010) and established by an official decree on August 29, 1931 with capital of £750,000. Bank of Egypt was willing to abandon its concessionary rights in return for a payment of Pound Sterling 40,000 and the transfer of ownership took place very smoothly and the offices and personnel of the Bank of Abyssinia including its manager, Mr. Collier, being retained by the new Bank. Ethiopian government owned 60 percent of the total shares of the Bank and all transactions were subject to scrutiny by its Minister of Finance.

Bank of Ethiopia took over the commercial activities of the Bank of Abyssinia and was authorized to issue notes and coins. The Bank with branches in Dire Dawa, Gore, Dessie, DebreTabor, Harar, agency in Gambella and a transit office in Djibouti continued successfully until the Italian invasion in 1935. During the invasion, the Italians established branches of their main Banks namely Banco di Italia, Banco di Roma, Banco di Napoli and Banco Nazionale del lavoro and started operation in the main towns of Ethiopia. However, they all ceased operation soon after liberation except Banco di Roma and Banco di Napoli which remained in Asmara. In

1941 another foreign bank, Barclays Bank, came to Ethiopia with the British troops and organized banking services in Addis Ababa, until its withdrawal in 1943. Then on 15th April 1943, the State Bank of Ethiopia commenced full operation after 8 months of preparatory activities. It acted as the central Bank of Ethiopia and had a power to issue bank notes and coins as the agent of the Ministry of Finance. In 1945 and 1949 the Bank was granted the sole right of issuing currency and deal in foreign currency. The Bank also functioned as the principal commercial bank in the country and engaged in all commercial banking activities.

The State Bank of Ethiopia had established 21 branches including a branch in Khartoum, Sudan and a transit office on Djibouti until it ceased to exist by bank proclamation issued on December, 1963. Then the Ethiopian Monetary and Banking law that came into force in 1963 separated the function of commercial and central banking creating National Bank of Ethiopia (NBE) and commercial Bank of Ethiopia (CBE). Moreover it allowed foreign banks to operate in Ethiopia limiting their maximum ownership to be 49 percent while the remaining balance should be owned by Ethiopians.

The State Bank of Ethiopia was established in 1943. However, Britain was against it, as a result, the process of the establishment of this bank was painful. Until 1963 the Bank of Ethiopia was operating as both a commercial and central bank. In 1963 it was remodeled into today's National Bank of Ethiopia (NBE). It was also re-established in 1976 and the Commercial Bank of Ethiopia (CBE) too. It was after this period many other banks were established and those banks were in operation before the 1974 revolution. Nevertheless, all privately owned financial institutions including three commercial banks, thirteen insurance companies, and two non-bank financial intermediaries were nationalized on 1 January 1975. The nationalized banks were

reorganized and one commercial bank Ethiopia (CBE), a national bank, two specialized banks, that is, the Agricultural and Industrial Bank, renamed recently as the Development Bank of Ethiopia and a Housing and Saving Bank, renamed lately as the Construction and Business Bank (CBB), and one insurance company (the Ethiopian Insurance Company) were formed (Degefe 1995 cited in Geda 2006).

Following the downfall of the Dergue regime in 1991 and the 1992 liberalization policy, these financial institutions were reorganized to operate in a market-oriented policy framework. Furthermore, private financial institutions were also allowed to operate alongside the publicly owned institutions. As a result, currently, the major financial institutions operating in Ethiopia are banks, insurance companies and micro-finance institutions. The number of banks operating in the country reached 18 of which 16 are private, and the remaining 2 are state-owned including the merger of CCB & ECB (NBE, 2015/16).

2.3 Theoretical Review

This section demonstrates the definition of ALM and over view of techniques used in ALM. It also presents classification and definition of banking risks.

2.2.1. Key concepts of asset liability management

According to (Kanhaiya Singh,2013),the ALM is defined as "managing both assets and liabilities simultaneously for the purpose of minimizing the adverse impact of interest rate movement, providing liquidity and enhancing the market value of equity. It is also defined as "planning procedure which accounts for all assets and liabilities of a bank by rate, amount and maturity." Banks now focus on funds management approach to manage liability management and Interest rates risk. The features of this approach are:

- a. It focuses more control on volume, mix and return / cost of both assets and liabilities.
- b. Effective coordination on both, the assets and liabilities, to maximize the spread, and
- c. Revenues and costs affect both sides of the balance sheet. Therefore this approach suggests maximize returns and minimize costs.

He pointed out the three important mainstays on which an ALM rests and these are: ALM Information system which comprises availability of information accuracy and its sufficiency, ALM organization which is about setting up of asset liability management committee and organizational setup at different levels and ALM process which is the management of liquidity risk, interest rate risk, market risk, trading risk, capital planning and profit planning.

ALM has evolved through different stages. It was developed as a hedging reaction against the risk of financial intermediation. As a discipline, ALM has been functioning since the beginning of 1970s. At the initial stage, the management was based on the simple gap model that analyzes risk in terms of cash flows and the gaps or mismatches between assets and liabilities. As the experiences of financial institutions with risk management evolved, the cash flow gap models gradually gave way to duration gap models, which look more at the market value of the bank's rate-sensitive assets and rate-sensitive liabilities (to changes in interest rates) rather than just at the difference between them. At present, the rapid development in the ALM field is driven by such forces like: recent growth in the capital markets, advancement in the theory and technology of risk analysis, education of financial intermediaries in the necessity as well as in implementation of ALM (katarzynazawalińska, 1999).

Fabozzi et al. (1998) identifies three requirements for a successful implementation of ALM. A thorough understanding of the ALM concept is the first among these requirements. It refers to a comprehensive recognition of the banking risk. Besides serving as a venue for understanding the scope of risk, ALM allows for the quantifiable assessment and effective management of various risk categories. Even in the absence of a formal ALM program, the understanding of these concepts provides a picture of the risk/reward trade-off in which the financial institutions are engaged. The second step or requirement for the implementation of ALM is the development of an information system. Risk management involves gathering and monitoring relevant data. The set of data alone is likely to provide valuable information about the degree of financial risk affecting the institution. The third step involves a design and implementation of the ALM decision making process. The Asset Liability Committee (ALCO) usually carries out this process.

The function of ALM is not just protection from risk. The safety achieved through ALM also opens up opportunities for enhancing net worth. Interest rate risk (IRR) largely poses a problem to a bank's net interest income and hence profitability. Changes in interest rates can significantly alter a bank's net interest income (NII), depending on the extent of mismatch between the asset and liability interest rate reset times. Changes in interest rates also affect the market value of a bank's equity. Methods of managing IRR first require a bank to specify goals for either the book value or the market value of NII. In the former case, the focus will be on the current value of NII and in the latter, the focus will be on the market value of equity. In either case, though, the bank has to measure the risk exposure and formulate strategies to minimize or mitigate risk. The immediate focus of ALM is interest-rate risk and return as measured by a bank's net interest

margin. ALM is a systematic approach that attempts to provide a degree of protection to the risk arising out of asset/liability mismatch

$$\text{NIM} = (\text{Interest income} - \text{Interest expense}) / \text{Earning assets}$$
A bank's NIM, in turn, is a function of the interest-rate sensitivity, volume, and mix of its earning assets and liabilities. That is, $\text{NIM} = f(\text{Rate}, \text{Volume}, \text{Mix})$ (Oracle, 2008)

2.2.2 Banking risk

Banking risk is an integral part of financial activities, and the management of risk is central to the bank financial management (katarzyna zawalińska, 1999).

In the course of their operations, banks are invariably faced with different types of risks that may have a potentially negative effect on their business. Risk management in bank operations includes risk identification, measurement and assessment, and its objective is to minimize negative effects risks can have on the financial result and capital of a bank. Banks are therefore required to form a special organizational unit in charge of risk management. Also, they are required to prescribe procedures for risk identification, measurement and assessment, as well as procedures for risk management.

Fabozzi et al (1998) distinguished, as in the previous section that the first step for a successful implementation of ALM is to have a complete understanding of risks in banking institutions. Therefore, this section demonstrates an overview of various risk, their measurement and management techniques.

2.2.2.1. Banking risk classification

A useful definition of banking risk is provided by Saunders (1997). According to his view, banking risk is —a probability that the actual return on banking investment will differ from its expected return due to internal and/or external factors. The literature divides banking risk into six distinctively different categories: 1) Balance sheet risk, 2) Regulatory risk, 3) Technological risk, 4) Operational risk, 5) Strategic risk, and 6) Affiliation risk (Sinkey, 1998). Only the balance sheet risk is the area of interest and is discussed below.

The balance sheet risk incorporates various types of portfolio risk recognition and assessment, which is particularly important to bank's management. The balance sheet risk (portfolio risk) in banking can be further classified into (katarzynazawalińska, 1999): Interest rate risk, Credit risk, Liquidity risk, Foreign exchange risk, Insolvency risk and Costs of fund risk.

All these diverse types of portfolio risk require application of different tools and techniques for its measurement and management. They are examined in the next section.

2.2.2.2. Balance sheet risk measurement and management

Hedging and minimizing the risk are the main functions of risk management. In general terms, risk management techniques can be grouped into three categories (Saunders, 1997):

1. On-balance sheet matching of assets and liabilities in terms of reprising. For that technique such tools like GAP analysis and duration analysis are in use.
2. Off-balance sheet hedging of one or more risk categories. Among main tools here are derivatives, financial futures, etc.

3. Securitization of assets. This technique takes the risk out of balance sheet by exchanging the assets into securities and selling them to investors.

All those risk management and measurement techniques are described in the next sections with reference to particular types of risk.

Interest Rate Risk

Among the main tools used for interest rate risk measurement are GAP analysis, duration analysis, and the combination of the two. GAP measures the difference between rate-sensitive assets (RSA) and rate-sensitive liabilities (RSL) over a particular time horizon. It provides a proxy measure of the bank interest income.

Credit Risk

Credit risk is the uncertainty associated with a borrower's loan repayment. If the expected probability of default is d , then the expected probability of receiving payment is $(1-d)$ (Sinkey, 1998). Banks must protect their interests by monitoring closely potential and existing borrowers. In order to diminish the probability of default, banks must screen out the good credit risks from the bad ones. According to katarzynazawalińska (1999), specialization in lending, long term customer relationships and loan commitment are mentioned as techniques of credit risk management.

Liquidity Risk

From the point view of Anthony M. Santomero (1997) liquidity risk, —can be described as the risk of a funding crisis. While some would include the need to plan for growth and unexpected

expansion of credit, the risk here is seen more correctly as the potential for a funding crisis. Such a situation would inevitably be associated with an unexpected event, such as a large charge off, loss of confidence, or a crisis of national proportion such as a currency crisis.

Saunders (1997) and Sinkey (1998) figured out that net liquidity position, peer group comparison, and application of liquidity index and measuring financing GAP and financing requirements as ways of measuring liquidity exposure of banks.

Foreign Exchange Risk

The currency risk is that of incurring losses due to changes in the exchange rates. Variations in earnings result from the indexation of revenues and charges to exchange rates or of changes of the values of assets and liabilities denominated in foreign currencies (Joel Bessis, 2002). There are, in principle, two ways in which banks can manage the foreign risk exposure: on-balance-sheet hedging and off-balance-sheet hedging.

2.4.1. Total income

Total income consists; income from interest charge, service fees and commissions. Interest income can emanate from loans and advances and surplus funds. Interest charge is subject a revision of lower floor and upper ceiling rate by the regulation of the national bank of Ethiopia. The remaining sources of income can be captioned as —other income, which includes Service revenue, transaction fee (letter of credit opening charges), commission income, gain on foreign exchange, investment (rental or dividend) revenue... etc(Annual Reports of Banks Under Study).

2.4.2. Net income

Net income is found after deducting interest expense sourced from deposits and other liabilities, and administrative expenses from total income (Muhammad and Mohammed, 2009). Accordingly, expenses other than interest, as can be seen from the profit and loss accounts of the banks are salaries and benefits, rent, general and administrative, and so on.

2.4.3 Net Interest Income

Net interest income is interest income minus interest expense. Interest income: interest earned on loans, deposits held at other institutions, and securities. Interest Expense: interest paid on deposits, other borrowings, and notes and debentures.

2.4.4. Assets and Liabilities

Depending on the classification basis, assets and liabilities of various natures can be observed on banks 'balance sheet. The classification is more or less similar among banks. Literature suggests some models on which assets and liability contents of the balance sheet can be labeled. The next section takes a quick glance at the models.

2.4.4.1. A Neoclassical model

The simplest model is the neoclassical model of the banking firm developed by Klein (1971) and Monti (1972). The asset side of the balance sheet of the bank consists of reserves with the central bank loans, and market-traded assets such as government bonds or inter-bank loans. The liability side includes deposits and equity. The balance sheet is as follows:

Asset	Liabilities	and	Shareholders
'Equity			

Reserves

Loan

Deposits

Bonds

Equity

2.4.4.2. A multi-period neoclassical model

In the one-period model, the relevant transfer price for pricing and for the evaluation of profitability is the matched-maturity market rate. A six-month inter-bank rate is the relevant rate to price a six-month deposit. However, two additional features can introduce a multi-period consideration (Dermine, 1984; Hannan and Berger, 1991). The first is that the supply of deposits can be a lagged function of past deposit rates. This is likely to be the case in the retail sector in which customers, facing switching costs, will display some form of loyalty. This creates a lag in the deposit supply function. The second reason for dynamic consideration is that, for marketing reasons, it can be costly to continuously adjust the deposit rate.

2.4.4.3 A valuation model

The valuation model of the banking firm has different scenarios - with no tax, no risk, no growth, to more complete models with tax and risk. It is based on Dermine (1985, 1987), and Dermine and Hillion (1992). The balance sheet of the bank without considering risk and tax is given below

Assets

Liabilities and Shareholders'Equity

Loans

Deposits

Bonds

Equity

2.4.5 Inflation (CPI)

Many economic transactions require commitment to exchange money at some future time, credit transactions are a good example of this. Since inflation reduces the future value of money, it pays people (both potential borrowers and lenders) to try to forecast inflation over the relevant time period. This forecast is called anticipated inflation. As the name suggests, anticipated inflation is forward-looking. It is the rate of change in the general price level that people think will occur during some specific future time period. The accuracy of forecasts depends on future events and circumstances that are unknown when the forecast is made. Consequently, these forecasts generally will be —wrong. Any difference between actual (or realized) inflation and anticipated inflation is called unanticipated inflation (G.J Santoni, 1986).

There is now a substantial body of evidence indicating that sustained—and, therefore, likely predictable—high rates of inflation can have adverse consequences either for an economy's long-run rate of real growth or for its long-run level of real activity (Boyd et al, 2000). A growing theoretical literature describes mechanisms whereby even predictable increases in the rate of inflation interfere with the ability of the financial sector to allocate resources effectively. More specifically, recent theories emphasize the importance of informational asymmetries in credit markets and demonstrate how increases in the rate of inflation adversely affect credit market frictions with negative repercussions for financial sector (both banks and equity market) performance and therefore long-run real activity (Huybens and Smith 1998, 1999). The common feature of these theories is that there is an informational friction whose severity is endogenous (Boyd et al, 2000).

Profitability in the banking sector has been extensively examined in developed countries, especially in North America and Europe. Evidence from these studies is an indication that bank profitability depends on several factors in which inflation is one of them. Inflation as a virus that has come to stay in virtually all the economies of nations of the world both emerging and industrialized economies has reduced competitiveness in the world markets and can have a general debilitating effect on almost all type of economic activities, especially banking. It has been described as what hits the consumer's pocket by eroding the purchasing power of the currency and sometimes acts as hidden tax . When one thinks of inflation what comes to mind is the dynamic situation of persistent increase in the price level which results in the diminution of real purchasing power of currency at one's disposal at any point in time. Inflation which can take the forms of cost push, demand pull, imported, creeping, wage push, mark-up or profit push is a condition of unrelenting price spiral. It has been generally described as a situation of persistent rise in prices of goods and services arising from too much money chasing too few goods in an economy. It always results when the aggregate demand exceeds the aggregate supply of goods and services and has the net effect of reducing the purchasing power of the monetary unit.

To express further how serious the issue of inflation is, Oritoni, (1981) defined it as the creation of money that eventually raises prices of goods and lowers the purchasing power of currency in question. When this reduction in the purchasing power of money is gradual as it was the case in Ethiopia in the early 2000's, the situation was never worrisome because there is no nation that is inflation-free. The only thing that makes the difference is the rate. Inflation rate is defined as an annual rate of increase of the average price level. Evidence has revealed that the countries with highest volume of money growth as is the case in Ethiopia today also has very high rate of inflation. The inflation if it crosses the single digit is an index of a weak economy. As a matter of

fact, high rate of inflation can occur only when there is a high volume of money supply; hence, one can conclude that inflation is a monetary phenomenon. When changes in price levels become ‘a run-away hyper-type-inflation’ the entire economic system would be at the brink of collapse as has been experienced in Ethiopia since late 2000s to date. However, Emekekwe (2008) opined that inflation is not completely dreadful; hence a certain level of inflation is desirable in order to ensure sustainable economic growth. Beyond that level, it becomes a hydra-headed monster that has baffled monetary economics over the years. At the undesirable level, inflation greatly affects the performance of corporate organizations like banks, hence hampers the financial decisions thereby constituting big source of uncertainty in the economic world.

2.4.6. Gross domestic product (GDP) growth rate

GDP measures the monetary value of final goods and services—that is, those that are bought by the final user—produced in a country in a given period of time (say a quarter or a year). It counts all the output generated within the borders of a country. GDP is composed of goods and services produced for sale in the market and also include some nonmarket production, such as defense or education services provided by the government.

The use of GDP growth as a variable does not feature extensively in the literature. However, Hoggarth et al. (1998) conclude that the behavior of real GDP fails to explain the greater variability of banking sector profits in the UK than in Germany. But they do not say that GDP variability did not affect profits, only that they could not use it to explain different UK/German banks performance. If this variable is not statistically significant in explaining profitability, then the conclusions of the authors are reinforced. Otherwise, the expected sign should be positive

since higher growth implies both lower probabilities of individual and corporate default and an easiest access to credit.

The linear regression model is used by Fadzlan and Khazanah (2009) to examine the effects of bank-specific and macroeconomic determinants of state-owned and joint-stock commercial banks in China during 2000-2007, the study shows that there are positive impacts of economic growth and inflation on bank profitability. The system GMM estimation is used by Heffernan and Fu (2008) to investigate the effects of bank-specific and macroeconomic determinants of profitability in China. The results show that GDP growth and unemployment rate are significantly related to bank profitability in China.

2.4.7. Market Share

The size of the bank is included in this study, as an independent variable, which account for size related economies and diseconomies of scale. Size is used to capture the fact that larger banks are better placed than smaller banks in harnessing economies of scale in transactions to the plain effect that they will tend to enjoy a higher level of profits. Consequently, a positive relationship is expected between size and profit (Indranarain 2009).

Scholars argue that the market share reflects the current competitive position that a firm attains in the marketplace, so that firms with high market shares are considered to better satisfy customers' needs and, therefore, enjoy a competitive advantage against their smaller competitors.

Since the first published study reporting a positive market share–profitability association (Gale, 1972), the nature of the relationship between market share and business profitability continues to be an important subject to research in economics. The debate regarding the underlying

relationship has been fueled by inconsistencies in the magnitude of the market share-profitability relationship, the statistical significance of this relationship, and the direction of the relationship reported across studies and across models within the same study.

Buzzell (2004) noted that the majority of studies on the topic find a linear positive relationship between market share and financial performance. Two theories are proposed to explain how the degree of sector concentration affects bank profitability. The structure-conduct-performance hypothesis (also referred to as the market-power hypothesis) states that a more concentrated sector favors bank profitability motivated by the benefits of greater market power, which reflects the setting of prices that are less favorable to consumers (lower deposit rates, higher loan rates) as a result of competitive imperfections in these markets (monopoly profits). On the other hand, the efficient structure theory explains the positive relationship between concentration and profitability as an indirect consequence of efficiency. The empirical evidence on the relationship between concentration and profitability is not conclusive. Whereas Claeys and Vander Venet (2008), among others, report evidence from Europe favoring the structure-conduct-performance theory, other studies (see, for example, Athanasoglou et al., 2008; Berger, 1995) find no relationship between the degree of concentration of the sector and bank profitability; some even show an inverse relationship between the two.

For the past three decades, a rich body of conceptual and empirical studies in economics, marketing, and strategic management areas has reported that a larger market share is associated with a higher profitability.

Macroeconomic factors, which in fact were ignored in previous studies, have significant effect on ALM. Had they been included they would have made the researches reach to a different findings. Shortly, the inclusion of such factors would increase the trust ability of findings

2.3. Empirical studies on ALM & profitability

Bank's profitability is of utmost concern in modern economy. Banks are in a business to receive deposits or liabilities and to issue debt securities on the one hand and create or invest in assets on the other hand (Fama 1980). Commercial Banks incur costs for their liabilities and earn income from their assets. Thus profitability of banks is directly affected by management of their assets and liabilities. In addition, different market and macroeconomic factors also influence the ability of the banks to make profits (Short 1979, Molyneux, and Thornton 1992, Athanasoglou et al. 2008).

Different studies are done explaining the influence of composition of assets and liabilities on banks 'profitability. Hester & Zoellner (1966); Kwast & Rose, (1982); Vasiliou, (1996); Kosmidou et al, (2004); and Asiri, (2007) can be mentioned. Hester & Zoellner (1966) employed statistical cost accounting (SCA) method on US banks and found statistically significant coefficients for most of the categories of assets and liabilities and rejected the null hypothesis that there is no relationship between them. Vasiliou (1996), by employing SCA method, suggests that asset management rather than liability management play more prominent role in explaining inter-bank differences in profitability. However, these findings contrast with the findings of Kosmidou et al., (2004) who find that liability management contributes more in creating the profitability differences among the banks. These authors did not incorporate the variables relating to macro-economic and market structure in their model. In fact, a number of bank specific or

macroeconomic factors such as market structure, Inflation, gross domestic product (GDP) growth rate, etc do impact bank's net earnings which were ignored by these authors. With this view, Kwast & Rose (1982) expanded the traditional SCA model by including market structure and macro-economic variables. Nonetheless, their model found no evidence that differential returns and costs on different categories of assets and liabilities exist between high and low profit banks. In a recent study, Asiri (2007) has applied SCA method and finds that assets are positively and liabilities are negatively related to the profitability of the Kuwaiti banks.

Muhammad & Mohammad (2009), in their application of SCA to assess ALM impact on profitability they recognized that Private commercial Banks are better than public banks in terms of asset management, but they do not have any superiority over public banks in terms of liability management. This does not provided them conclusive support that ALM in private banks is superior to ALM in public banks. Thus, study could not explain the profitability differences between these two sets of banks through analyzing ALM. Their study considered the market concentration index and GDP growth rate, unlike the previous ones.

Muhammad and Mohammad (2009) measured profitability by assuming two levels of measures of income: total income and net operating income.

There are many asset-liability management models in the practice. Looking to the past, the first mathematical models in the field of bank management are found. Asset and liability management models can be deterministic or stochastic (Kosmidou and Zopounidis, 2001). Deterministic models use linear programming, assume particular realizations for random events, and are computationally tractable for large problems. The deterministic linear programming model of Chambers and Charnes (1961) is the pioneer in ALM. Chambers and Charnes were concerned

with formulating, exploring and interpreting the use and construction which may be derived from a mathematical programming model which expresses the actual conditions of current operations more realistically than past efforts. Their model corresponds to the problem of determining an optimal portfolio for an individual bank over several time periods in accordance with requirements laid down by bank examiners which are interpreted as defining limits within which the level of risk associated with the return on the portfolio is an acceptable one.

Cohen and Hammer (1967), Robertson (1972), Lifson and Blackman (1973), Fielitz and Loeffler (1979) have realized successful applications of Chambers and Charnes' model. Even though these models have differed in their treatment of disaggregation, uncertainty and dynamic considerations, they all have in common the fact that they are specified to optimize a single objective profit function subject to the relevant linear constraints.

Eatman and Sealey (1979) developed a multi-objective linear programming model for commercial bank balance sheet management considering profitability and solvency objectives subject to policy and managerial constraints.

Giokas and Vassiloglou (1991) developed a goal-programming model for bank asset and liability management. They supported the idea that apart from attempting to maximize revenues, management tries to minimize risks involved in the allocation of the bank's capital, as well as to fulfill other goals of the bank, such as retaining its market share, increasing the size of its deposits and loans, etc. Conventional linear programming is unable to deal with this kind of problem, as it can only handle a single goal in the objective function. Goal programming is the most widely used approach that solves large scale multi-criteria decision making problems.

Apart from the deterministic models, several stochastic models have been proposed since the 1970s. These models, including the use of chance-constrained programming (Charnes and Thore, 1966; Charnes and Littlechild, 1968; Pogue and Bussard, 1972), dynamic programming (Samuelson, 1969; Merton, 1969, 1990; Eppen and Fama, 1971), sequential decision theory (Wolf, 1969; Bradley and Crane, 1972) and stochastic linear programming under uncertainty (Cohen and Thore, 1970; Booth, 1972; Crane, 1971; Kallberg et al. 1982), presented computational difficulties. The stochastic models, in their majority, originate from the portfolio selection theory of Markowitz (1959) and they are known as static mean-variance methods. Pyle (1971) and Brodt (1978) adapted Markowitz's theory and presented an efficient dynamic balance sheet management plan that considers only the risk of the portfolio and not other possible uncertainties or maximizes profits for a given amount of risk over a multi-period planning horizon respectively. Wolf (1969) proposed the sequential decision theoretic approach that employs sequential decision analysis to find an optimal solution through the use of implicit enumeration.

An alternative approach in considering stochastic models is the stochastic linear programming with simple recourse. Kusy and Ziemba (1986) employed a multi-period stochastic linear program with simple recourse to model the management of assets and liabilities in banking while maintaining computational feasibility. Their results indicate that the proposed ALM model is theoretically and operationally superior to a corresponding deterministic linear programming model and that the computational effort required for its implementation is comparable to that of the deterministic model. Another application of the multistage stochastic programming is the Russell-Yasuda Kasai model (Carino et al., 1994), which aims at maximizing the long term wealth of the firm while producing high income returns.

Mulvey and Vladimirou (1992) used dynamic generalized network programs for financial planning problems under uncertainty and they developed a model in the framework of multi-scenario generalized network that captures essential features of various discrete time financial decision problems. 14

Mulvey and Ziemba (1998) present a more detailed overview of various asset and liability modeling techniques, including models for individuals and financial institutions such as banks and insurance companies.

Moreover, over the years, many models have been developed in the area of financial analysis and financial planning techniques. Kvanli (1980), Lee and Lerro (1973), Lee and Chesser (1980), Baston (1989), Sharma et al. (1995), among others have applied goal programming to investment planning. Booth et al. (1989), Giokas and Vassiloglou (1991), Seshadri et al. (1999) presented bank models using goal programming.

Hester & Zoellner (1966) employed statistical cost accounting (SCA) model on US banks. Mihir & Ravi (2009) implemented the canonical analysis to assess the nature of relationship between assets and liabilities setting the hypothesis assets influence liabilities. This method was also used by Seem Jawal (2010), who found that strong canonical correlation between asset and liability accounts, indicating high asset-liability dependency and the canonical correlation in each sector (public, private and foreign banking sectors) of banks in India under study declined from the period 1997-2000 to 2005-2008.

2.4. Variables Summary & Hypothesis Formulation

Most of the empirical investigations on ALM consider the effect of ALM and other macroeconomic factors on profitability. This section attempts to demonstrate the relationships existing between profitability and ALM along with other factors through developing a testable hypothesis. The study conducts a regression assuming Net Interest Income as a measure of profitability. The variables considered are; assets, liabilities, inflation, GDP growth rate, and Market share.

2.4.1. Asset

Bank balance sheet assets are earning items. According to Kwast and Rose (1992) when total income is used as measure of profitability, assets directly contribute in increasing in marginal rate of return which in turn increases total income. Even, when net income is used as a profit measure a net return from assets is still positive. The SCA model adopted by Hester and Zoellener (1966) marks a positive relationship between assets and profitability of a bank. Based on the nature of assets and SCA model the researcher hypothesizes that:

Hypothesis one: There is a positive relationship between assets and net interest income.

2.4.2. Liabilities

Liabilities are reasons for incurring costs. These liabilities emerge from deposits and other borrowings. Since it is customary that banks impose service charges on deposit accounts and non –other deposit liabilities , the return on liability should be positive (Muhammad and mohammed,2009) . This holds true so long as total income is taken. When the net counterpart is taken, a liability’s marginal cost is deemed. Apparently; operating costs are generally higher than

the service charges earned from deposits, which would signify a negative return of liabilities (Muhammad and Mohammed, 2009,). Thus, based on this the researcher hypothesizes that:

Hypothesis two: There is a negative relationship between liabilities and net interest income.

2.4.3. Inflation

Inflation is a recurrent increase in price. It can also be defined as defined it as the creation of money that eventually raises prices of goods and lowers the purchasing power of currency in question. Inflation rate on the other hand is defined as an annual rate of increase of the average price level. Evidence has revealed that the countries with highest volume of money growth as is the case in Ethiopia today also has very high rate of inflation. The inflation if it crosses the single digit is an index of a weak economy Profitability is adversely affected by inflationary situation which make banks vulnerable to default risks, interests rate risk and liability risk. Due to the onslaught of so many risks, bank may face huge amount of loss in a variable inflationary environment (Oguzsoy and Guven, 1997).Based on this the researcher hypothesize that:

Hypothesis three: There is a negative relationship between inflation and net interest income.

2.4.4. GDP (gross domestic product) growth rate

GDP measures the monetary value of final goods and services—that is, those that are bought by the final user—produced in a country in a given period of time (say a quarter or a year).It counts all the output generated within the borders of a country. GDP is composed of goods and services produced for sale in the market and also include some nonmarket production, such as defense or education services provided by the government.

GDP shows the total contribution of sectors of an economy to economic growth of a country. Sectoral breakdown of GDP encompasses financial sector. The more the financial sector glares the more its contribution to economic growth would be. The more it contributes to the economic growth, the more participants evolved in it to enjoy profit. Based on this the researcher hypothesizes that:

Hypothesis four: There is a positive relationship between GDP and net interest income.

2.4.5. Market Share

Since the first published study reporting a positive market share–profitability association (Gale, 1972), the nature of the relationship between market share and business profitability continues to be an important subject to research in economics. The debate regarding the underlying relationship has been fueled by inconsistencies in the magnitude of the market share-profitability relationship, the statistical significance of this relationship, and the direction of the relationship reported across studies and across models within the same study.

The size of the bank is included in this study, as an independent variable, which account for size related economies and diseconomies of scale. Size is used to capture the fact that larger banks are better placed than smaller banks in harnessing economies of scale in transactions to the plain effect that they will tend to enjoy a higher level of profits. Consequently, a positive relationship is expected between size and profit (Indranarain 2009).

One of the most important questions regarding bank profitability is whether or not bank size optimizes profitability. The effect of size on profitability is expected to be positive. Based on this the researcher hypothesizes that:

Hypothesis five: There is a positive relationship between market share and net interest income

2.5. Conclusion & Knowledge Gap

A number of empirical studies are available on ALM. Some of these have been presented pertaining to their resemblance to this study. The studies major emphasis were identifying the relationship between asset and liability (Hester and Zoellner, 1966), the cause of difference in inter-bank profitability- whether it is asset or liability management (Vasiliou, 1996), the impact of ALM on profitability (Muhammad and Mohammed , 2009), the nature of dependency between asset and liabilities(Seema Jaiswal, 2010) and so on. SCA regression and the canonical correlations analysis are used particular to the research objectives. Using the SCA regression, Hester & Zoellner , assured that there is a relationship between asset and liabilities of US banks. Vasiliou achieved that the interbank profitability difference is well explained by asset management, which actually was opposite to the finding of Kosmidou et al., (2004)-liability management explains profitability difference between banks. Seema Jaiswal (2010) indicted a higher asset liability dependency administering canonical correlation analysis. Mehir & Ravi (2009) and inferred assets influence liabilities.

Hence, given the contradicting results of earlier studies on the relationship between Asset Liability Management and profitability, and most of previous studies attempted to test the relationship between Asset Liability Management and profitability using comprehensive measures of profitability return on asset (ROA) and return on equity (ROE), no one was emphasized on the core business operations profitability of banks. Hence, didn't take into account other measures of profitability particularly the measure of profitability for core business operations of banking sector, net interest income , there is an objective ground to study the effect

of Asset Liability Management on profitability in the context of banking industry working in Ethiopia with a focus on the profitability of core business operations of banks. Besides, even though studies addressing ALM in developed and some developing economies are available and they would be of great value for related literatures. But, scant attention has been given to cover an assessment of ALM in the banks of least developed countries, like Ethiopia..

Therefore, this study is designed to scrutinize the effect of Asset Liability on profitability of core business operations of Commercial banks in Ethiopia by using net interest income (NII) as measure of profitability of the core business operations of banks.

CHAPTER THREE

3. RESEARCH METHODOLOGY

The previous chapter presented the literature review along with the knowledge gap which this study intended to address. The purpose of this chapter is to discuss the methods to be adopted throughout the study to accomplish the research objectives. The chapter is organized as follows: The first section 3.1 presents about the research approach adopted to examine the effect of ALM on profitability. Section 3.2 discusses the data source to be used and collection methods. The sampling design and selection methods will be discussed in section 3.3. In section 3.4 we discuss the summary of the variables. Furthermore, section 3.5 states about the data analysis and model specification.

3.1. Research approach

As noted in Creswell (2003), in an investigative study there are three familiar types of research approaches to business and social research namely, quantitative, qualitative and mixed methods approach. Though, each approach has its own strengths and limitations, Creswell (2003) advocates that certain types of social research problems call for specific approaches. Hence, in selecting an approach one should take in to account the nature of the research problem, the personal experience of the researcher, and the audience for whom the report will be written.

Quantitative research is one in which the investigator primarily uses positivist claims for developing knowledge and its strategies of inquiries are associated with experimental and survey research methods. Creswell (2009) mentioned that experimental research seeks to determine if a specific treatment influence an outcome. This impact is assessed by providing a specific treatment to one group and withholding it from another and then determining how both groups scored on an outcome. Therefore, pure experiment enables the researcher to manipulate an independent variable in order to see the effect on the dependent variable with the random assignment of subjects to treatment conditions while quasi experiments uses non randomized designs and it is a single subjects design Whereas, survey research provides quantitative or numeric description of research trends attitudes or opinions of a population by studying a sample of population. It includes cross-sectional (data will be collected in one point in time) and longitudinal studies (data will be collected through time with different interval) using questionnaires, structured interviews and documentary reviews for data collection, with the intent of generalizing from the sample to the population Creswell (2009).

Qualitative approach is centered on the interpretive social sciences paradigm. Qualitative methodology of investigation tends to be based on recognition of the importance of the subjective, experiential “life-world” of human beings (Blanchi and Durrhein, (1999). Shaw (2006) described that qualitative research seeks to come to terms with meaning rather than frequency because they discover or uncover issues in order to generate ideas and hypothesis. This paradigm therefore focuses on context and capture ways in which people interpret events, experiences and relationship.

Triangulation is about exposing potentially conflicting perspectives to analysis and showing that data can be integrated and cross-referenced to highlight consistency. Pervez and Kjell (2005) stressed that to enhance validity, there is a need to collect or analyze data through triangulation and where correctness or precision is important. Hence, it is quite logical to collect information through different methods and angles. Babbie (1995) mentioned that a combination of qualitative and quantitative approaches should be viewed as an acceptable methodological approach for research occupying a variety of epistemological positions.

Creswell (2009) defined that mixed approach is one in which the researcher tends to base knowledge claims on pragmatic grounds (e.g., consequence-oriented, problem-centered, and pluralistic). It employs strategies of inquiry that involve collecting data either simultaneously or sequentially to best understand research problem. The data collection also involves gathering both numeric information (e.g., on instruments) as well as text information (e.g., on interviews, open-ended questionnaires) so that the final database represents both quantitative and qualitative information. As a result, when methods are combined, the advantages of each methodology

complement those of the other, making a stronger research design that will yield more valid and reliable findings. Indeed, the inadequacies of individual methods are reduced.

In general, according to Mc Kerchar (2008) the choice among the three research approaches is guided by mainly the research problem apart from the underlying philosophy of each research method. That is, whether the research problem is based on a framework developed deductively through a review of the literature and prefigured information to be collected in advance of the study or to allow it to emerge from participants in the project or both.

Method Adopted

Considering the research problem and objective along with the philosophy of the different research approaches, the quantitative nature of the data collected, quantitative research approach was found to be appropriate for this study. Because, quantitative research is a systematic and scientific investigation of quantitative properties and phenomena and their relationships (Abiy, 2009), and the primary aim of this study is to investigate the relationship between ALM and profitability on commercial banks.

A quantitative approach is one in which the investigator primarily uses postpositive claims for developing knowledge, i.e., cause and effect relationship between known variables of interest (Cresswell 2003).

Cresswell further noted that a quantitative research approach employs strategies of inquiry such as experiments and surveys, and collect data on predetermined instruments that yield statistics. Quantitative research employs a review of the existing literature to deductively develop theories

and hypotheses to be tested i.e., in this approach, the research problem is translated to specific variables and hypotheses.

Specifically, this study employs a survey design administered through structured record review. It is employed in order to infer from a sample to population. Survey method is preferred because of its high-speed in data collection and its being economical. In line with this, a panel balance sheet data, i.e., Panel balance sheet data have the dimensions of both time series and cross-sections (Brooks), for seven commercial banks will be collected for 2005-2015 study period. The advantage of using the panel data set is that, because of the several data points, co linearity among the explanatory variables is reduced, thus improving the efficiency of econometric estimates and it takes into account a greater degree of the heterogeneity that characterizes firms (Daskalakis and Psillaki, 2008).

3.2 Source of data and collection methods

Given the research design, secondary data has been used to meet the objectives of the study. According to Stewart and Kamins (1993) cited in Li Yuqi (2007), secondary data have its own advantages. Compared to primary data, secondary data gives higher quality data, the feasibility to conduct longitudinal studies and the permanence of data. That is, secondary data generally provide a source of data that is both permanent and available in a form that can be checked relatively easily by others and increases the dependability of the data, hence ensure data quality.

As a result, the data for the banks' asset and liability management and profitability indicator variables were obtained from audited financial statements of the respective banks. Thus, the data collected from National Bank of Ethiopia (NBE) and from the respective commercial banks. In

order to avoid the risk of distortion in the quality of data, the data to be used is the audited financial statements particularly balance sheet and income statement.

The study included seven commercial banks composed of one state owned and six private banks. Accordingly, this study used panel data of eight commercial banks for twelve years (2005 to 2015) resulted in 70 observations.

3.3. Population and Sampling design

Samplings design ‘in fact means the joint procedure of selection and estimation. Sampling should be such that error of estimation is minimal. Three indispensable factors are the concern of sampling design –sample frame, sample size, the technique used to select the sample size. If a study applies the sample observation to make generalization to the phenomena, the samples taken ought to be representative of the population.

In line with balanced panel data approach, to meet the desired objective of this study and to make generalization from sample to population, the researcher will use maximum combination of years and number of banks and will achieve the maximum number of observations through purposive sampling technique. Since it is unfair to compare banks that operated longer time period with the newly one & even profitability of those newly opened banks depend on many factors Thus, banks that operate less than 10 years were excluded from the sample. Due to this, from 18 commercial banks operating in the country this study takes sample of seven banks namely, commercial bank of Ethiopia (CBE), Dashen bank (DB), Awash international bank (AIB), Bank of Abyssinia (BOA), Wegagen bank (WB), United bank (UB) and Nib international bank (NIB) for the period of 2002 to 2015 (in which audited financial statements were available). It is known

that Construction and Business bank of Ethiopia (CBB) has been merged with Commercial Bank of Ethiopia in 2015.hence deliberately excluded from the study.

According to NBE 2015/16 report, the sample banks market share in terms of branch network and capital was 77.5 % and 74.7 % respectively. Besides, they have good experience in the banking operation and the sample taken also 41.17 % of the total population of 17 commercial banks in the country. Hence, it is believed that possible to make generalization from sample to population.

The total number of observations will be 98. The sources of bank specific audited balance sheet and profit and loss accounts are from NBE and each of the banks. The assets and liabilities will be classified according to their presentation on balance sheets of the banks. Data's from MoFED, NBE and Ethiopian statistical agency will be a major ingredient for the study to incorporate macroeconomic data.

3.4. Variables in the research

The study consists of three dependent variables (total income, net income and Net interest Income) and five independent variables (Assets, Liabilities, and GDP Growth Rate, Inflation Rate, and Market share). All variables are measured by using their book values. Muhammad and Mohammad (2009) use book values for assets and liabilities in such a way that beginning and ending book values are added to compute the average book values. These values are divided by average total asset of the year to express them as ratios for the same period.

3.4.1. Dependent variable

Profit is the ultimate goal of commercial banks. All the strategies designed and activities performed thereof are meant to realize this grand objective. However, this does not mean that commercial banks have no other goals. Commercial banks could also have additional social and economic goals. However, the intention of this study is related to the first objective, profitability. To measure the profitability of commercial banks there are variety of measures used of which total income, net Income and net interest income Alexandru et al (2008).

3.4.1.1. Net interest income

Net income is the difference between interest income and interest expense

In this research we are going to measure banks profitability by using the net-interest income measures by conducting a multivariate regression for the dependent variable.

3.4.2. Independent variables

Based on the suggestions and deeds of previous empirical studies (section 2.4.), this study uses five independent variables .i.e. assets, liabilities, inflation rate, GDP growth rate, and Market share.

3.4.2.1. Assets

This study accounts the book value of assets. Because, notes to the financial statements‘of banks excerpt that financial statements are prepared in accordance with the historical cost convention. Average variable are computed by adding beginning and ending book values and dividing by

two. These values are further divided by average total assets of the year to express them in ratios for the same period. Explanatory variable assets are described in the following table.

Table 3.1 Explanatory variables included in the model and description relating to ECBs' assets

Assets	
Variable	Description
A1	Loans and Advances
A2	Deposits & Placements to Banks
A3	Sum of Investments* (i.e. short-term inv. + equity inv. + other inv.)

* In a case of variable A3 the researcher decided to use aggregated accounts instead of individual accounts that are shown in brackets. Disaggregating these variables and entering the individual accounts into equation, would introduce many zero values, which could distort our result.

3.4.2.2. Liabilities

Like the assets counter parts liabilities figures show book values. Averages are taken and then are divided for average total assets to come with ratios. Liabilities included from the balance sheet are described in the subsequent table.

Table 3.2 Explanatory variable and descriptions relating to ECB's liabilities

Liabilities	
Variable	Description
L1	Saving deposit
L2	Demand deposit
L3	Fixed deposit

3.4.2.3. Inflation (CPI)

Consumer price index is a key inflation indicator. It is gauged based on data related to consumer spending habits and the prices paid for a variety of goods, including food, clothing, medications, energy, homes and furnishings. In the study the general inflation rate will be taken from Ethiopia statistics agency.

3.4.2.4. GDP

GDP is one of the primary macroeconomic indicators used to measure the health of the economy of a country, and it is a measure of the overall economic output within a country's borders over a particular time, usually a year. Since economic growth and financial sector performance are positively correlated (Levine, 2000), the real GDP growth, used in this study, is expected to have a positive impact on bank's profitability.

3.4.2.5. Market Share

There is consensus in academic literature that economies of scale and synergies arise up to a certain level of size. Beyond that level, financial organizations become too complex to manage

and diseconomies of scale arise. The effect of size could therefore be nonlinear; meaning that profitability is likely to increase up to a certain level by achieving economies of scale and decline from a certain level in which banks become too complex and bureaucratic. Hence, the expected sign of the coefficient of bank size is unpredictable based on academic literature.

$$\text{Market share} = \frac{\text{The deposit of a company operates in a specific year}}{\text{The total deposit amount of all banks for the same year}}$$

3.5. Data Analysis

The statistical cost accounting (SCA) multivariate model will be employed to figure out the effect of explanatory variables on the dependent variable. The study will conduct three multivariate regressions for banks, assuming, net income and net interest income. SPSS/STATA application will be used for analysis purpose.

The traditional model (Hester and Zoellenr, 1966) suggests an equation for showing the variations in banks net income, Y_{bt} expressed for bank b and time t in terms of variations of assets and liabilities in the following way:

$$Y_{bt} = \alpha_1 + \sum \alpha_{2i} A_{ibt} + \sum \alpha_{3j} L_{jbt} + e_{bt} \dots \dots \dots (1)$$

Where,

$A_i = I^{th}$ asset.

$L_j = j^{th}$ liability.

α_1 = net fixed income that is not dependent on assets and liabilities.

e_{bt} = error term.

α_{2i} = marginal rate of return on assets.

α_{3j} = marginal cost of liabilities

As the banks have wide variations in their business volume, all variables of equation (1) are divided by a bank's average total assets (TAbt) (kosmidou et al, 2004). Thus equation (1) takes the form of:

$$Y_{bt} / T_{Abt} = \alpha_1 / T_{Abt} + \sum \alpha_{2i} A_{ibt} / T_{Abt} + \sum \alpha_{3j} L_{jbt} / T_{Abt} + u_{bt} \dots\dots\dots(2)$$

Where, the stochastic term $u_{bt} = e_{bt} / T_{Abt}$

The structure of the traditional SCA model ignores macroeconomic variables. In reality, a number of factors affect bank's earning and cost relating to assets and liabilities. These factors are market structure and macroeconomic conditions. If these factors are not included in the model, regressions results will be unreliable and coefficients biased. Kwast & Rose (1982) incorporated the influences of these factors and presented a modified model as equation 3. This model is applied to this study.

$$Y_{bt} / TAbt = \alpha_1 / TAbt + \sum \alpha_2 i A_{ibt} / TAbt + \sum \alpha_3 j L_{jbt} / TAbt + \sum \alpha_4 f M_{ft} + \sum \alpha_5 R + \sum \alpha_6 H + u_{bt}$$

..... (3)

Where, M = Inflation as a variable for number of years.

R= Real GDP growth rate for each study year

H= Market share of each bank in the industry.

As discussed earlier (section 3.6.1) since income is measured for banks assuming a dependent variable- net interest income, and the study conducts one regression .i.e.Y1bt.

The study will not use net income after tax as a dependent variable as tax rate is fixed by the government from time to time and not influenced by ALM. All assets and liabilities will not be included as independent variables in the model. This will be done to avoid perfect collinearity with in the independent variables. Hence, cash and fixed assets on the assets side and equity capital on the liabilities side will be excluded from the model (Muhammad and Mohammad, 2009).

CHAPTER FOUR

4. Results Analysis and Discussion

Preliminaries on econometric analysis

The previous chapter presented the research methodology applied to meet the objective of the study. This chapter presents the results and analysis of the findings as well as discussion of results. The chapter is organized in to four sections. Section 4.1 presents summary of statistics. Then Section 4.2 and 4.3 presents the Classical Linear Regression Model assumptions tests and results of regression analysis respectively. Finally, section 4.4 presented the summary of findings.

The study, as indicated in methodology section, constitutes the use of balanced panel data where an observation is made for the variables in the model for the firms taken from the banking sector along with the time period for the study. The time period covers fourteen consecutive years (2002-2015), while the total number of cross sections is seven, namely- Awash Bank, Dashen

Bank, Commercial Bank of Ethiopia, United Bank, Bank of Abyssinia, Nib Bank and Wegagen Bank. Measurement of the impact of ALM with market structure and macroeconomic variables on the profitability of the banks is carried out by employing the modified SCA (statistical cost accounting) model. For the traditional model ignores the external factors which have influence on the modeling of profitability of banks, the research takes a proxy of the modified model (model 3).

All variables, including components of assets and liabilities to be comprehended in model 3 are described in methodology section. Panel data models are usually estimated using either fixed effect or random effect techniques. According to Judge et al., (1988), if the number of time series data (T) is large and the number of cross-sectional units (N) is small, there is likely to be little difference in the values of parameters estimated by the two models. Hence Hausman test has been made to check the suitability of each model & has been found that fixed effect is the best and so the regressions in this study are estimated by the fixed effect model. The suitability of the model to explain the variability of dependent variable and the joint insignificance of variables are tested through adjusted R² & F-statistic respectively. Normality tests have been conducted using Histogram. Woodbridge test is also used to test for autocorrelation.

4.1 Summary of statistics

As clearly mentioned in earlier chapters, in this study a sample of seven commercial banks for 12 year (2002 – 2015) were considered. The audited financial statements, particularly balance sheet and income statements collected directly from the respective banks and National Banks of Ethiopia (NBE). In this study a profitability measure of the core business operation of banks, Net Interest Income was taken as a dependent variable. Whereas, Loans & Advances Deposit with

other banks, Investments, Demand deposits, Saving deposits, Fixed deposits, Market share, GDP growth rate and Inflation rate were used as independent variables.

Table 4.1 provides a summary of the descriptive statistics of the dependent and independent variables for seven commercial banks in Ethiopia for the period of 14 years from year 2002-2015 with a total of 98 observations.

Table 4.1 Summary statistics of variables run for Commercial Banks

	Observations	Mean	Std. Dev.	Min	Max
Net Interest Income(Y1)	98	0.030723	0.007557	0.008625	0.044325
Loans and Advances(A1)	98	0.506249	0.114584	0.224572	0.727676
Deposit & placement in Other Banks(A2)	98	0.099167	0.051523	0.007649	0.289318
Sum Of Investments(A3)	98	0.118728	0.128215	0	0.473862
Saving Deposit(L1)	98	0.451752	0.110004	0.230891	0.645553
Demand Deposits(L2)	98	0.247682	0.093196	0.117338	0.465692
Fixed Deposits(L3)	98	0.071673	0.050545	0.006501	0.258155
Market Share(H)	98	0.134413	0.219565	0.011081	0.781495
Real GDP Growth Rate(R)	98	0.092704	0.040755	-0.02099	0.126442
Inflation Rate(M)	98	0.133017	0.119481	-0.10572	0.364

Source: STATA 12 output

Tables 4.1 depict summary results of descriptive statistics for variables in the regressions run for Y1bt. Since ratios, rather than absolute figures, are fed in the regression, dependent variable in

the regression represent net interest income to average total asset ratio. The averages (mean) for variables included in each of the regressions along with their minimum, maximum and standard deviation values are outlined in the tables. The statistics on regression variables indicates negative minimum values for inflation and real growth domestic product rate. These result due to the inclusion of negative values for macroeconomic variables (Inflation and GDP).

As shown in chapter three, profitability of core business operations of commercial banks for the purpose of this study was measured by Net interest income ratio (NII) which in turn calculated as net interest income divided by total assets. The mean of Net Interest Income (NII) was 3.07% and standard deviation of 0.7%. This means commercial banks in Ethiopia, under the period of study, earned on average 3.07% net interest income on total asset employed. This also means that on average, for each one birr asset of commercial banks there was 0.0307 cent return in the form of net interest income. The highest NII ratio for a bank in a particular year was 4.43% and in the same way the minimum ratio for a bank in a year was 0.86%. Regarding the standard deviation, it means that the value of net interest income ratio deviates from its mean to both sides by 0.7%.

The Asset Management was represented by Loan & Advance ratio (total loans & advances divided by total asset), then deposit with other banks to asset ratio and investment to asset ratio. The Liability management was also represented by Saving deposit to asset ratio, demand deposit to asset ratio and fixed deposit to asset. Loan to Asset ratio (LAR) measures liquidity of banks in relation to loan and total assets comparison, the higher the ratio, less liquid is the bank. It means that banks have offered more loans than their capacity and may feel difficulty in meeting their short term obligations. The mean of loan & advances ratio of the sampled banks in the study period was 50.6%. It reveals that loan and advances represents nearly 51% of the total assets of

commercial banks in Ethiopia. The highest loan & advance ratio for a bank in a particular year was 72.7% in the year 2006 by Nib Bank and in the same way the minimum ratio for a bank in a years under study was 22.4% in 2007 by commercial bank of Ethiopia. The value of loan & advances to asset ratio can deviate from its mean to both sides by 11.4%. From the summary of statistics it was observed that 51% of the total asset of commercial banks in Ethiopia in the period under study was made up of loan. The trends in LAR of other banks are different from that of state bank. In case of other banks LAR shows the highest growth in 2006 (72%) a period in which CBE_s was minimum i.e. 20% which confirms their high level of risk taking by other banks in order to earn profit as banking industry major profit still flows from this source. Other Banks' loan- to-Asset ratio has fallen dramatically in recent years as banks kept accumulating deposits but were restricted from lending out most of these deposits because NBE requires private banks to make investment on bonds that amounts about 27% of their deposit. It is clear from the data that LAR of CBE is less than other banks in all the analysis year. Overall, the mean LAR of CBE which may lead to the conclusion that CBE is more liquid than other banks in meeting its short term obligation.

Similarly, the mean of deposit with other banks to asset ratio of the sample banks in the study period was 9.9%. It reveals that total deposit available in other banks represents on average nearly 9.9% of assets of commercial banks in Ethiopia. The highest deposit with other banks to asset ratio for a bank in a particular year was 28.9% and in the same way the minimum ratio for a bank in a year was 0.7%. The value of deposit to asset ratio can deviate from its mean to both sides by 5.1%.

Furthermore, the mean of investment and treasury bills to asset ratio of the sample banks in the study period was 11.9%. It reveals that investment represents on average nearly 11.9% of the total asset of commercial banks in Ethiopia. The highest Investment and Treasury bill to asset ratio for a bank in a particular year was 47.4% by CBE. This 47.4% was observed due to the highest Investment and Treasury bill to asset ratio of Commercial Bank of Ethiopia (CBE) in the year 2015. This ratio's shows that CBE's investment in treasury bills and coupon bond is significantly higher than other Banks. This gives as evidence that most of CBE's fund is allocated in the form of investments in treasury bills and coupon bonds rather than loans and advances which is the principal business activity for most commercial banks. In the same way the minimum ratio for a bank in a year was 0.0% by Bib Bank in the year 2008. The value of Investment & Treasury bill ratio can deviate from its mean to both sides by 12.8%.

Whereas, The Liability Management was represented by Saving deposit to asset ratio , then demand deposit to asset ratio and fixed deposit to asset. It reveals that saving deposit represents nearly 45.2 % of the total assets of commercial banks in Ethiopia. The highest saving deposit ratio for a bank in a particular year was 64.6% by Awash International Bank in The year 2003 and in the same way the minimum ratio for a bank in a year was 23.1% by Wegagen Bank in the year 2007. The value of saving deposit to asset ratio can deviate from its mean to both sides by 11.0%.

Moreover, the descriptive statistics shows that the mean value of the demand deposit to asset ratio was 24.7 %. This implies that on average out of commercial banks' asset 24.7 % constitutes deposit from customers that will be availed on demand. The maximum value of demand deposit for the study period was 46.5% and the minimum value was 11.7%. The value of demand deposit

can deviate from its mean to both sides by 9.3%. The last measure of the Liability Management is fixed deposit where the mean value of same accounts 7.2% of the total asset. And the maximum value of this variable is recorded at 25.8% by United Bank in the year 2005. The lowest value had been 0.6% recorded by CBE in 2007.

The lion share of market measured in terms of total deposit goes to CBE in almost all of the years under this study with a maximum share of 78% in the year 2002. CBE's share of market share has dropped from 78% which is during 2002 into 58% per cent in the year 2010. The sharp decline in CBE's share in total deposits was primarily due to the performance of the private banks. But through implementation of various deposit mobilization strategies CBE's share of market share tends to increase into 66.8% during the year 2015.

Table 4.1 also shows that the mean real GDP growth in Ethiopia for the last twelve years was 0.09270(9.27%), with a maximum of 12.6% and a minimum of -2.1 %. Table 4.1 also presents for GDP a small standard deviation of 0.045; this implies that economic growth in Ethiopia during the period of 2001 to 2012 remains reasonable stable and the result was more or less in agreement with the government's report regarding economic growth. The other macro-economic variable employed in this study inflation, had somewhat a higher standard deviation (0.138) with a minimum and maximum value of -10.6% and 36.4% respectively and an average value of 13.3%. This implies that inflation rate in Ethiopia during the study period remains somewhat unstable.

4.2 Tests for the Classical Linear Regression Model (CLRM) assumptions

This section presents the test for the assumptions of classical linear regression model (CLRM). That is, the error has zero mean, heteroskedasticity, autocorrelation, normality and multicollinearity. To maintain data validity and robustness of the regressed result of the research under the classical linear regression model (CLRM) there are five basic assumptions required to be satisfied. According to Brooks (2008) when the assumptions are satisfied, it means that we have used all the information available from the patterns. But if there is assumption violation of that data usually means that there is a pattern of data that we have not included in our model, and we could actually find a model that fits the data better. But before testing significance of the slopes and analyzing the regressed result, multi-collinearity, autocorrelation, homoscedasticity, and normality tests are made for identifying and correcting when there are miss specifications of data so as to augment research quality.

4.2.1 Assumption one: the errors have zero mean ($E(\epsilon) = 0$)

The regression model used in this study included a constant term. As clearly stated in Brooks (2008), if a constant term is included in the regression equation, this assumption will not be violated. Hence, this assumption was not violated in the study.

4.2.2 Assumption two: homoscedasticity (variance of the errors is constant ($\text{Var}(u) = \sigma^2 < \infty$))

The assumption of homoscedasticity is that the residuals are approximately equal for all predicted dependent variable scores- the variance of errors is constant, if the assumption are met the pattern of the residuals will have about the same spread on either side of a horizontal line drawn through the average residual wooldridge (2005). Otherwise if the errors do not have a

constant variance, they are said to be heteroscedastic. Data are homoscedastic if the residuals plot is the same width for all values of the predicted. Heteroscedasticity is usually shown by a cluster of points that is wider as the values for the predicted dependent variable get larger. According to this assumption, if the errors do not have a constant variance, it is said to be the assumption of homoscedasticity has been violated. The violation of this assumption is called heteroscedasticity. In this study Heteroskedasticity white test was used to test for existence of heteroscedasticity across the range of explanatory variables.

Table 4.2 Heteroskedasticity Test: White

```
. estat imtest, white
```

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

```
chi2(54)    =    61.49  
Prob > chi2 =    0.2256
```

Cameron & Trivedi's decomposition of IM-test

Source	chi2	df	p
Heteroskedasticity	61.49	54	0.2256
Skewness	6.98	9	0.6395
Kurtosis	0.02	1	0.8983
Total	68.48	64	0.3278

Source:STATA 12 output

As we can see in the table above the test for heteroskedasticity shows that the data is homoskedastic. The null hypothesis in this test is that the data is homoskedastic and as per the result we fail to reject the null hypothesis since the P-value is greater than 0.05. So we confirmed the absence of heteroskedasticity.

Alternatively we can use Breusch-Pagan test to check for the absence of heteroskedasticity. The null hypothesis in this test is that variance of the error terms are constant and similar to the above test the result confirms that the variance of the errors are constant and so we fail to reject the null hypothesis since the P-value is greater than 0.05.

Table 4.3 Heteroskedasticity Test: Breusch-Pagan

```
. estat hettest, rhs

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: A1 A2 A3 L1 L2 L3 H R M

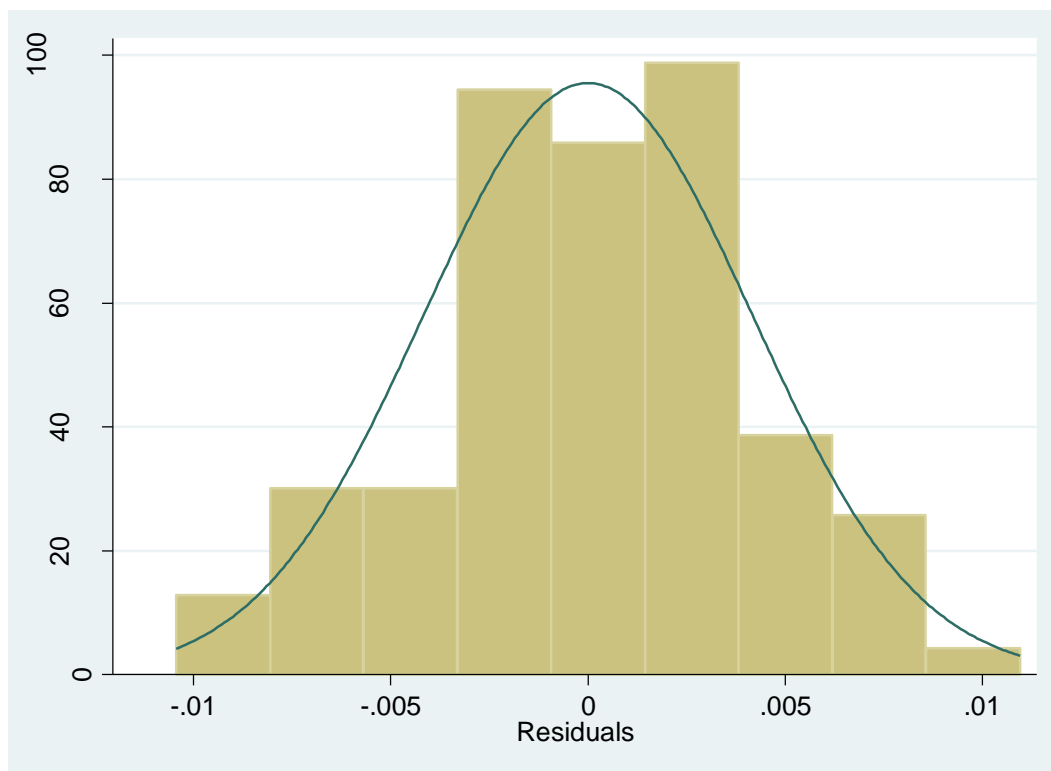
chi2(9)      =    12.04
Prob > chi2  =    0.2108
```

Source: STATA 12 output

4.2.3 Assumption three: normality (errors are normally distributed ($ut \sim N(0, \sigma^2)$))

Another third important diagnostic test conducted in this paper is the normality assumption (i.e. normally distributed errors). Brooks (2008) stated that the normality assumption ' $(ut \sim N(0, \sigma^2))$ ' is required in order to conduct single or joint hypothesis tests about the model parameters. One of the most commonly applied tests for normality is through the use of Histogram. In case of this study, the researcher predicted the error terms and made a histogram of the errors. Since the histogram is bell shaped the normality assumption is not violated.

Table 4.4 Normality Test



Source:STATA 12 output

4.2.4 Assumption four: covariance between the error terms over time is zero ($\text{cov}(u_t, u_j) = 0$)

This is an assumption that the errors are linearly independent of one another (uncorrelated with one another). If the errors are correlated with one another, it would be stated that they are autocorrelated.

According to the rules, the null hypothesis is rejected and the existence of autocorrelation presumed if the P-value in Wooldridge test (XTserial) for autocorrelation is greater than 0.05 values; the null hypothesis is not rejected and no significant residual autocorrelation is presumed if the P-value in Wooldridge test for autocorrelation is greater than 0.05 values. So based on our

result in the test having a P-value of 0.2216 we fail to reject the null hypothesis which states that there is no first order auto correlation between the error terms since the P-value is higher than 0.05 and confirm the absence of autocorrelation problem in our model.

Table 4.5 Auto-corelation test: Wooldridge test

```
. xtserial Y1 A1 A2 A3 L1 L2 L3 H R M

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
      F( 1,      6) =      9.491
      Prob > F =      0.2216
```

Source:STATA 12 output

4.2.5 Assumption five: Multicollinearity Test

Brooks (2008), states that an implicit assumption that is made when using the OLS estimation method is that the explanatory variables are not correlated with one another. If there is no relationship between the explanatory variables, they would be said to be orthogonal to one another. If the explanatory variables were orthogonal to one another, adding or removing a variable from a regression equation would not cause the values of the coefficients on the other variables to change. However, in any practical context, the correlation between explanatory variables will be non-zero, although this will generally be relatively benign in the sense that a small degree of association between explanatory variables will almost always occur but will not cause too much loss of precision.

But, a problem occurs when the explanatory variables are very highly correlated with each other, and this problem is known as multicollinearity. There are two classes of multicollinearity: perfect multicollinearity and near multicollinearity. Perfect multicollinearity occurs when there is an exact relationship between two or more variables. In this case, it is not possible to estimate all of the coefficients in the model. Perfect multicollinearity will usually be observed only when the same explanatory variable is inadvertently used twice in a regression. Whereas, near multicollinearity is much more likely to occur in practice, and would arise when there was a non-negligible, but not perfect, relationship between two or more of the explanatory variables. Thus, Multicollinearity refers to the situation in which the independent variables are highly correlated. When independent variables are multi collinear, there is overlap or sharing of predictive power. This may lead to the paradoxical effect, whereby the regression model fits the data well, but none of the explanatory variables (individually) has a significant impact in predicting the dependent variable Gujarati (2004). This is because when the predictor variables are highly correlated with one another, they share essentially the same information. Thus, together, they may explain a great deal of the dependent variable, but may not individually contribute significantly to the model. Thus, the impact of multicollinearity is to reduce any individual explanatory variable's predictive power by the extent to which it is associated with the other explanatory variables. That is, none of the predictor variables may contribute uniquely and significantly to the prediction model after the other independent variables is included.

Multicollinearity introduces a problem because the estimates of the sample parameters become inefficient and cause large standard errors, which makes the coefficient values and signs unreliable. Furthermore, multiple independent variables with high correlation add no additional information to the model. It also conceals the real impact of each variable on the dependent

variable. Cooper & Schindler (2009) suggested that a correlation above 0.8 should be considered as a problem of multicollinearity. In addition, Hair (2006) concluded that correlation coefficient below 0.9 may not cause serious multicollinearity problem.

Among several ways of multicollinearity tests autocorrelation matrix and Variance Inflation Factor (VIF) are used for this purpose. The correlation matrix is another important technique of testing multicollinearity of explanatory variables by investigating the relationship of bivariate variables. The correlation matrix is also useful to measure the propensity of how much the independent influences the dependent variable Wooldridge (2005).

Table 4.6 Correlation matrix of coefficients of xtreg model

e(V)	A1	A2	A3	L1	L2	L3	H	R	M	_cons
A1	1									
A2	0.1098	1								
A3	0.3292	0.3687	1							
	-	-								
L1	0.1976	0.0871	-0.143	1						
		-								
L2	0.0416	0.1772	-0.1351	0.715	1					
	-									
L3	0.4544	-0.279	-0.0778	0.6786	0.4021	1				
H	0.0756	0.1499	-0.0952	-0.0753	-0.5674	0.0463	1			
R	0.0816	0.0163	0.0086	-0.1668	-0.1936	-0.0891	0.1415	1		
M	0.1451	0.1034	0.1145	0.0594	-0.0338	0.0601	0.1477	-0.2336	1	
	-	-								
_con	0.3438	0.0719	-0.129	-0.8051	-0.7805	-0.4386	0.1281	0.0104	-0.16	1

Source:STATA 12 output

As it is depicted in the above table , the correlation matrix between independent variables was used in this study to test the existence of multicollinearity problem. Since, all correlation results are below 0.80, it indicates that multicollinearity is not potential problem for this study. The low inter correlations among the explanatory variables used in the regressions indicate no reason to suspect serious multicollinearity.

To confirm the absence of multicollinearity, the variance inflation factors (VIF) for the independent variables are computed. Therefore, those independent variables with the values of VIF greater than 10 indicate possible problem of multicollinearity. Multicollinearity between explanatory variables may result in the wrong signs, or implausible magnitudes, in the estimated model coefficients, and the bias of the standard errors of the coefficients. To avoid this problem, the Variance Inflation Factor (VIF) test was used. The results of this test are presented in next Table 4.6. The mean VIF was 3.15, which is much lower than the threshold of 10. The VIF for individual variables was also very low. This indicates that the explanatory variables included in the model were not substantially correlated with each other.

Table 4.7: Variance Inflation Factor (VIF) of the explanatory variables

. estat vif

Variable	VIF	1/VIF
L2	7.56	0.132345
L1	4.77	0.209599
H	3.82	0.261490
L3	3.54	0.282123
A1	2.79	0.358269
A3	2.01	0.496597
A2	1.56	0.639042
M	1.17	0.856476
R	1.14	0.876477
Mean VIF	3.15	

Source: STATA output

4.3 Results of the regression analysis

As stated in Brooks (2008), in financial research, there are two major classes of panel estimator approaches that can be employed. Namely, the fixed effects model and random effects model. In order to select the appropriate model which provide consistent estimates for this study, Hausman test was employed.

Table 4.6, presents the Hausman specification test which suggests the fixed effects model was better than random effects model as the p-value (0.005), is less than 0.05 for dependent variables which imply that the random effects model should be rejected and thus, the analysis is based on the fixed effects estimates.

Table 4.8: Hausman Test

. hausman fe re

	—— Coefficients ——			
	(b) fe	(B) re	(b-B) Difference	sqrt (diag(V_b-V_B)) S.E.
A1	.0477281	.0471791	.000549	.0016494
A2	-.0215908	-.0350363	.0134455	.0049361
A3	.0344916	.0301244	.0043672	.0023556
L1	-.0375949	-.0405373	.0029424	.0141268
L2	-.0272723	-.0154939	-.0117783	.0133157
L3	-.0245591	-.0176126	-.0069465	.0064274
H	-.0042106	-.0188149	.0146043	.0209648
R	.0456045	.044675	.0009295	.
M	.0081497	.0069751	.0011747	.0009368

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(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
 = 23.49
 Prob>chi2 = 0.0052
 (V_b-V_B is not positive definite)

So based on the result i.e the P-Value is less than 0.05 we will employ fixed method of panel data estimation.

Table 4.9 Results of the regression based on Fixed Effect method

```
. xtreg Y1 A1 A2 A3 L1 L2 L3 H R M, fe

Fixed-effects (within) regression      Number of obs   =      98
Group variable: CS                    Number of groups =       7

R-sq:  within = 0.6037                Obs per group:  min =      14
      between = 0.7064                  avg   =     14.0
      overall  = 0.5879                  max   =      14

                                         F(9,82)        =     13.88
corr(u_i, Xb) = 0.2148                 Prob > F       =     0.0000
```

Y1	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
A1	.0477281	.0066971	7.13	0.000	.0344055	.0610508
A2	-.0215908	.0118823	-1.82	0.073	-.0452284	.0020469
A3	.0344916	.0054612	6.32	0.000	.0236275	.0453556
L1	-.0375949	.0166644	-2.26	0.027	-.0707457	-.0044441
L2	-.0272723	.0187006	-1.46	0.149	-.0644737	.0099292
L3	-.0245591	.017784	-1.38	0.171	-.0599371	.0108189
H	-.0042106	.0213365	-0.20	0.844	-.0466556	.0382344
R	.0456045	.0115341	3.95	0.000	.0226596	.0685494
M	.0081497	.0041335	1.97	0.052	-.0000732	.0163727
_cons	.0253593	.0100383	2.53	0.013	.0053899	.0453286
sigma_u	.00315091					
sigma_e	.00425878					
rho	.35375252	(fraction of variance due to u_i)				

Source;STATA output

4.4 Analysis of the regression model

This section presents the empirical findings from the econometric results on the relation between asset liability management and bank profitability in Ethiopia. The section covers the empirical regression model used in this study and the results of the regression analysis.

Significant of the model is tested, accordingly, table 4.7 of linear regression indicated that the regression model predicts the outcome variable significantly with the p-value of (0.000) and it shows the overall model applied was significantly good enough in predicting the outcome variable. It shows dependent variable (Net Interest Income) R² is 58.7 percent explained by its independent variables, which is a good one. To conclude, the regression model used for the study has explained the overall model signifying the study was not lost very important variables that affect the study output.

The asset explanatory variables of this study were decomposed into explanatory variables as loans and advances (A1), deposits and placement in other banks (A2), and Sum of investments (A3). As shown in the above table, the pooled regression result shows that all assets except A2 (deposit & placement with other banks) have positive effect on commercial banks profitability. In other words, assets management has positive effect on commercial banks profitability. This finding coincides with the findings of Asiri (2007), Sufian and Habibulah (2009), and Miller and Noulas (1997), who found that assets management has positive effect on commercial banks 'profitability.

Loans and advances: Interest income from loans and advances are the major source of revenue for commercial banks. The more the deposit that are transformed in to loans, the higher the profitability of banks due to interest rate on loans are much higher than interest expense on deposits. Therefore, the loans to total asset ratio of the sample banks during the studied period shows positive and highly significant impact on profitability. It is indicated that Loans and advances had positive relationship with profitability with strongly statistically significant (p-value = 0.0001) at 1% significance level. This finding is similar with Naceur et al. (2003) who

explained that more deposits are transformed into loans for earning interest incomes from borrowers. The higher the interest rate margins, the higher the profits and banks are able to shield themselves against hazards of credit risk resulting from adverse selection and moral hazard. Kosmidou et al. (2004) also found loans and advances were the asset items which create profitability difference between banks. And it was in accordance with the expected sign. As a result, the null hypothesis : which states there is no significant relationship between ALM proxied by Loans & advances to Asset ratio and profitability of core business operations of commercial banks in Ethiopia was rejected. This implies that every 1 unit (birr) change (increase or decrease) in bank's loans & advances ratio keeping the other thing constant has a resultant change of 4.2 cents (Coeff. = 0.0477282) on the net interest income in the same direction. This result also shows that an increase in amount of loan advances to customers from deposit has a positive impact on profitability of Ethiopian banking industry. The possible reason could be that the interest income associated with loan advances was greater than the costs or interest paid to depositors.

Deposits and Placements with Other Banks (A2): is found to have negative but insignificant impact on regression equation conducted for commercial bank's at 5% percent significant level in terms of interest income .But still has a significant negative impact on NII at 10% significant level. This is not consistent with the expected sign and opposes the assumption which states there is a positive relationship between asset management proxy by deposit & placement with other banks to asset ratio and profitability as measured by net interest income. The amounts in this variable are composed of mainly deposits in foreign banks so the negative relation is attracted by

the less interest income paid by foreign banks as compared to the saving interest rate. This implies that every 1% change (increase or decrease) in bank's deposits & placement with other bank ratio keeping the other thing constant has a resultant change of 0.021% (Coeff. = 0.0215908) on the net interest income in the opposite direction. This result also shows that an increase in amount of deposit & placement with other banks has a negative impact on profitability of Ethiopian banking industry. But since we are considering a 95% confidence level we take this variable as insignificant to affect profitability as measured by net interest income.

Sum of investments (A3) is found to be significant relation with net income. . It is indicated that sum of investments had positive relationship with profitability with strongly statistically significant (p-value = 0.0001) at 1% significance level. This result indicates that every 1% change (increase or decrease) in bank's sum of investments ratio keeping the other thing constant has a resultant change of 0.0344 cents (Coeff. = 0.0344916) on the net interest income in the same direction. The interest earned here is minimal due to in the reason that coupon bonds earn lower interest income (6%) compared to loan (9.5%).

Regarding the liability variables, the explanatory variables are decomposed as saving deposit (L1), demand deposit (L2), fixed deposit (L3). This decomposition is done by considering the characteristics of the liability and its maturity. Concerning the impact of deposits on profitability, even though it is the main source of funds for banks, the number one expense item for a banking sector is interest payment on saving and fixed deposits. Saving deposits are opened with a primary aim of encouraging saving so that banks pay a higher interest rate compared to demand deposits. Banks, then, can invest the money on areas that take, somewhat, longer pay back period than demand deposits. A2s (demand deposits) are opened, often, by businesses that

require immediate cash so that the amount involved is large. The National Bank of Ethiopia (NBE) report on 2010 portray classification of time deposits on the basis of time bound as up to 1 year, 1-2 years and over 2 years. The average deposit interest rate on L3 amongst other deposits is highest. A higher interest payment on time deposit is attributable to the arrangement that it is not payable on demand without the consent of the bank.

Saving Deposit (L1): Interest expense paid for saving deposits are the major expense item for commercial banks. The more the deposit acquired by the banks, the higher the interest paid by banks. Therefore, the saving deposit to total asset ratio of the sample banks during the studied period shows negative and highly significant impact on profitability. It is indicated that saving deposits had negative relationship with profitability with statistically significant (p-value = 0.027) at 5% significance level. This finding is similar with Kosmidouet al. (2004) who found that liability management plays its own pivotal role in contributing profitability difference among commercial banks and Asiri(2007) who mentioned that assets management positively and liabilities management negatively related to the profitability of Kuwaiti banks.

This result indicates that every 1% change (increase or decrease) in bank's sum of investments ratio keeping the other thing constant has a resultant change of 0.0375% (Coeff. = 0.0375949) on the net interest income in the opposite direction. As a result, the null hypothesis which state there is no significant relationship between liability management and profitability of core business operations of commercial banks in Ethiopia was rejected.

This study finds a negative but insignificant impact of fixed and demand deposit on Ethiopian banks profitability as measured by net interest income. This is because commercial banks do not pay any interest for demand deposit.

Market Share(H): There is a negative relationship between the size of a bank and banks profitability as measured by net interest income financial performance measures and yet it is statistically insignificant. The finding support previous studies and arguments made in which bank size negatively influences performance (Sanda et al, 2005; Amran, 2011; Al-Manaseer, et al, 2012). It can be explained as large banks have economies of scale and scope from this point it is supposed to influence bank performance positively. However, banks may not be able to fully control and monitor the business as the companies become larger in size which may out weight the efficiencies of large banks efficiency achieved through economies of scale and scope this may lead to bank inefficiencies. This may be explained by ineffective supervision of operations as a bank expands, giving room for resource dissipation this will negatively influence performance. Financial performance of the banks was strongly and positively influenced by the operational efficiency and asset management, in addition to the bank size. This result implies size of a bank measured by its deposit does not necessarily enhance performance if this is not put to efficient use. Therefore, sample Ethiopian banks are not utilizing their market share to enhance their financial performance and also market share is not a significant factor for profitability. The result is inconsistent with our hypothesis which states that there is a significant positive relationship between market share and banks profitability as measured by net interest income.

GDP Growth Rate(R): This study justified that a positive and significant impact of Ethiopia real GDP growth and banks profitability in terms of net interest income and. This results about GDP support the argument of the positive association between economic growth and the financial sector performance that revealed by the numbers of researchers (e.g. Neely and Wheelock, 1997; Demirguc-Kunt and Huizinga, 2000; Athanasoglou et al., 2005 and Bikker and

Hu, 2002). They concluded that positive and strong correlation existed between economic growth (GDP) and bank profitability. This is because the default risk is lower in upturn than in downturn economy. In addition, higher economic growth may lead to a greater demand for both interest bearing and non-interest bearing financial services, thereby improving the profitability of banks. GDP has the expected positive effect since the banking sector is sensitive to the overall development of the economy. With the real sector growing, banks are beneficiaries from technological advancement and also can successfully collect their loans and extend new ones. It is indicated that GDP had a positive relationship with profitability with statistically significant (p -value = 0.000) at 1% significance level. It indicates that every 1% change (increase or decrease) in real GDP ratio keeping the other thing constant has a resultant change of 0.045 % (Coeff. = 0.0456045) on the net interest income in the same direction. As a result, the null hypothesis which state there is no significant relationship between liability management and profitability of core business operations of commercial banks in Ethiopia was rejected. And this is consistent with our hypothesis number 4(H:4) which states that there is a significant positive relationship between real GDP growth and banks profitability as measured by net interest income(NII).

Inflation: this study shows a positive and significant relationship between inflation and banks profitability at 10% significant level. Regarding inflation empirical studies suggest that High inflation rate is associated with higher costs as well as higher income. If a bank's income rises more rapidly than its costs, inflation is expected to exert a positive effect on profitability. Another reason for a positive relation between inflation and bank profitability may be Inflation reinforces the precautionary motive of saving in order to cushion from persistent instability and as an insurance against unpredictable large shocks. This will allow banks to lend this money in

the credit market and earn a profit. The result indicates that every 1% change (increase or decrease) in inflation ratio keeping the other thing constant has a resultant change of 0.08 % (Coeff. = 0.0081497) on the net interest income in the same direction. As a result, the null hypothesis which state there is no significant relationship between liability management and profitability of core business operations of commercial banks in Ethiopia was rejected. But it is in consistent with our hypothesis number 5(H:5) which states that there is a significant positive relationship between real GDP growth and banks profitability as measured by net interest income(NII).

At last the intercept $1/TA$ has positive impact on the profitability of commercial banks which is significant at 5% significance level in terms of net interest income. $1/TA$ measures income flows unrelated to the balance sheet items and the positive coefficient of $1/TA$ which represents economies of scale suggests that Ethiopian commercial banks earn net positive income from off-balance sheet activities. Off balance sheet items could be letter of credit and acceptances & guarantees and performance bonds. This could be attributable to the fact that Ethiopian banking sector is an emerging and unsaturated sector which strive for a better coverage and service diversification. Thus, the model signals that non balance sheet items impact profitability of ECB's and that means that these banks enjoy increasing returns to scale in their operation.

4.5 Summary

This chapter discussed the results of the data analysis and the discussions of these results using the appropriate method. Accordingly, the chapter discussed the descriptive statistics, the tests for the Classical Linear Regression Model (CLRM) assumptions, and through the regressions analyses; it illustrates the relationship between dependent and independent variables as well as

the impact of asset liability management on profitability of banks in Ethiopia. Hence, the result indicates that loans & advances and sum of investments had a statistically significant positive effect on net interest income from the asset part and saving deposit had a statistically significant negative effect from the liability part, whereas deposit & placement with other banks from the asset part and demand deposit and fixed deposit from the liability part don't have statistically significant effect on profitability as measured by net interest income. On the other hand market share do not have statistically significant effect on profitability while real GDP growth rate and Inflation has got a statistically significant effect on profitability as measured by net interest income. So we can conclude that most asset variables and liability variables (components)not all has got an effect on profitability. The subsequent chapter presents conclusions and recommendations of the study.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATIONS

The earlier chapter presented the results and discussion, whereas this chapter deals with the conclusions and recommendations based on the findings of the study. Accordingly this chapter is organized into two sub-sections. Section 5.1 presents the conclusions and section 5.2 presents the recommendations in line with findings of the study.

5.1. Conclusions

To cope with the changes in the environment, banks have been forced to effectively manage their asset and liability to mitigate various risks that arise due to mismatch between their assets and liabilities, Risk is inherent to any business, but it can be controlled to mitigate its impact on profitability. ALM involves a set of actions and procedures designed to control banks risks and financial positions. The core issue of Asset-Liability Management (ALM) is the bank's balance sheet and the main question is: Given a certain level of risk, government regulation, globalization, competitors, and alternative choices of investment, and liquidity and interest rate changes in the market, what should be the composition of a bank's assets and liabilities in order to maximize the bank's profit? Extensive researches attempted to identify the effects of asset liability management on profitability of firms. However, the findings of prior empirical studies have provided varying and in some cases contradicting evidence related to the effect of asset liability management on profitability. Furthermore, the majority of these studies have been conducted in developed countries.

In light of the above, the main objective of this study was to examine the impact of asset liability management on profitability of core business operation of commercial banks in Ethiopia, employing the SCA model. This project paper also tried to examine the effects of market share, GDP and inflation on performance of Ethiopian commercial banks. To achieve the intended objectives the study used quantitative approaches panel data analysis methodology. The panel data were collected from audited financial statements particularly balance sheets and income statements of a sample of eight banks over the time period from 2002-2015. The collected data were analyzed by employing a fixed effect model using statistical package ‘STATA 12’.

In order to conduct the empirical analysis, one dependent variable and nine independent variables were selected and used by taking in to account the nature of banks operation. Net interest income was taken as dependent variable, while the independent variables were loans & advances to asset ratio, deposits & placement with other banks to asset ratio, sum of investment to asset ratio, saving deposit to asset ratio fixed deposit to asset ratio demand deposit to asset ratio, market share, real GDP growth rate and inflation rate.

It was observed that 58.7 % of banks interest income variation is explained by the above mentioned variables. The results of the fixed effect estimation model showed the existence of the following relationship between the variables.

- The empirical findings of this study provide evidence that the profitability of commercial banks in Ethiopia is positively affected by assets management. The significance of individual assets differs; loans and advances have the most significant effect on the profitability of commercial banks followed by sum of investments while deposit and placement with other banks doesn't significantly affect commercial banks profitability.

This leads us to generalize that the spreads realized from loans and advance in the Ethiopian commercial banking market is attractive. Profit earned from investments in securities and coupon bonds is still positive but not that much attractive and significant.

- From the liability variables only saving deposit is the significant variable that negatively affects profitability of commercial banks. This may be due to the costliness of this source of fund. The demand and fixed deposits variable has negative and insignificant effect on commercial banks profitability. This is due to the fact that commercial banks do not pay any interest for demand deposit but charge high service fees.
- Next, the researcher find's that banks market share has negative and yet insignificant effect on profitability. This inverse relationship between market share and profitability, suggests that larger banks tend to earn lower profits. This indicate that the Ethiopian commercial banking industry is inconsistent with the Market-Power (MP) hypothesis, which stated relative size of a firm expands its market power and profits increases. From this result the researcher conclude that, in Ethiopian banking industry the large size banks are adversely affected by its size. The negative quadratic effect of size indicates that there is point after which the increase in a bank's size provides diseconomies of scale in operating a large structure.
- Inflation is positively related to banks profitability, which could imply that during the period of our study the levels of inflation were anticipated by banks management. Correctly predicting inflation gave banks an opportunity to adjust the interest rates accordingly and consequently to earn higher profits.
- Finally, the study also justified a positive and significant impact of Ethiopia real GDP growth toward banks profitability. This is because; the current Ethiopian economy

growth could create a new and potential demand for financial services and it might reduce the probability of default loan.

5.2 Recommendations

Overall these empirical results provide evidence that, the profitability of Ethiopian commercial banks are shaped by composition of asset liability and macroeconomic variables that are not the direct result of a bank's managerial decisions. So, policy makers and decision makers at the commercial banks should give high concern and set direction in order to set the optimum composition of asset and liability which maximizes the bank profit.

- Revenue from off balance sheet activity is a positive and highly significant factor of profitability of Ethiopian commercial banks. Hence, the commercial banks should strive in extending fee based activities in order to be more profitable in the sector.
- Since, the loan component was found to be the most significant contributor towards bank profitability; commercial banks should focus on loans rather than investment in securities, investment in subsidiaries and coupon bonds because, the banks earn relatively higher interest income from loans than investment in securities. On the other hand, in order to resist the challenges of credit risk, a more thorough analysis of the loans portfolio may be useful for the commercial banks in structuring a sound, stable and profitable asset portfolio.
- Since deposits are banks' primary sources of funds that they can be invested to generate income. The commercial banks should make unreserved efforts to mobilize deposits that will meet the growing credit demand of the economy by implementing several deposit mobilization strategies which in return make the bank more profitable.

- Commercial banks should take the necessary actions to increase its current account deposit, which create free funding from floats and contribute positively towards profitability. Thus, in order to secure from the almost nil cost current account deposits, commercial banks should try to make their current account service attractive as much as possible. Thus, volume in regard to demand deposit should be a strategic tool for commercial banks to improve its profitability and at the same time to place themselves in a better position above other banks in a competition for deposits the so called ‘deposit war’.
- The effect of inflation on banks’ earning depends on whether it is correctly anticipated by the bank. By making accurate inflation forecasts decision makers at commercial banks may have an opportunity to increase the rates on loans faster than the operating cost allowing earning higher profits.
- In general, as many literatures supports financial intermediation in Ethiopia is still in its early stages even by the standards of other low-income countries: in terms of unbanked society and many other metrics such as the total number of banks, banks contribution to GDP, bank accounts per person, branches per person, and bank credit per person are lower in Ethiopia compared to other African countries. Thus, commercial banks should focus to reach this unmet demand of finance.

References

- Athanasoglou, P. P., Brissimis, S. N., & Delis, M. D. (2008). Bank-specific, industry-specific and macroeconomic determinants of bank profitability. *Int. Fin. Markets, Inst. and Money* 18,
- Asiri, B. K. (2007). Assets-liabilities management in banks - a case of Kuwait. *Indian Journal of Economics and Business*, 6(1).
- Brooks, C. (2008). *Introductory Econometrics for Finance*. New York: Cambridge University Press.
- Chambers, D., and Charnes, A. (1961). Inter-Temporal Analysis and Optimization of Bank Portfolios. *Management Science*
- Creswell, J. W. (2003). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. California: Sage Publications Inc.
- Creswell, John W. (2009). *Research design: Qualitative, quantitative, and mixed method approaches I* by John W. Creswell. - 2nd ed.
- Fama, E. F. (1980). Banking in the theory of finance. *Journal of Monetary Economics* 6.
- Frank J. Fabozzi (1998), *Active Equity Portfolio Management*. *Journal of portfolio management*
- G.J Santoni, 1986: The Effects of Inflation on Commercial Banks, *Journal of Economic research*
- Hannan, Timothy H., and Allen N. Berger. 1991. "The Rigidity of Prices: Evidence from the Banking Industry." *American Economic Review* 81
- Hair, J. F. (2006). *Multivariate data analysis*. New York: Prentice Hall.
- Hester, D. D., & Zoellner, J. F. (1966). The relation between bank portfolios and earnings: an econometric analysis, *Review of Economics and Statistics* 48.
- J. Dermine (1984) : *Pricing Policies of Financial Intermediaries*, Springer Verlag, (Studies in Contemporary Economics nE 5) Berlin.
- J. Dermine (1985) : "Accounting Framework for Banks, a Market Value Approach", *SUERF Series*, 50 A.
- Joseph F. Sinkey, Jr., (1998), "Commercial Bank Financial Management – In the Financial Services Industry", Fifth Edition, Prentice-Hall International Inc., New Jersey
- Katarzyna Zawalinska (1999), *Asset and Liabilities Management. The Institutional Approach to ALM by Commercial Banks in Poland: a Special Focus on Risk Management*, Center for Social and Economic Research

Kwast, M. L., & Rose, J. T. (1982). Pricing, operating efficiency, and profitability among large commercial banks. *Journal Of Banking And Finance* 6.

Kosmidou, K., Pasiouras, F., & Floropoulos, J. (2004), Linking profits to asset-liability management of domestic and foreign Banks in the UK. *Applied Financial Economics* 14

K Kosmidou K., and Zopounidis C. (2001). Bank Asset Liability Management Techniques: An Overview. C. Zopounidis, P.M. Pardalos, G. Baourakis (Eds.), *Fuzzy Set Systems in Management and Economy*, World Scientific Publishers.

Kosmidou, K., and Zopoundis, C. (2008) "Measurement of Bank Performances in Greece."

South-Eastern European Journal of Economics 1

Levine, R. (2000) " Financial development and economic growth: views and agenda." *Journal of Economic Literature* Vol.35

Molyneux, P. & Thornton, J. (1992). Determinants of European bank profitability: A note. *Journal of Banking and Finance* 16.

Muhammad A. S & Mohammad Z. H(2008)., Impact of Asset and Liability Management on Profitability: A study on public vs private commercial banks in Bangladesh, Jahangirnagar University, Dhaka, Bangladesh & Monash University, Melbourne, Australia

NBE. (2015/16). Annual Report. Addis Ababa: National Bank of Ethiopia.

Oguzsoy, C. B., & Guven, S. (1997). Thoery and Methodology: Bank asset and liability management under uncertainty *European Journal of Operational Research*, 102,

Okoth, V. a. (2013). ' Determinants of Financial Performance of Commercial Banks in Kenya'. *International Journal of Economics and Financial*, 3(1).

Tamiru Belete(2013)Asset Liability Management and Commercial Banks Profitability in Ethiopia, *Research Journal of Finance and Accounting* www.iiste.org ISSN 2222-1697 (Paper) ISSN 2222-2847 (Online) Vol.4, No.10,

Vasiliou, D. (1996). Linking profits to Greek production management. *International Journal of Production Economics*, 43,

Vickery, J. (2011). *Interest Rate Risk and Bank*. New York: Federal Reserve Bank of New York.

Appendices

Appendix I: Correlation Matrix

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. estat vce, correlation
```

Correlation matrix of coefficients of regress model

e(V)	A1	A2	A3	L1	L2	L3	H	R
A1	1.0000							
A2	0.1877	1.0000						
A3	0.4429	0.5267	1.0000					
L1	-0.1032	-0.0009	0.0732	1.0000				
L2	-0.0906	-0.1818	-0.0765	0.7609	1.0000			
L3	-0.3441	-0.2292	0.0425	0.6995	0.5554	1.0000		
H	0.3051	0.2226	0.0320	-0.0879	-0.4649	-0.0994	1.0000	
R	0.1432	-0.2327	0.0457	-0.2081	-0.2264	-0.0594	-0.0231	1.0000
M	0.1428	0.2454	0.2453	0.2517	0.1263	0.1964	0.0502	-0.3167
_cons	-0.4089	-0.1585	-0.3848	-0.8206	-0.7120	-0.5192	0.0170	0.0273

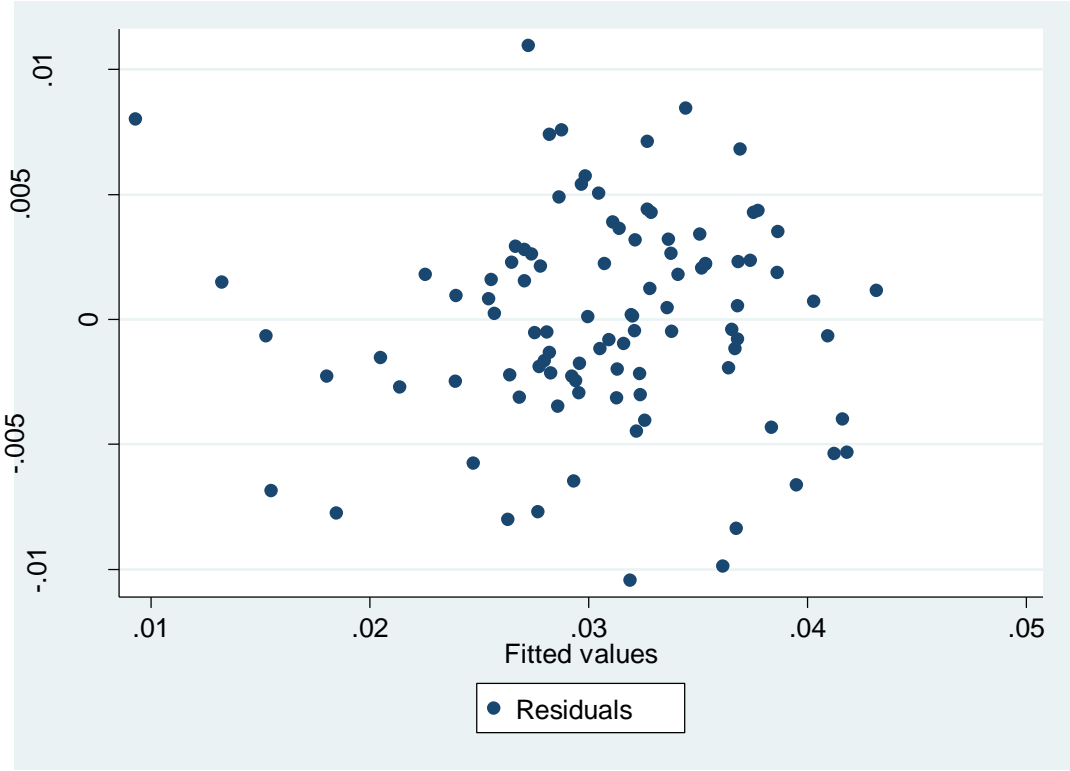
e(V)	M	_cons
M	1.0000	
_cons	-0.3394	1.0000

Appendix II: Descriptive statistics

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. summarize
```

Variable	Obs	Mean	Std. Dev.	Min	Max
CS	98	4	2.010283	1	7
T	98	2008.5	4.051855	2002	2015
Y1	98	.0307228	.0075572	.0086246	.0443253
Y2	98	.0350375	.0126442	-.0228935	.0568328
Y3	98	.0017197	.002943	.0000135	.0239558
A1	98	.506249	.1145839	.224572	.7276764
A2	98	.0991665	.0515227	.0076494	.2893175
A3	98	.118728	.1282147	0	.4738616
L1	98	.4517523	.1100043	.2308908	.6455526
L2	98	.2476816	.0931962	.117338	.4656923
L3	98	.0716733	.0505446	.0065005	.2581547
H	98	.1344132	.2195649	.0110805	.7814948
R	98	.0927042	.0407549	-.0209852	.1264421
M	98	.1330171	.1194807	-.105722	.364

Appendix III: Histogram of the residuals (rvf plot)



Appendix IV: Hausman test

```
. hausman fe re
```

	Coefficients		(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	(b) fe	(B) re		
A1	.0477281	.0471791	.000549	.0016494
A2	-.0215908	-.0350363	.0134455	.0049361
A3	.0344916	.0301244	.0043672	.0023556
L1	-.0375949	-.0405373	.0029424	.0141268
L2	-.0272723	-.0154939	-.0117783	.0133157
L3	-.0245591	-.0176126	-.0069465	.0064274
H	-.0042106	-.0188149	.0146043	.0209648
R	.0456045	.044675	.0009295	.
M	.0081497	.0069751	.0011747	.0009368

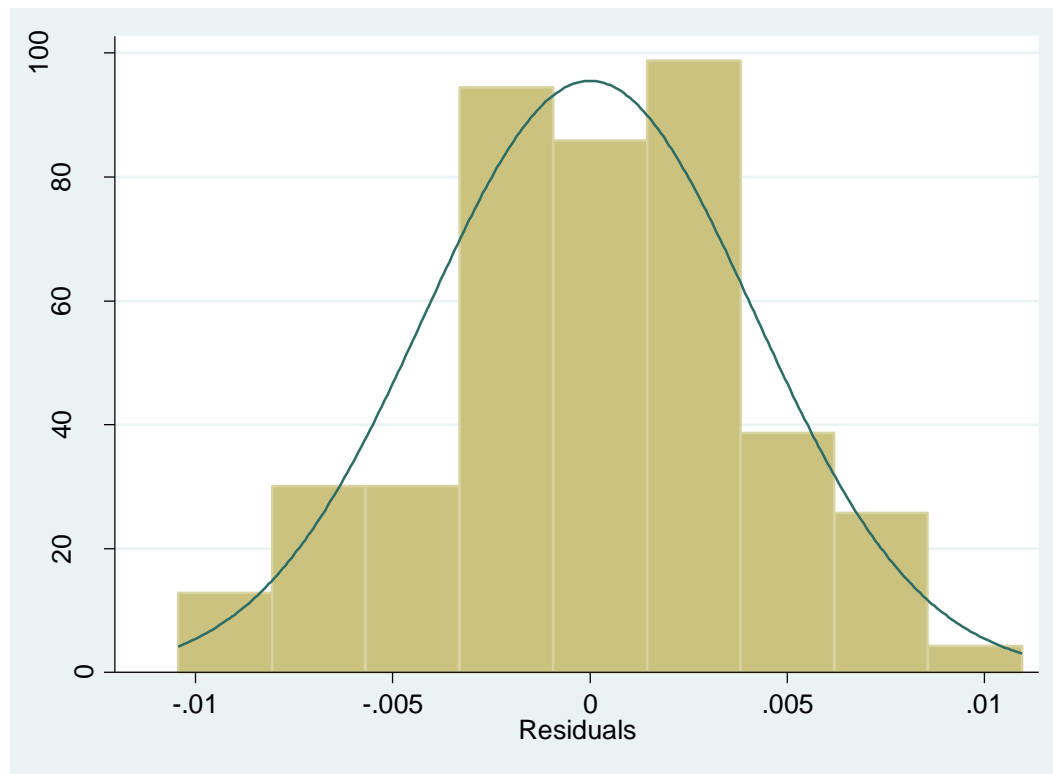
b = consistent under Ho and Ha; obtained from xtreg

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

Test: Ho: difference in coefficients not systematic

```
chi2(9) = (b-B)' [(V_b-V_B)^(-1)] (b-B)
          = 23.49
Prob>chi2 = 0.0052
(V_b-V_B is not positive definite)
```

Appendix V: Normality test



Appendix VI: Pannel Data

Y1	A1	A2	A3	L1	L2	L3	H	R	M
Net Interest Income (%)	Total Loans & Advances	Deposit with foreign banks	Treasury Bills & Other Investments	Saving Deposits	Demand Deposits	Fixed Deposits	Market Share	Real GDP Growth Rate	Inflation rate
0.008472	0.606742	0.179775	0.000000	0.380150	0.177903	0.088015	0.018844	0.016339	-0.105722
0.004340	0.621469	0.109605	0.001130	0.379661	0.171751	0.112994	0.027562	0.020985	-0.109241
0.003432	0.630313	0.073777	0.000802	0.395349	0.183641	0.088212	0.032708	0.117294	0.073471
0.002555	0.654157	0.115473	0.001155	0.409353	0.168591	0.128176	0.036653	0.126442	0.061256
0.002169	0.727676	0.102615	0.000987	0.412926	0.161322	0.142082	0.037475	0.115394	0.105767
0.0019	0.6969	0.0955	0.001151	0.4161	0.1622	0.1423	0.0385	0.1179	0.1582

49	70	12		87	55	09	81	49	27
0.0017 67	0.5791 10	0.0486 50	0.000727	0.3935 72	0.1838 24	0.0992 77	0.0445 11	0.1118 72	0.2530 00
0.0015 26	0.4619 34	0.0443 07	0.000786	0.4151 70	0.2146 52	0.0559 96	0.0476 03	0.1004 13	0.3640 00
0.0008 03	0.4264 52	0.1069 04	0.000633	0.4216 03	0.2192 23	0.0504 36	0.0467 54	0.1056 71	0.0280 00
0.0007 83	0.3890 20	0.1215 71	0.080151	0.4411 52	0.2533 63	0.0307 03	0.0389 12	0.1140 00	0.1810 00
0.0007 01	0.4481 68	0.1084 87	0.151229	0.4200 95	0.2439 16	0.0414 44	0.0339 87	0.0869 95	0.3410 00
0.0008 35	0.4967 98	0.0390 83	0.215817	0.4353 07	0.2322 32	0.0602 40	0.0303 00	0.0990 00	0.1350 00
0.0006 53	0.5031 73	0.0076 49	0.256063	0.4230 84	0.2336 86	0.0804 67	0.0293 08	0.1034 75	0.0810 00
0.0006 30	0.5200 65	0.0109 00	0.291122	0.4115 67	0.2260 56	0.0997 05	0.0323 99	0.1040 00	0.0770 00
0.0022 52	0.5868 10	0.1292 06	0.108345	0.4959 62	0.2644 68	0.0410 50	0.0524 38	0.0163 39	- 0.1057 22
0.0015 70	0.6363 64	0.1230 54	0.076344	0.5303 87	0.2340 53	0.0497 24	0.0620 06	- 0.0209 85	0.1092 41
0.0012 88	0.6313 04	0.0709 75	0.121405	0.5409 04	0.2327 23	0.0399 70	0.0702 16	0.1172 94	0.0734 71
0.0011 89	0.6526 32	0.1304 09	0.008187	0.5546 78	0.2318 71	0.0418 13	0.0723 75	0.1264 42	0.0612 56
0.0010 30	0.6959 96	0.1201 06	0.006159	0.5153 98	0.2285 53	0.0681 92	0.0840 47	0.1153 94	0.1057 67
0.0008 06	0.6601 56	0.1071 01	0.004635	0.4706 17	0.2252 94	0.1087 57	0.0894 02	0.1179 49	0.1582 27
0.0006 29	0.5597 43	0.1058 72	0.003626	0.4907 57	0.2065 27	0.0884 93	0.0954 66	0.1118 72	0.2530 00
0.0004 71	0.4573 82	0.0676 39	0.002916	0.5171 81	0.2249 92	0.0721 24	0.0963 90	0.1004 13	0.3640 00
0.0002 17	0.4087 01	0.1845 82	0.115451	0.5448 20	0.2198 10	0.0565 66	0.0967 37	0.1056 71	0.0280 00
0.0001 88	0.4241 22	0.1507 22	0.115818	0.5318 94	0.2324 77	0.0433 65	0.0802 15	0.1140 00	0.1810 00
0.0002 10	0.4636 87	0.1279 32	0.163072	0.5073 53	0.2507 25	0.0447 51	0.0719 52	0.0869 95	0.3410 00
0.0001 78	0.4487 89	0.1274 70	0.190142	0.5356 44	0.2160 17	0.0510 50	0.0654 32	0.0990 00	0.1350 00
0.0001 63	0.4293 57	0.1049 44	0.187615	0.5421 16	0.2095 82	0.0533 83	0.0598 90	0.1034 75	0.0810 00

0.0001 60	0.4654 76	0.0608 29	0.236582	0.5489 84	0.1922 78	0.0588 59	0.0605 24	0.1040 00	0.0770 00
0.0034 14	0.5728 42	0.0593 53	0.125899	0.6411 87	0.1492 81	0.0458 63	0.0392 41	0.0163 39	- 0.1057 22
0.0018 74	0.5710 21	0.0713 78	0.227695	0.6245 54	0.1748 75	0.0314 06	0.0436 31	- 0.0209 85	0.1092 41
0.0015 31	0.5344 63	0.0655 37	0.192090	0.6446 33	0.1621 47	0.0367 23	0.0464 26	0.1172 94	0.0734 71
0.0015 02	0.5795 15	0.1199 46	0.106918	0.6455 53	0.1895 78	0.0363 88	0.0471 07	0.1264 42	0.0612 56
0.0012 35	0.6337 17	0.1242 38	0.068043	0.6205 15	0.1943 13	0.0541 64	0.0546 14	0.1153 94	0.1057 67
0.0013 54	0.6558 75	0.1112 27	0.000783	0.5804 18	0.1574 41	0.0746 74	0.0566 81	0.1179 49	0.1582 27
0.0008 84	0.5679 98	0.1103 78	0.027709	0.5791 28	0.1712 06	0.0524 35	0.0587 80	0.1118 72	0.2530 00
0.0006 85	0.4224 18	0.1304 57	0.000632	0.5681 44	0.1763 99	0.0281 11	0.0636 08	0.1004 13	0.3640 00
0.0003 66	0.3959 44	0.1452 27	0.101428	0.5866 60	0.1740 88	0.0077 99	0.0622 14	0.1056 71	0.0280 00
0.0002 70	0.3940 84	0.1169 86	0.158478	0.5582 95	0.1990 96	0.0081 24	0.0553 51	0.1140 00	0.1810 00
0.0003 36	0.4611 51	0.1093 04	0.230954	0.5499 86	0.1808 11	0.0403 01	0.0490 22	0.0869 95	0.3410 00
0.0002 94	0.5188 84	0.1133 79	0.180487	0.5724 25	0.2213 96	0.0504 72	0.0492 35	0.0990 00	0.1350 00
0.0002 01	0.4581 58	0.0972 77	0.206154	0.5117 68	0.1811 77	0.0579 60	0.0546 18	0.1034 75	0.0810 00
0.0001 81	0.5229 26	0.0475 25	0.227634	0.5173 08	0.1778 14	0.0807 78	0.0583 39	0.1040 00	0.0770 00
0.0035 76	0.5858 14	0.0744 31	0.004378	0.5525 39	0.1173 38	0.1260 95	0.0402 99	0.0163 39	- 0.1057 22
0.0027 49	0.6069 02	0.1057 76	0.003751	0.5393 85	0.1552 89	0.1125 28	0.0415 14	- 0.0209 85	0.1092 41
0.0033 97	0.6069 40	0.0776 03	0.112303	0.5911 67	0.1406 94	0.0725 55	0.0415 74	0.1172 94	0.0734 71
0.0024 53	0.5999 03	0.0938 26	0.000000	0.5751 09	0.1618 86	0.0539 62	0.0435 31	0.1264 42	0.0612 56
0.0020 20	0.6926 61	0.0716 30	0.000000	0.5462 24	0.1422 02	0.0797 46	0.0523 95	0.1153 94	0.1057 67
0.0015 12	0.6787 40	0.0765 61	0.058893	0.5588 93	0.1504 71	0.0918 73	0.0502 58	0.1179 49	0.1582 27

0.0011 97	0.6597 64	0.0690 72	0.000000	0.5647 61	0.1839 02	0.0658 13	0.0520 70	0.1118 72	0.2530 00
0.0009 70	0.4946 42	0.0684 60	0.000000	0.5568 67	0.2211 78	0.0425 69	0.0542 40	0.1004 13	0.3640 00
0.0005 65	0.5021 46	0.1015 53	0.000000	0.6024 78	0.1941 80	0.0216 90	0.0491 74	0.1056 71	0.0280 00
0.0006 07	0.4555 79	0.0806 63	0.112257	0.6077 06	0.2186 56	0.0083 85	0.0398 23	0.1140 00	0.1810 00
0.0005 68	0.4730 14	0.0986 08	0.177497	0.5975 73	0.1978 88	0.0263 67	0.0338 39	0.0869 95	0.3410 00
0.0003 79	0.4642 02	0.0366 67	0.242439	0.5821 03	0.2032 05	0.0534 55	0.0335 64	0.0990 00	0.1350 00
0.0004 39	0.4488 15	0.0438 29	0.255760	0.5677 41	0.1642 00	0.0747 42	0.0307 50	0.1034 75	0.0810 00
0.0003 62	0.4320 62	0.0327 44	0.249034	0.5600 37	0.1880 28	0.0654 06	0.0334 04	0.1040 00	0.0770 00
0.0072 46	0.6284 83	0.0990 71	0.000000	0.3126 93	0.2662 54	0.2120 74	0.0227 96	0.0163 39	- 0.1057 22
0.0039 55	0.6422 95	0.1574 80	0.000000	0.3082 11	0.2823 40	0.2013 50	0.0276 86	- 0.0209 85	0.1092 41
0.0045 62	0.6473 68	0.1622 81	0.000000	0.3078 95	0.3289 47	0.1315 79	0.0299 02	0.1172 94	0.0734 71
0.0026 55	0.6200 50	0.2165 84	0.000000	0.3205 45	0.3650 99	0.1113 86	0.0341 98	0.1264 42	0.0612 56
0.0020 44	0.7051 79	0.1097 83	0.000000	0.3200 53	0.3209 38	0.1460 82	0.0417 64	0.1153 94	0.1057 67
0.0013 08	0.6192 53	0.2017 24	0.000000	0.2308 91	0.3475 57	0.2041 67	0.0515 01	0.1179 49	0.1582 27
0.0012 12	0.5689 32	0.1514 98	0.000000	0.2655 64	0.2887 34	0.1648 31	0.0503 01	0.1118 72	0.2530 00
0.0011 52	0.4127 11	0.0846 90	0.000000	0.2965 79	0.3653 95	0.0664 67	0.0506 91	0.1004 13	0.3640 00
0.0007 90	0.4308 43	0.1928 06	0.034830	0.3414 28	0.3083 17	0.0334 39	0.0449 64	0.1056 71	0.0280 00
0.0005 48	0.3610 01	0.1305 01	0.111648	0.3137 85	0.3866 65	0.0385 95	0.0441 08	0.1140 00	0.1810 00
0.0005 77	0.4271 73	0.1094 17	0.214687	0.3441 92	0.2790 84	0.0665 62	0.0342 81	0.0869 95	0.3410 00
0.0004 90	0.4512 44	0.0795 32	0.249527	0.3822 38	0.2890 19	0.0552 02	0.0344 40	0.0990 00	0.1350 00
0.0007 16	0.4095 52	0.0641 15	0.000864	0.4147 60	0.2744 41	0.0565 78	0.0306 58	0.1034 75	0.0810 00
0.0003 84	0.4428 38	0.0287 08	0.307753	0.3914 18	0.2972 26	0.0312 66	0.0335 11	0.1040 00	0.0770 00

0.0239 56	0.5191 08	0.1210 19	0.079618	0.3630 57	0.1337 58	0.1050 96	0.0110 81	0.0163 39	- 0.1057 22
0.0112 53	0.6183 37	0.1492 54	0.000000	0.3667 38	0.1279 32	0.1172 71	0.0146 06	- 0.0209 85	0.1092 41
0.0069 19	0.5697 33	0.2893 18	0.000000	0.4094 96	0.1750 74	0.2047 48	0.0176 79	0.1172 94	0.0734 71
0.0048 55	0.5526 56	0.2702 70	0.000000	0.3699 91	0.1780 06	0.2581 55	0.0227 07	0.1264 42	0.0612 56
0.0037 92	0.6278 92	0.1044 40	0.000000	0.4258 91	0.2070 04	0.1300 81	0.0295 62	0.1153 94	0.1057 67
0.0029 77	0.6460 48	0.2144 33	0.000000	0.3890 03	0.1764 03	0.1406 64	0.0322 99	0.1179 49	0.1582 27
0.0023 24	0.5722 11	0.1248 50	0.000000	0.4198 26	0.2073 87	0.1245 95	0.0396 32	0.1118 72	0.2530 00
0.0016 31	0.4626 77	0.1325 42	0.000109	0.4266 14	0.2378 03	0.1128 81	0.0460 70	0.1004 13	0.3640 00
0.0012 99	0.4432 68	0.1126 67	0.000086	0.4845 28	0.2547 58	0.0620 49	0.0461 72	0.1056 71	0.0280 00
0.0010 66	0.4241 68	0.1086 13	0.104976	0.4657 72	0.2645 77	0.0548 09	0.0422 73	0.1140 00	0.1810 00
0.0012 27	0.4649 42	0.0824 55	0.186833	0.4793 88	0.2052 86	0.0843 73	0.0360 86	0.0869 95	0.3410 00
0.0011 98	0.4721 31	0.0324 40	0.290630	0.5144 58	0.2266 55	0.0670 39	0.0330 61	0.0990 00	0.1350 00
0.0010 23	0.4268 67	0.0696 06	0.247382	0.4770 55	0.2228 25	0.0499 27	0.0323 87	0.1034 75	0.0810 00
0.0008 91	0.4776 93	0.0380 24	0.287705	0.4848 46	0.2054 61	0.1316 74	0.0350 99	0.1040 00	0.0770 00
0.0000 43	0.4403 05	0.0973 99	0.231419	0.3674 70	0.4164 63	0.0222 16	0.7814 95	0.0163 39	- 0.1057 22
0.0000 83	0.3534 30	0.0946 69	0.102521	0.3241 74	0.4507 02	0.0158 26	0.7536 59	- 0.0209 85	0.1092 41
0.0000 63	0.2975 87	0.0747 10	0.101090	0.3333 69	0.4542 27	0.0133 33	0.7337 70	0.1172 94	0.0734 71
0.0000 52	0.2881 00	0.0252 34	0.165456	0.3205 10	0.4189 45	0.0122 70	0.7019 30	0.1264 42	0.0612 56
0.0000 52	0.2593 10	0.0388 30	0.127368	0.3295 49	0.4158 55	0.0391 92	0.6627 78	0.1153 94	0.1057 67
0.0000 48	0.2245 72	0.0243 00	0.183611	0.2954 71	0.4522 74	0.0069 27	0.6431 11	0.1179 49	0.1582 27
0.0000 51	0.3439 08	0.0245 21	0.285782	0.3002 80	0.4396 74	0.0065 01	0.6147 99	0.1118 72	0.2530 00

0.0000 62	0.3518 86	0.0244 06	0.333774	0.2989 52	0.4242 79	0.0087 73	0.5884 02	0.1004 13	0.3640 00
0.0000 45	0.3237 36	0.0445 18	0.423098	0.2947 83	0.4284 19	0.0134 00	0.5809 44	0.1056 71	0.0280 00
0.0000 28	0.3148 93	0.1258 43	0.378912	0.2727 27	0.4557 07	0.0136 87	0.6252 28	0.1140 00	0.1810 00
0.0000 23	0.3923 72	0.0611 26	0.406455	0.2650 07	0.4224 28	0.0466 57	0.6522 29	0.0869 95	0.3410 00
0.0000 21	0.3629 78	0.0913 46	0.425330	0.2628 35	0.4656 92	0.0445 97	0.6531 04	0.0990 00	0.1350 00
0.0000 16	0.3629 73	0.0710 79	0.466756	0.3377 84	0.4217 74	0.0402 28	0.6555 88	0.1034 75	0.0810 00
0.0000 14	0.3789 57	0.0534 40	0.473862	0.3568 74	0.4328 84	0.0389 03	0.6679 50	0.1040 00	0.0770 00

