ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

SCHOOL OF BUSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

ESTIMATING THE ECONOMIES OF SCALE IN ETHIOPIAN BANKING INDUSTRY

(A PANEL DATA ANALYSIS)

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This is to certify that the thesis prepared by RAHEL BELAY MEKONNEN, entitled: ***"ESTIMATING TH ECONOMIES OF SCALE IN THE BANKING INDUSTRY: THE CASE OF ETHIOPIA: A PANEL DATA ANALYSIS"*** and submitted in partial fulfillment of the requirements for the Degree of master of Development Economics complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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ACRONYMS

AC	**Average Cost**
CBE	**Commercial Bank of Ethiopia**
FY	**Fiscal Year**
ETB	**Ethiopian Birr**
EUR	**Euro**
GDP	**Growth Domestic Product**
GLS	**Generalized Least Square**
GMM	**Generalized Method of Moments**
GTP	**Growth and Transformation Plan**
IMF	**International Monetary Fund**
IE	**Interest Expense**
II	**Interest Income**
LLC	**Levin-Lin-Chu**
MC	**Marginal Cost**
NBE	**National Bank of Ethiopia**
NIE	**Non Interest Income**
NII	**Non Interest Income**
PK	**Price of Capital**
QIV	**Quarterly Base**
R&D	**Research and Development**
TBTF	**Too Big To Fail**
TC	**Total Cost**

US	**United States**
USA	**United States of America**
USD	**United States Dollar**
VAR	**Variable**

ABSTRACT

The paper aims to empirically test the existence and trend of scale economy in Ethiopian commercial banking industry using trans-log cost function. It also aims to investigate the level of scale economy in different bank groups. The impact of bank ownership on cost is also examined. A sample of nine commercial banks operating in Ethiopia is considered for the analysis. Descriptive and Econometric method of analysis are used. Panel Generalized Least Square (GLS) method of estimation is employed using quarterly data from 2008/09 (QIV) to 2013/14(QIV). A total of 16 econometric panel models are estimated. In calculating prices of labor, physical capital and funds the most widely recommended proxies are used in the course of estimation. The results indicated that the banking industry in Ethiopia reap economies of scale in all periods of the analysis, and still not reach at the minimum efficient scale of production (MC = AC). The trend confirmed that the industry is approaching the minimum efficient scale of production. Like the industry, all bank groups enjoy economies of scale benefit in the analysis period. Regarding the effect of ownership on cost structure, public banks are less cost efficient than private banks. Finally, the researcher forward recommendation for concerned bodies.

Keywords: Economies of scale, Commercial Banking, Panel GLS,

CHAPTER ONE: INTRODUCTION

1.1. BACKGROUND OF THE STUDY

The existence and extent of economies of scale in banking industry has been interested both policy makers and academicians. Literally speaking, The production process for a specific good or service exhibits economies of scale over a range of output when average cost (i.e., cost per unit of output) declines over that range. If average cost (AC) declines as output increases, then the marginal cost of the last unit produced (MC) must be less than the average cost. If average cost is increasing, then marginal cost must exceed average cost, and we say that production exhibits diseconomies of scale (Koutosyiannis, 1994). In other words, doing things more efficiently with increasing size or speed of operation is considered as economies of scale.

The key objective of commercial banks, as a business entity, is maximizing profit. Banks would therefore need to monitor profitability ratios such as returns on assets (net profit to average total assets) and return on equity (net profit to average capital) which reflects the average return investors get from holding bank capital. As Jeffrey, (1988) posits, among the primary determinants of bank profitability is the extent that production economies and resultant cost reduction can be achieved as firms expand their operation. In an industry there are two types of production economies; economies of scale which resulted from firm size and economies of scope which is related with the joint production of two or more products. Moreover, if a bank becomes efficient in providing services, there will be a tendency to expand its own market share.

The existent of economies of scale at financial institutions comes from the empirical estimation of cost functions. To this end applied empirical research, with flexible functional forms, has enabled numerous studies of efficiency measures in banking to be estimated. (Richard, 1999). But, still there exists a problem in estimating economies of scale in banking industry which is mainly emanated from formulation of representative cost function. And this is due to the absence of argued definition of bank output. Generally, there are two alternative approaches in defining output of a bank: production approach and intermediation approach. As Robert, et.al. (2011) Summarized, under the intermediation approach banks are considered as producers of services related to their role as an intermediary in financial markets. That is, they collect deposit from surplus segment of the economy and transfer the fund to borrowers. Hence deposit is considered as an input like labor and capital and the volume of earning asset considered as an output. On the other hand, under production approach banks are considered as producers of services related with loan and deposit. In this case capital and labor is considered as inputs and the number of deposit and loan account is treated as output. Hence, Interest expense of a bank is excluded from the total cost of under the production approach.

Theory of firm literature hypothesized different factors which result in economies of scale in production. Making better use of specialized labor & capital and spreading fixed cost over large levels of output are usually considered as predominant sources of economies of scale. Consistent with the theory of firm, specialized labor, computer & telecommunication technology, and information are the sources of depository institutions economies of scale. (Jeffrey, 1988). The paper will investigate the existence and extent of economic of scale in Ethiopian banking industry.

1.2. STATEMENT OF THE PROBLEM

Literature showed that the size of commercial banks has been increasing from time to time in almost all economies. And, the nearly universal increase in the size of banks over the past two decades is, for some prima facie evidence of scale economies in banking. But even in the absence of opportunities for scale economies, banks still have reasons to grow large. On one hand, the desire to rule a large corporate empire can drive bank managers to grow their firms beyond the size that maximizes shareholder value. On the other hand, gaining access to subsidies that the government bestows on very large banks is a powerful incentive for banks to grow inefficiently large at the taxpayers' expense (DeYoung, 2013). Commercial banks' operating in Ethiopia has been increasing in number and size in recent periods. The number of commercial banks has doubled in the past 10 years. Currently there are eighteen commercial banks and one specialized bank (Development Bank of Ethiopia) operating in the country. (NBE database, 2015).

The amount of loan disbursed, deposit mobilized and capital of commercial banks increased by 11.4, 14.8 and 19.0 fold respectively at the end of June 2014 as compared with the fiscal year 1999/2000. This raised the question whether banks are increasing their size to gain economies of scale or an empire building. Did the cost of producing loans and deposits decline as banks grew larger? If so, by how much? And for what size bank did costs stop declining, that is, what was the 'minimum efficient scale' for a bank. Furthermore, the presence or absence of significant economies of scale has important public policy implications for bank regulation. Financial sector regulator, mostly central bank, has the mandate to control for the healthy functioning of financial sector. And if a financial crisis occurs in a country, mostly the government bailout failed banks. The recent financial crisis can be taken as an example. Hence, the financial sector regulator must follow the efficient functioning of commercial banks. In addition, as "Too-big- To-

Fail" (TBTF) has become a central issue in banking industry, policy makers worried about the size of a bank. In particular, the recent financial crisis has brought forward concerns about banks that regulators deem TBTF in the sense that their failure would pose serious systemic risks, which has prompted calls for regulatory limits on bank. However, Stern and Feldman (2009) argued that policymakers should consider the loss of any scale benefits when determining the net benefit of limiting the size of banks. Hence, assessment of the extent of scale economies is important for gauging the costs and benefits of any policy intervention to control the size of banks. Likewise, National Bank of Ethiopia (NBE), central bank of the country, has the mandate to supervise and issue policy, directive & procedures in related to banking business. Hence, the NBE must follow the efficient functioning of commercial bank which is operating in Ethiopia.

In addition, the Growth and Transformation Plan (GTP) gives higher emphasis to the financial sector in general and the banking sub-sector in particular. The sector is believed to mobilize saving that is needed to finance mega projects, such as sugar corporations, railway construction, hydroelectric dams and etc, which the government gives a priority that believed to speed up the economic growth and development. This clearly shows us the important of the sector. Hence, banking sector efficiency has a paramount importance.

Although the existence and extent of economies of scale in the banking industry is deeply studied in developed economies there are only limited numbers of studies conducted in case of developing countries. Moreover, to the best of researcher knowledge, there is no published research work in the case of Ethiopia. Thus this theory tries to fill the existing gap by providing base-line information for further study.

1.3. OBJECTIVE OF THE STUDY

1.3.1. GENERAL OBJECTIVE

Drawing from the aforementioned problems, the research is generally aiming at estimating the existence and extent of scale economies in Ethiopian banking industry.

1.3.2. SPECIFIC OBJECTIVES

Specifically the research;

- Overlook Ethiopian banking industry
- Estimate the cost function of Ethiopian Commercial Banks
- Asses the trend of scale economies in Ethiopian banking industry
- identify whether economies of scale exist in large, medium, small sized banks

1.4. ASSUMPTIONS

For conducting this research manageably the following basic Assumptions needs to be considered.

- Banks are multi-product firms
- The objective of a bank is profit maximization or cost minimization
- Banks have seemingly the same cost structure

1.5. SIGNIFICANCE OF THE STUDY

The study help for many purposes concerning about scale economies in Ethiopian commercial banking industry. More specifically, it provides helpful information for regulatory body (NBE), investors both who are already engaged in and planning to join

the sector, and other researchers who intend to conduct research on the same or related areas.

1.6. SCOPE OF THE STUDY

The overarching aim of the research work is to find out the economies of scale of commercial banks operating in Ethiopia. To achieve this objective from eighteen banks nine sample commercial banks operating in the country are included in the study. And the time span covers from FY 2008/09 to 2013/14 and the frequency of data is on quarterly basis.

1.7. LIMITATION OF THE STUDY

The study faces lack of time in relation with data and financial constraints. Moreover, some banks are unwilling to share the full information and the researcher is forced to take only sample commercial banks. Given these limitations the researcher exerts the maximum effort to meet the research objectives.

1.8. ORGANIZATION OF THE STUDY

The research is organized in five chapters. The first chapter includes the introduction part where the background, statement of the problem, objective, significance, assumptions and scope of the study is covered. In the second chapter both theoretical and empirical literature reviewed, in deep, which is related to the problem under study. Following the literature review section, the methodology and data discussion appears in chapter three. Chapter four presents the finding of the study analyzed using both descriptive and econometric analysis. In the last chapter conclusion and policy implications are presented based on the finding of the study.

CHAPTER TWO: SURVEY OF LITERATURE

2.1. THEORETICAL SURVEY

Economies of Scale: definition

Before we go to the survey of literature it is better to have some concepts regarding economies of scale. Different literatures define economies of scale from different perspectives, but the main ideas of all were almost the same.

Economies of scale arise when the cost per unit falls as output increases. Economies of scale are the main advantage of increasing the scale of production and becoming 'big'. Alternatively, this means that as a company grows and production units increase, a company will have a better chance to decrease its costs.

Economies of scale are related to firm size and exist if average production costs decrease as output increases. Conversely, a firm displays diseconomies of scale if average production costs increase with output. On the other hand, Economies of scope are present if a firm can jointly produce two or more products and/or services at a lower cost than if they are produced separately. The cost of joint production is higher if there are diseconomies of scope (Baumol et al., 1982).

From microeconomics perspective, the production process for a specific good or service exhibits economies of scale over a range of output when average cost (i.e., cost per unit of output) declines over that range. If average cost (AC) declines as output increases, then the marginal cost of the last unit produced (MC) must be less than the average cost But, If average cost is increasing, then marginal cost must exceed average cost, and we say that production exhibits diseconomies of scale (Prahalad, C. K., and G. Hamel (1987).

2.1.1. BANK OUTPUTS AND INPUTS (AND RESULTANT COSTS)

The measurement of output and input in banking industry among different researchers were not the same. What one research considers as output is not considered by other author. In general, there was no consensus among researchers to take a product of bank as input and output because of confusion nature of variables in the banking sectors.

The measurement of bank output has long been a difficult and sometimes contentious topic that has yet to see a consensus resolution (Triplett and Bosworth (2004) and Diewert (2010)). Achieving the right output measure for bank services has become more important in the aftermath of the recent devastating financial crisis, as the role of financial firms has come under intense scrutiny. One of the questions attracting greater attention concerns how much banks have truly contributed to the real economy in terms of the services they provide.

Benston (1965, 1970) and Bell and Murphy (1968) have defined output in terms of what banks or savings and loan associations do that cause them to incur operating costs. While the primary services provided are in the form of funds, most of their operations consist of handling documents and dealing with people. The dollar amount written on the document somewhat affects the cost of handling it and the customer; but the operating costs are related primarily to the number of documents handled and customers served rather than to the dollars deposited or loaned. There-fore, these researchers measure output in terms of the number of deposit accounts and loans produced. These numbers are computed as the average number serviced per year (a simple average of the number of accounts outstanding at each month-end or the number made per year). Thus, they are flow statistics that measure a rate of output per period. The average dollar balances (also measured as an average of twelve month-end figures) of these deposits and loans are included in the analysis as cost homogeneity variables. Benston (1965) and Bell and Murphy (1968) also approach the multiproduct

problem differently from other researchers. They divide commercial banks output into six relatively homogeneous services: demand deposits, time deposits, real estate loans, installment loans, business loans, and securities. The direct costs of each are analyzed separately. Indirect costs are divided into administrative, business development, and occupancy; and cost functions are estimated for each. Their procedure, which depends on the data generated by the Federal Reserve's functional cost analysis, allows them to provide estimates of individual bank services from which estimates of the marginal costs and economies of scale from expansion or contraction of specific "services" can be computed for use by regulators and managers.

Greenbaum (1967) and Powers (1969) use an estimate of "real value" output in their analyses of commercial banking. Their approach is dictated by a desire to estimate the social value of banking services because, as Greenbaum states, "If the ultimate findings of bank-costs studies are to have cogency, the measures of output employed must be related to community well-being," (p. 466). Greenbaum and Powers measure the amount of "community well-being" produced by a bank with a variant of the bank's gross income, in the belief that the bank's services are worth what its customers are willing to pay. Greenbaum recognizes that a bank's gross income is a function of market conditions in its area.

Before a model of production and cost can be developed for the financial firm, the outputs and inputs of the financial firm must be clearly delineated. The outputs of financial institutions (with particular emphasis on commercial banks) which have been used by various authors are total assets, earning assets, total deposits, demand deposits, the number of deposit and loan accounts, gross operating income and/or combinations of these measures(Charlotte and Alhadeff. 1957**).** It has even been suggested by various writers that the researcher can adopt any measure of output for the financial firm as long as the measure is consistent with the researcher's goal (George and Benston. 1972).

Indeed, one of the major confusions in the theory of the financial firm arises over the lack of agreement concerning appropriate measures of outputs and inputs for the financial firm. In the authors' opinion, this confusion is a direct result of the failure to carefully analyze both the technical and economic aspects of production at financial institutions; however, this analysis must be carried out if an adequate classificatory framework is to be developed for the inputs and outputs of the financial firm.

Many studies of bank cost functions classify demand deposits as an "output" without testing whether they are in fact an output. The intuition is that deposits involve transactions "services" that are costly to produce. Of course, all leveraged firms incur debt issuance and redemption costs. Only commercial banks rely heavily on *demandable* debt and are willing to assume its' added costs of frequent. When these studies treat deposits as an output, they include the quantity of deposits in the cost function. But there is a complication: as debt, deposits involve a direct expense—the interest paid to depositors. Hence, some of these studies include the interest expense in the measure of costs and include the interest rate on deposits in the cost function. Thus, deposits enter the cost function as a quantity (output) and as prices (an expense) while the measure of costs includes the interest expense of deposits (Joseph et al, 2000).

The theoretical literature on the banking firm offers two separate approaches of bank production which have been used in most of the previous cost studies: *Production and intermediation approach*. According to the production approach, banks produce transactions on accounts by processing loans and deposits and using labor and real capital. In this approach, output is measured in terms of number of transactions or number of accounts or in terms of money volume of accounts. According to Fama (1980), banks produce deposit services in their fundamental role as an accounting system of exchange and purveyor of portfolio services. Contrary to this, in the intermediation approach, the banks which assume intermediation function offer

different kinds of assets, using different kinds of liabilities. They produce loans and other assets. Sealey and Lindley (1977) stated that bank deposits are an input (instead of an output) in their role as a source of loan-able funds. These differing viewpoints on the nature of bank output are not surprising in light of the lack of consensus in the literature on the theory of a bank as a firm. Consistent with these two approaches, operating cost is taken as a cost in production approach but financial costs and operating cost is considered as a cost in the second approach.

In modeling the cost function of multiproduct firms such as banks, we deal with the problem of defining the appropriate specification. Despite the large body of literature on banks there is no general consensus on how to define inputs and outputs of multi-product financial firms (Bernardo et.al, 2003). The two main issues are related to the role of deposits and whether inputs and outputs should be measured in physical or monetary units. The following five are the most used approaches in literature.

The production *approach*, being more concerned with the technical efficiency of financial institutions, defines the bank activity as production of services. Deposits are counted as output and interests paid on deposits are not included in bank total costs (Ferrier and Lovell, 1990). According to this approach input and output are measured in physical quantity (number of accounts, transactions processed, etc.).

The *intermediation approach* views banks as institutions that collect and allocate funds in loans and other assets; deposits are included among the inputs and interests in the total costs.

The *asset approach* is a variant of the intermediation approach where liabilities are considered as inputs and assets as output.

The *value added approach* identifies any balance sheet item as output if it absorbs a relevant share of capital and labor, otherwise it is considered as an input or non-

relevant output; according to this approach deposits are considered as an output since they imply the creation of value added.

Finally the *user cost approach* assumes that it is the net contribution to the bank revenue that defines inputs and outputs; in this case deposits are counted as outputs.

2.1.2. TYPES AND SOURCES OF ECONOMIES SCALE

Economies of scale can be of two kinds-- internal economies and external economies (Silberston, 1972).

Internal economies of scale are those which arise from the firm increasing its plant size. On the other hand, external economies arise outside the firm-from improvement (or, deterioration) in the environment in which the firm operates. The economies external to the firm may be realized from actions of other firms in the same or in another industry. While the internal economies of scale relate only to the long run and determine the shape of the long-run cost curve, the external economies affect the position of the long-run cost curves.

Internal Economies

Internal economies can be categorized into real and pecuniary economies. Real economies arise when the quantity of inputs used for a given level of output decreases. While pecuniary economics are those savings in expenses, which accrue to the firm in the nature of relatively, lower prices paid for inputs and lower costs of distribution. These savings arise due to bulk buying and selling by the growing firm.

Real Economies of Scale

Real economies are of four kinds: Production economies, Marketing economies, Managerial economies and Transport and storage economies

a) Production Economies: production economies arise from:Labor**,** Fixed capital and Inventory requirements of the firm. Labor economies arise because of the following factors:

(i) Division of labor economies-- Larger output allows division of labor, which reduces cost by increasing specialization, by saving time (otherwise lost in passing from one operation to another), and providing good conditions for inventions of a great number of machines.

(ii) Cumulative volume economies-- The technical personnel engaged in production tend to acquire significant experience from large-scale production. This 'cumulative volume' experience helps in higher productivity and, therefore, reduced costs

Technical economies-- These are associated with fixed capital, which includes machinery and equipment. Such economies arise because of the following:

(iii) Specialized equipment. The production methods become more mechanized as the output scale increases. This would imply more specialized capital equipment and lower variable costs.

(iv) Indivisibility. The machinery and equipment generally have the property of indivisibility, which means that equipment is available only in minimum sizes or in definite ranges of size. When output is increased from zero to the maximum capacity level of the machine, the same machine and equipment are used. As a result the cost of machine is shared between more and more units of output. In short, as the output is increased, the machinery and equipment comes to be utilized more intensively and consequently the cost of production per unit declines.

(v) Integration of processes. The large size firms enjoy economies of large machines. Integration of processes occurs where one large automatic transfer or numerically controlled machine can carry out a series of consecutive processes, saving labor cost and time required to set up the work on each of a series of successive specialized machines.

(vi) Economies of increased dimensions for many types of equipment both initial and running costs increase less rapidly than capacity (e.g., tanks, blast furnaces and other static and mobile containers). These result in economies of increased dimensions. Any container whose external dimensions are doubled has its volume increased eight times,

but the area of its surface walls would have increased only four times. This reduces material costs and, where appropriate, heat loss and surface, air and water resistance per unit.

(vii) Economies in set-up costs. The larger the scale of output, the more multipurpose machinery is left to one set-up and, therefore, set-up costs of general purpose machines reduce.

(viii) Economies of overhead costs. Obviously, the larger the scale of output, the lower the unit costs of initial fixed expenses which are need for a new business or a new product.

b) Marketing Economies. These economies arise because:

i. The advertising expenditure is generally found to have increased less than proportionately with scale. Consequently, larger the output, smaller the advertising cost per unit. Similar situation prevails in case of other types of selling activities.

ii. The development and adoption of new models and designs involve considerable expenses in R&D. The larger the output, more thinly this R&D expenditure spreads over output.

c) Managerial Economies. Managerial economies arise because:

i. Larger the firms, greater are the opportunities for the division of managerial tasks. The division of managerial tasks helps managers to specialize in their own areas of responsibility, thus leading to greater efficiency.

ii. Teamwork experience. By working in a team, the managers of large firms tend to acquire a more comprehensive outlook as well as a quicker and better decision-making ability.

iii. In a large firm, with decentralization in decision-making, the delay in the flow of information is reduced, thereby increasing the efficiency of management.

IV. Modern managerial and organizational techniques. Large firms provide opportunities for the introduction of modern managerial techniques and organizational restructuring. These help the management to increase efficiency.

d) Transport and Storage Economies. Storage costs obviously fall with the increase in the size of output, as it provides the economies of increased dimensions (discussed already). The transportation costs, on the other hand, involve an L-shaped average cost curve-transport unit costs falling up to the point of the full capacity and remaining constant thereafter.

Pecuniary Economies of Scale

These economies include the discounts that a firm can obtain due to its large size. These discounts may be in the nature of:

i. Lower raw material price due to bulk buying.

ii. Lower cost of capital, as banks usually place greater faith in the large firms and, therefore, charge lower rate of interest.

iii. Offers of lower rates for advertising to large firms because of their large-scale advertising.

iv. Lower transportation rates due to bulk transportation.

v. In case the large firm is able to attain a size to gain monopolistic power or is able to create an image of prestige to be associated with the firm it may be in a position to save on labor costs by paying lower wages and salaries.

External Economies

Like internal economies, external economies also help in cutting down production costs. With the expansion of an industry, certain specialized firms also come up for working up the by-products and waste materials. Similarly, with the expansion of the industry, certain specialized units may come up for supplying raw material, tools, etc., to the

firms in the industry. Moreover, they can combine together to undertake research, etc., whose benefit will accrue to all the firms in the industry. Thus, a firm benefits from expansion of the industry as a whole. These benefits are external to the firm, in the sense that these arise not because of any effort on the part of the firm but accrue to it due to expansion of industry as a whole. In this sense these economies are external to the firm. All these external economies help in reducing production costs.

Economies of Scale in banking Sector

As stated by Clark (1998), there are two potential sources of economies of scale and scope in banking. The first is the spreading of fixed costs. If excess capacity exists, fixed or quasi-fixed branch costs, labor costs, or computer and telecommunications equipment costs may be spread over large amounts of output and/or joint usage of these fixed resources. Information production is the second basis for economies of scale and scope. For example, the information collected from servicing a customer's deposits and loans may be 'reused'. As the cost of reusing information is usually less than the independent cost of its production, reuse may help reduce the incremental costs of extending additional services. According to Berger et al. (1987), there are two further sources of economies of scope: risk reduction and customer cost economies.

Theoretically, asset diversification and asset-liability maturity matching can reduce portfolio and interest rate risks. To reduce risk in their revenue streams, banks may be willing to incur extra costs. In addition, when bank services are situated jointly, customer incurred banking costs may be reduced due to transportation cost savings, and ease of inter-account fund transfers, etc.

2.2. EMPIRICAL LITERATURE

The estimation of existence and extent of economies of scale in banking industry was deal by many researchers at different time in different economic environment though it is mostly tested in developed countries. Below we summarized prominent research works in the area from the past to present

After the first work of Alhadeff (1954), numerous empirical researches were conducted to test the existence of production economies in the banking industry using one or more cost functions and find different results. In the estimation of economies of scale different methods and different variables have been used for estimation. For the clarity, the section is divided into two parts: empirical works in the developed countries and developing countries.

2.2.1. DEVELOPED ECONOMIES[1]

David and Paul (2009) used non-parametric local linear estimation to evaluate both ray-scale and expansion-path scale economies for two panel datasets comprised of 1) quarterly observations on all U.S. commercial banks during 1984–2006, and 2) all commercial banks during 1984–2000 and a mix of commercial banks and top-tier bank holding companies during 2001-06. Using either sample, or either measure of scale economies, they found that most U.S. banks operated under increasing returns to scale.

Benston (1965, 1972), Bell and Murphy (1968), studied for US banks how bank costs varied with bank size found slight, but statistically significant scale economies for all banks, regardless of size. The results of these studies suggested that banks that doubled their size, all else held constant, and would experience a reduction in average costs on the order of about 5% to 8%. This result would occur for all banks, regardless of size. Unfortunately, these conclusions were later seen to overstate the true scale economies.

[1] Classification was according to IMF data 2011.

Another researches conducted was by, Mester (1987), Clark (1988), Humphrey (1990), Berger, Hunter, and Timme (1993) who tried to see scale economies based on Benston (1965, 1972), Bell and Murphy (1968) in the US banks. They found that the average cost curve in banking has a relatively flat U-shape with medium-sized banks being slightly more scale efficient than either large or small banks. Only small banks appear to have the potential for scale efficiency gains and the measured economies are usually relatively small, on the order of 5% or less.

Another studies Hunter and Timme (1986), Noulas et al. (1990), Hunter, et al. (1990) Studied that only banks with over USD1 billion in assets usually found the minimum average cost point to be between USD2 billion and USD10 billion in assets.

Wang (2003),found the estimates of returns to scale range from as low as 0.77 for the production function to as high as 4.5 for the cost function, while the most plausible range is 0.77 to 2.5, depending on the sources of errors in variables.

In contrary to other researchers Stimpert&Laux, 2011 found diseconomies in US banks. The two authors' uses 2007 data from more than 1,200 US banks to examine the relationship between size and costs. Their results suggested that increasing size is associated with higher costs that increase at an increasing rate, inevitably leads to scale diseconomies.

Moshe Kim and Jacob Weiss (1989) performed regression for Israel banks sector at the sample mean and for each bank in each year using bank (and year) specific data on outputs, input prices, and the number of bank branches. The overall scale elasticity for the typical bank is estimated as 0.6494 with standard error of 0.201 1 indicating strong and significant ray economies of scale. When we evaluate the cost elasticity's at each bank's data the average of scale elasticity's for the large banks is 0.7121 and for the

smaller banks 0.6237. In both cases (large and small banks), we find strong evidence for increasing returns to scale.

Nathan and Neave (1992) estimate a translog cost function for a cross-section of Canadian banks. Their results on economies of scale depend on whether or not deposits are assumed to be inputs.

Jason Allen and Ying Liu (2007) studied economies of scale in banks and found that, banks on average, could enjoy cost savings of at least 6% by doubling their scale of production, keeping its business conditions constant.

Paul and Wagenvoort(1999) studied about economies of Scale and Efficiency in European Banking and they found positive economies of scale "scanty" for the overall European banking industry. The picture they found slightly different when looking only at the saving sector. The results indicated that cost reductions of about 6% can be achieved for savings banks through larger (or, in some cases, smaller) scale. However, according to their finding, increasing returns to scale do only exist for firms up to a size of EUR 600 million. The average cost curve is clearly U-shaped for saving institutions since the ten largest firms, i.e. with total assets exceeding EUR 50 billion, have significantly higher costs than savings banks in the optimal size class. For commercial banks the optimal size picture is less transparent, which is possibly due to the fact that this group of banks is highly heterogeneous.

2.2.2. DEVELOPING ECONOMIES[2]

Estimation of scale economies in banking industry of developing economies, especially in Africa, is not studied very well compared to developed economies.

[2] Classification was according to IMF, 2011

Fu (2011) used banking data to examine the economies of scale and scope in the Macau's (China's) banking sector. They used data collected for the period from 1995 to 2006, the random effects model with a panel data set is employed to estimate a translog cost function. They concluded major from their study. First, in general, Macau banks exhibit diseconomies of scale and economies of scope. In particular, small and medium-sized banks face significantly decreasing returns to scale, while constant returns to scale is not rejected for large banks. On the other hand, economies of scope are greater for small and medium-sized banks than large banks.

Ho (2014) studied a panel data of 23 banks for seven years is used to estimate a representative cost function for the banking industry of Hong Kong. The cost function is then used to examine the existence of economies of scale in banking production. The results indicated that scale economies exist in smaller categories of banks. The effect is most prominent for the smallest category of banks. The findings reveal that most Hong Kong banks are operating at a scale that is under the minimum average cost point. Moreover, the average cost curve is decreasing up to an asset size of USD 33 billion, which is much larger than the results of empirical studies on US banks.

Ojo (1979), had undoubtedly indicated and analyzed the existence of economies of scale in Nigerian banking; but their study has failed to indicate the presence of such economies would materialize automatically. Rather, it had emphasized that their realization depends mainly upon how efficiently the potential economies are exploited and the extent to which incidental diseconomies of scale are minimized; i.e., size alone does not guarantee the achievement of scale economies or high profitability.

Malhotra (2012) analyzed the cost efficiencies of 35 Indian commercial banks over the period 2007 to 2011. They used translog cost function to evaluate economies of scale in the Indian banking sector. Translog cost function was estimated for total cost and for

operating cost with respect to total deposits and total assets of 35 banks. Estimates of cost elasticity showed that Indian commercial banks are reaping economies of scale with a cost elasticity of less than one. The study had showed that total cost and operating cost increases less than proportionately to increase in assets and deposits since 2009, which points to economies of scale with reference to assets and deposits. Results also show that ownership structure of a bank plays a role in determining economies of scale in the Indian banking industry. Cost increases in the private sector banks have been less than proportionate to increases in assets and deposits throughout the sample period.

Das and Das (2007) used a multi-product Fourier flexible cost function specification to investigate scale economies, cost complementarities and technical progress of Indian banks during the post reform period 1992 to 2003 and found economies of scale during the period.

Kasman (2005) examined the cost efficiency and scale economies of banks operating in Poland and the Czech Republic during the period from 1995 to 2000. They found that Polish banks are, on average, more efficient than Czech banks.The study also suggested that foreign banks operating in the Czech banking sector had significantly higher efficiency levels than those of domestic banks.They also reported evidence of significant economies of scale for small and medium-sized banks, but diseconomies of scale for large-sized banks.

Akoena, et.al (2007), in their analysis of the returns to scale properties of the Ghanaian banks reveals that for the industry as a whole, 58.2% of the efficiency measures indicate constant returns to scale while 32.4% and 9.4% indicate decreasing returns and increasing returns respectively. For the six big banks, 43.8% of the efficiency measures indicate constant returns to scale, while 32.4% indicate decreasing returns to scale.

There was no case of increasing returns to scale for the six big banks. The corresponding figures for the small banks were 66.9% for constant returns, 18.1% for decreasing returns and 15% for increasing returns. These results suggest that on the whole, more large banks operate with decreasing returns compared to the small banks.

They have also seen that the mean technical efficiency and scale efficiency of the six big banks are 97.7% and 93.4% respectively, while those for the smaller banks are 98.0%, and 98.7% respectively. These suggest that small banks have larger scale efficiencies than the big banks. The implication of this is that (on the average at least) the large banks in Ghana are more removed from the point of their lowest average costs than the small banks.

Despite the importance of estimating existence and extent of economies of scale in banking industry, as far as researcher knowledge is concerned, there is no any published research work in the case of Ethiopia. Hence, this paper adds a lot to the empirical literature concerning economies of scale in banking industry.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1. DATA TYPE, SOURCE AND METHOD OF COLLECTION

The study used both primary and secondary type of data. For primary type of data, the study used interview with experts in selected commercial banks and National Bank of Ethiopia. For secondary type of data, the study used audited commercial banks financial statement, National Bank of Ethiopia banking database, World Bank database and IMF data base. In addition, different Books, Internet and journals are used.

The span of our panel data covers the time period 2008/09 to 2013/14 for nine banks (The list of selected banks is available in appendix 1). The researcher selected banks based on seniority, size and data availability. The study used quarterly data taken from sampled banks operating in the country. Then classify the period into different sub – periods. The researcher do this for two reasons: first it helps to see the trend of scale economies in the industry. Second; it makes the estimation more powerful as the data become balanced in the whole sample period.

3.2. METHOD OF DATA ANALYSIS

In the way to estimate scale economies in Ethiopian Banking industry, the researcher used both descriptive and econometric analysis**.**

3.2.1. DESCRIPTIVE ANALYSIS

The researcher uses descriptive statistics for the analysis of the collected data. It is used because of its simplicity & clarity to see what is going on in the industry at a glance and helps to support the finding we get in econometric analysis. The analysis of the secondary data generated from different sources is graphically represented with the help of excel.

3.2.2. ECONOMETRIC ANALYSIS

In order to address specific objectives, the researcher posed in the introduction section, the paper employed the following data and model.

3.2.1. THE MODEL

In the finance literature, the translog cost function is used to obtain estimates of economies of scale. Because the derivation of the translog cost function is intractable from corresponding translog production functions, it is obtained as a log-linear quadratic approximation and restrictions are added that are consistent with duality conditions (Dietsch, 1993). Given Yi outputs and Pi input prices, the general form of the translog cost function is:

$$\ln(C) = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln y_i + \sum_{j=1}^{m} \beta_j \ln p_j + 1/2 \sum_{i=1}^{n} \sum_{k=1}^{m} \alpha_{ik} \ln y_i \ln y_k + 1/2 \sum_{j=1}^{m} \sum_{h=1}^{m} \gamma_{jh} \ln p_j \ln p_h + \sum_{i=1}^{n} \sum_{j=1}^{m} \delta_{ij} \ln y_i \ln p_j + \varepsilon \ldots\ldots\ldots(1)$$

Where;

C is the total cost of a bank

Y_i is quantity of the i^{th} output

P_j is the price of J^{th} factor input

ε is a random error

α_0, α_i, β_j, α_{ik}, γ_{jh}, δ_{ij}, are the parameters to be estimated

To estimate scale economies in the Ethiopian banking industry, the current paper takes the lead from the work of Dietsch, (1993) with slight adjustment to specify the following model.

$$\ln(TC_{it}) = \alpha_i + \alpha_{1it} \ln Q_{1it} + \alpha_{2it} \ln Q_{2it} + \beta_{1it} \ln p_{1it} + \beta_{2it} \ln p_{2it} + \beta_{3it} \ln p_{3it} + \varepsilon_{it} \text{.....(2)}$$

Where; TC_{it} = total cost of bank i at time t

Q_{1it} = Loan disbursement of bank i at time t

Q_{2it} = Birr value of non-traditional banking activity of bank i at time t

P_{1it} = Price of labor of bank i at time t

P_{2it} = Price of capital of bank i at time t

P_{3it} = price of fund of bank i at time t

ε_{it} = random error

α_i, α_{1it}, α_{2it}, β_{1it}, β_{2it}, β_{3it} are the parameters estimated in the model

To define the variables that are included in the model, the researcher followed the ***"intermediation approach"*** definition of output. In the intermediation approach, bank output is loan and other non-interest income bearing activities. Labor, capital (fixed capital) and deposit (financial capital) is considered as input. Hence, the total cost of a bank includes both interest and non-interest expense.

Variable definition and construction

i. Dependent Variable

Total Cost (TC): Since the model is based on intermediation approach of output definition,total cost includes the bank expense for inputs used: labor, capital and deposit. The expenses for capital and labor are summed to Non-Interest expense whereas the expense for deposit is considered as Interest expense. Therefore, Total cost can be expressed as:

Total Cost (TC) = Interest expense (IE) + Non-Interest Expense (NIE)

Moreover, as the study used quarterly data, the researcher didn't simply take the quarterly total cost which is reported in banks' income statement. What the researcher does is: as total cost is a flow concept, subtract the existing quarter total cost from its previous quarter which gives the exact cost incurred in that quarter. Mathematically,

$TCQ_t = TCQ^*_t - TCQ_{t-1}$

Where: TCQ_t is total cost incurred in that quarter

TCQ^*_t is total cost incurred up to that quarter

TCQ_{t-1} is total cost incurred upto the previous quarter

ii. Explanatory Variables

Loan disbursement (Q1): As discussed above, one of bank output in the intermediation approach is loan disbursement. Hence, in the model Q1 is represented as loan of a bank. As the model is estimated based on quarterly basis, fresh loan disbursed in that quarter is taken rather than the stock of loan at the end of the quarter which is reported in their balance sheet.

Birr value of non-traditional banking activity (Q2): Banks are not limited to give loan for their customers. They also provide services like money transfer, foreign currency buying & selling, writing export guarantee and etc. these activities also help a bank to generate income other than interest income from loan. Hence, the total earning of these activities are considered as Q2 in the model.

Price of Labor (P1): As the study considered labor as an input in the production, it is a must to include price of labor in the cost function. In literature it is peroxied by the ratio of total salary expenses to total asset. But, it is not the exact price paid for the

employees. Bikker et.al (2006) and others suggested using ratio of total salary expense to total number of employees as the proxy for price of labor is best; this paper does that. As it used quarterly data, it didn't simply divide the quarterly salary expenses by the total employees which are reported by banks' income statement. What the researcher do is: as salary expenses is a flow concept, subtracts the existing quarter total salary expense from its previous quarter which gives the exact expenses paid to employees in that quarter. Mathematically,

$$SQ_t = SQ_t^* - SQ_{t-1}$$

Where: SQ_t is total salary expense paid in that quarter

SQ_t^* is total salary expense paid up to that quarter

SQ_{t-1} is total salary expense paid upto the previous quarter

Then, $$PL = SQt / L = P1$$

Where; L is total number of employees (labor) in that quarter.

Price of Capital (P2): Like labor, capital is also considered as input. Hence the price of capital must be included in the cost function. Mostly, because of lack of data, price of capital is peroxided by dividing Depreciation by fixed asset or by dividing non – interest expenses by fixed asset. But, dividing general expense by number of branch is the best proxy for price of capital as suggested by previous literature including Bikker et.al (2006). Hence, the study used the recommendation and calculate price of capital as;

$$PK = General\ expense / number\ of\ branches = P2$$

Where, general expense is non - interest expense of a bank excluding salary and benefit to the employees. Regarding the quarter value of general expense, the same calculation is done as that of salary expense in the above formula.

2.5. Price of Fund (financial capital (P3): The third input in banks production function is deposit. Hence, like price of labor and capital, price of deposit (fund) must be included in the cost function of a bank. Proxying this variable, in previous works as well, is straight forward. It is calculated by dividing total interest expense by total deposit. But in this case the researcher takes care when divide the variables because the study used quarterly data. So, it follows the same step that used in calculating quarterly salary expenses and general expense. Finally, the researcher calculate price of fund as;

PF = Interest expense / Total deposit = P3

3.2.2.3. ESTIMATION PROCEDURE

Brow et.al, (1979) theoretically, a nice model is the one which passes through three necessary steps. That is, pre estimation test, model estimation and post estimation test (Diagnostic test).

A) Pre Estimation Test (Unit Root Test)

In panel data analysis unit root test is the basic test in order to select estimation method. If the variables have a unit root, then applying Generalized Method of Moments (GMM) estimation / panel VAR is best method other than random/fixed effect. Therefore, the researcher has tested stationarity of variables using Levin-Lin-Chu (LLC) unit root test (Levin et.al, 2002).

B) Estimation of the Models

After testing for unit root of the variables, the researcher specified and estimated both Random effect and Fixed effect models as all the variables found stationary. However, both techniques failed to pass the post estimation (diagnosis) test of cross-sectional interdependence. Hence, the researcher used Panel Generalized Least Square (GLS) to correct the problem of cross sectional interdependence. Using the general model of

regression suggested above in equation 2 and employing Panel GLS, the researcher estimated sixteen different models.

C) Post-Estimation (Diagnostic Check)

In panel data models, mostly, cross-sectional interdependence test has to be undertaken to confirm the fitness of estimated model. Hence, after estimating the models, the researcher checked for the validity of the models by testing cross-sectional interdependence using Breush – Pegan Lagrangian Multiplier test.

Moreover, the researcher tested whether the estimated cost function is well behaving or not. It is done by checking whether the cost function is non-decreasing in prices and output. The test condition can be summarized as follows;

Table 3.1 test condition of estimated cost function

Condition	The Cost function
Cofficent of Output (stastically)/1	
Positve & significant	well behaving
Negative & significant	Not well behaving
Cofficent of Price (stastically)	
Positve & significant	well behaving
Negative & significant	Not well behaving
1/ derivation is presented in the appendex	

3.2.2.4. DECISION RULE FOR THE EXISTENCE OF DIS/ECONOMIES OF SCALE

For a multi- product cost function, overall Economies of scale, then, are computed as the sum of the individual cost elasticity's (Brow et.al, 1979) or $\sum \ln c / Q_i$. If this sum is less than, equal to, or greater than one, then there are increasing (economies of scale), constant, or decreasing returns to scale (diseconomies of scale), respectively. Table 3.2 below summarized the decision regarding the existence of scale economy.

Table 3.2: decision rule for the existence of dis/economies of scale

Sum of output elasticity	Returns to scale	Scale Economy
Less than one	Increasing Returns to Scale	Economies of Scale
Equal to one	Constant Retruns to Scale	Minimum Efficient Production
Greater than one	Decreasing Returns to Scale	Dis-economies of Scale

CHAPTER FOUR: DATA ANALYSIS AND PRESENTATION

4.1. DESCRIPTIVE ANALYSIS

4.1.1. OVERVIEW OF ETHIOPIAN BANKING INDUSTRY

The history of modern banking system of Ethiopia dated back to Emperor Minilik II when agreement is reached between the emperor and Mr.MaGillivray, representative of the British owned National Bank of Egypt, on the establishment of Bank of Abyssinia in 1906. Then after Emperor Haile Selassie come to power Bank of Abyssinia is legally replaced by Bank of Ethiopia and became the first indigenous banks for Ethiopia as well as Africa. Bank of Ethiopia have dual role both as commercial bank and central bank until it split into National Bank of Ethiopia (as a central bank) and Commercial Bank of Ethiopia in 1963. During the H/Selassie era the banking sector was open to foreign banks with requirement of at least 51 percent domestically owned. As a result there was 1 state owned, 1 private owned and 2 foreign owned commercial banks operating in the country until nationalized by communist government in 1974. The communist government merging three private owned banks in 1976 to make Addis Bank and further merge Addis Banks with state owned commercial banks in 1980 to make one state owned commercial banks. Following the downfall of Derg regime banking sector is liberalized for private sector as a result currently there are 1 central bank, 18 commercial banks (of which 2 of them are government owned) and one special bank operating in the country, Development Bank of Ethiopia. However, still the sector is closed for foreign banks (NBE Database, 2015).

The current banking system of Ethiopia is dominated by public owned bank, Commercial Bank of Ethiopia. Commercial Bank of Ethiopia (CBE) has a share of around 67 percent of commercial banks total assets and total deposits each, 62 percent of total loan extended by commercial banks, and 37 percent of total commercial banks

capital as of June 2014. Moreover, CBE dominate the sector in terms of branch expansion. The total number of bank branch as of June 2014 is 2,176 of which 856 branches are owned by CBE (39 percent of total commercial banks branch). In addition, from total bank account holder of 13,044,228, CBE has a share of around 63 percent (8,187,070 account holders). This is mainly due to current government development model, democratic developmental state; in which government highly participates in the production as well as distribution of selected goods and services, which government believe essential for economic growth and in which private sector fails to do it with expected efficiency and magnitude. As a result during the same period from total banking sector credit, 64 percent is goes to government and public enterprise whereas the rest goes to other sectors (private and cooperative). However, in terms of deposit only 18 percent of bank deposit is come from government and public enterprises.

The other peculiarity of Ethiopia banking system is the high profitability of the sector mainly due to ample potential of the sector and the restriction of foreign banks that give domestic banks the opportunity to earn high profit. During the last four fiscal years (2009/10-2013/14) income after tax of commercial banks observed to be greater than 2 percent of their total assets.

Table 4.1: Ratio of selected financial performance indicators[3]

(Ratio's are expressed in percentage)

Particulars	2009/10	2010/11	2011/12	2012/13	2013/14
Income after tax to total assets	2.01	2.03	1.93	2.18	2.23
Total expense to total income[4]	47.37	51.53	40.60	46.77	53.09

Source: Authors computation based on National Bank of Ethiopia database

[3]While calculating those ratio all commercial banks operating at respective period are included in addition to those covered by the study.

[4] Bank level ratios of expense to total income are attached as an appendix.

Total expense to total income ratio is calculated to look at the amount of expense incurred to produce 1 unit of income (since ratio is calculated in percentage). On average, the ratio of total expense to total income for the last four years is found to be 0.479. Implying, on average 0.479 Birr of expense is required to earn 1 Birr income. Even the recent data for 2013/14 shows ratio of total expense to total income is 0.5309 implying commercial banks outlay Birr 0.5309 to produce output equal to Birr 1. This in turn shows us how much the sector is profitable.

4.1.2. CONCENTRATION IN ETHIOPIAN BANKING INDUSTRY

Ethiopian banking industry can be characterized by high concentration. If we take Top three[5] banks concentration ratio, though it is declining over time still there is high concentration on Asset and Deposit (Table 4.2).The concentration is declining because the number of banks joined to the industry was increased as the sector is highly profitable. Bank entry in Ethiopia has been historically fairly easy as the Minimum paid-up capital (ETB 70 Million) was relatively low if we compare it with the new requirement (ETB 500 Million). In early period lack of skilled manpower was the problem rather than financial requirement. But, concentration by itself will not tell us the level of competition in the industry since the industry can be characterized by competition in the presence of high concentration if the market is contestable.

[5] The banks include Commercial Bank of Ethiopia, Awash International Bank and Dashen Bank

Table 4.2: Top Three Banks Concentration Ratio

(In Percent)

Period	Asset	Deposit	Loan
2000/01	0.91	0.91	0.81
2001/02	0.90	0.89	0.80
2002/03	0.89	0.88	0.78
2003/04	0.87	0.87	0.76
2004/05	0.85	0.84	0.73
2005/06	0.85	0.82	0.68
2006/07	0.80	0.80	0.65
2007/08	0.78	0.78	0.61
2008/09	0.78	0.74	0.55
2009/10	0.74	0.72	0.56
2010/11	0.75	0.73	0.56
2011/12	0.80	0.75	0.55
2012/13	0.76	0.74	0.56
2013/14	0.73	0.73	0.54
Average	***0.82***	***0.80***	***0.65***

Source: Own computation based on National Bank of Ethiopia data

4.1.3. COMMERCIAL BANKS INCOME COMPOSITION IN ETHIOPIA

Generally, Income of a bank is divided into two: Interest (II) and Non-interest income (NII). The first one is generated by giving traditional banking activity which is from disbursing a loan to the economy. Whereas the latter includes the income that is earned from forex, commission and charge this is beyond the traditional banking activity.

As it is shown under Table 4.3 & Fig 4.1, Generally, The share of interest income was much higher than Non-interest income in early times. But the trend shows that share of NII is increasing overtime and starts to decline after it reaches the pick on the year 2010/11. If we look at the share by type of banks: on average, public banks Non-interest income was higher than that of private banks. But the share of Non-interest income at private banks starts to dominate onwards the year 2009/10 until 2010/11. Though the share of NII at private banks starts to decline after 2011/12, still the share at private banks is higher than that of public banks.

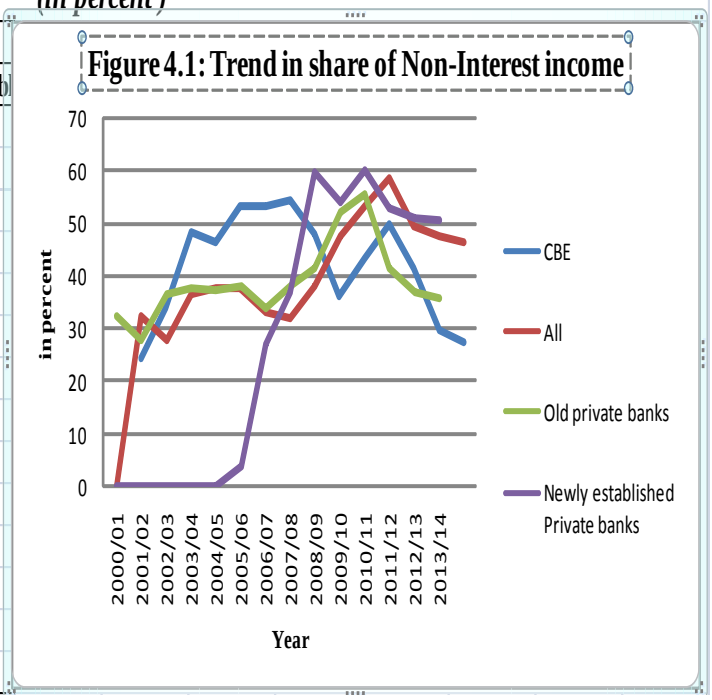
More specifically, the share of NII from total income at newly established banks are higher than that of old established banks[6] in recent periods. The share of NII at private banks (both old & new) starts to dominate interest income onwards the year 2009/10 where there was a credit cap policy in the specified period. The highest record was on the year 2010/11 in which newly established banks earned 60.0 percent of their income from NII. The trend shows that public banks are getting their income mainly from traditional banking activities (giving loan) whereas private banks, especially newly established, earn their most income from non-primary banking activities. Currently public banks income is mainly composed of interest income which is around 70 percent and the remaining 30 percent from NII. On the other hand, newly established banks earn their most income in the form of NII and it is around 51.0 percent and the part 49.0 percent is comes from interest income. Moreover, newly established banks are more responsive for NBE policy. This is explained in the period of credit cap where their income composition shows a quick shift from interest income to NII that is from 42.0 to 51.0 percent.

[6] We have categorized banks depend on the year of establishment.

Table 4.3: Share of Non-Interest Income: Trend

(in percent)

Particulars	CBE	Private Banks		
		All	Old	Newly Estab
2000/01	24.5	32.3	32.3	-
2001/02	33.8	27.8	27.8	-
2002/03	48.3	36.4	36.4	-
2003/04	46.4	37.7	37.7	-
2004/05	53.4	37.5	37.5	-
2005/06	53.3	33.0	37.9	3.9
2006/07	54.4	32.1	33.8	26.9
2007/08	48.1	37.9	38.1	36.8
2008/09	36.2	47.6	41.6	59.5
2009/10	43.6	53.2	52.0	54.1
2010/11	49.7	58.5	55.5	60.0
2011/12	41.6	49.3	41.3	52.9
2012/13	29.7	47.6	36.9	51.0
2013/14	27.3	46.4	35.72	50.43



Source: Own computation based on National Bank of Ethiopia data base

4.1.4. COMPOSITION OF COMMERCIAL BANKS' EXPENSE IN ETHIOPIA

Like other Business, Commercial banks incur costs in their course of business. Generally, the cost of commercial banks can be divided into Interest and Non-interest expense. Interest payment on deposit by banks considered as Interest expense whereas Non-interest expense include salary & benefit for the employees, rent and other expenses.

Throughout the analysis period Non-Interest expense of commercial banks outweigh Interest expense. As it is shown in table 4.4 ,average of all period, Non-interest expense take 59.1 percent of the total expense and the remaining 40.9 percent is goes to interest expense. Interest expense is relatively lower than non-interest expense due to the fact that Commercial banks deposit in Ethiopia is highly composed of demand deposit in

which most banks did not pay any interest Demand deposit accounts for 44 percent of total deposit of banks (as of June 2014)(Table 4.6).

Table 4.4: Composition of Bank expense in Ethiopian Banking Industry (2008/09 - 2013/14)

(In millions of Birr, unless specified

Period	Interest Expense	Non Interest Expense	Total Expense	Percentage Share (in %)	
				IE	NIE
2008/09	1,750.9	1,671.1	3,422.1	51.2	48.8
2009/10	1,694.2	2,780.3	4,474.5	37.9	62.1
2010/11	2,434.0	5,188.2	7,622.2	31.9	68.1
2011/12	3,468.3	4,479.3	7,947.5	43.6	56.4
2012/13	4,632.7	6,289.0	10,921.8	42.4	57.6
2013/14	6,308.5	10,084.1	16,392.6	38.5	61.5
Average	***3,381.4***	***5,082.0***	***8,463.5***	***40.9***	***59.1***

Source: Own computation based on National Bank of Ethiopia database

4.1.5. DEPOSIT MOBILIZATION AND LOAN DISBURSEMENT BY THE BANKING SECTOR IN ETHIOPIA

The most important activity of a commercial bank is to mobilize deposits from the public and disburse loan (credit) to the same. Hence, this section provides a general overview of the patterns and trends in total commercial banks deposit mobilization and loan disbursement for the period 2008/09 to 2013/14. Here total bank deposits are defined to include both rural and urban deposits mobilized by all commercial banks.

Commercial Banks deposit mobilization in Ethiopia from the year 2008/09 to 2013/14 reveals an upward trend (Table 4.5).A sample of all banks indicates an average yearly increase of 29.5 percent calculated from the yearly percentage increase in deposits. Indeed, it is remarkable that annual deposit growth has never fallen below 23.0 percent during the analysis period. Theoretically, a growth rate of 29.5 percent in deposits may be considered sufficient to increase supply of loanable funds. However, the present level of commercial banks deposits as a ratio of the total amount of GDP, due to

different reasons, is woefully inadequate, which is only 27.9 percent of the total GDP as of June 2014.

Similar with deposit mobilization, Commercial Banks loan disbursement to the economy also registered an upward trend. The increase in number of banks, availability of loanable fund and high credit demand from the economy are the reasons for the continuous increment in loan disbursement by commercial banks. Throughout the period, the growth rate of deposit is higher than that of loan disbursement (Table 4.5).

Table 4.5: Deposit Mobilizaion and Loan Disbursment of Commercial Banks (2008/09-2013/14}

(In millions of Birr)

Period	Deposit Mobilized	Loan Disbursed	Growth *(in percent)*	
			Deposit Mobilized	Loan Disbursed
2008/09	77,660.75	40,436.55		
2009/10	98,078.18	49,089.43	26.3	21.4
2010/11	140,111.62	63,692.23	42.9	29.7
2011/12	186,586.78	96,827.11	33.2	52.0
2012/13	236,470.49	117,398.08	26.7	21.2
2013/14	291,836.04	145,530.67	23.4	24.0

Source: Own computation based on National Bank of Ethiopia database

4.1.6. DEPOSIT STRUCTURE OF COMMERCIAL BANKS IN ETHIOPIA

Commercial Banks in Ethiopia use traditional tools to mobilize deposits. These tools have dual functions. Primarily, they are means of mobilizing deposits from customers. Secondly, they are media through which other financial products and services are sold to the customers. These tools are in the form of products and services and may have different names in the various commercial banks; however, they have similar modes of operation and effectiveness. The mechanisms discussed below are the general and

specific products designed to meet their wide range of targets thereby shows there deposit composition.

i. Demand Deposit (Current Account)

A current account is the type of account which customers have access to their money at all times. There are no restrictions as to the number of times a current account holder can withdraw provided there is sufficient balance in the account and the maximum daily withdrawal limit of the account is not exceeded.

Current accounts are cheques guaranteed and depending on the bank that operates them as well as the outstanding balance left may or may not attract interest. It enables customers (enterprises, societies, individuals and corporate bodies) to transact business and pay for them later. Current accounts in Ethiopia are normally operated by wealthy individuals, cooperate bodies, Government who wants to enjoy flexibility regarding withdrawals.

It is unstable (volatile) type of deposit hence all most all commercial banks do not pay an interest on it. As it is shown in the table below, Demand deposit has a stable share from the total deposit for the last six years.

ii. Saving Deposit (Saving Account)

Savings accounts are available to all customers, personal individuals, groups, corporate bodies and societies. It enables customers to deposit their money for investment and/or future use. This account is a provision for future convenience. Customers have the benefit of accumulating funds from their own occasional savings and earning interest.

For this type of account Commercial banks pay an interest ranging from 5 percent (which is the minimum saving deposit rate set by NBE) to 5.75 percent. Unlike Demand deposit, saving deposit is stable source of fund for private banks.

iii. Fixed Deposit (Certificate of Deposit)

The account which is opened for a particular fixed period (time) by depositing particular amount (money) is known as Fixed (Time) Deposit Account. The term 'fixed deposit' means that the deposit is fixed and is repayable only after a specific period is over. Under fixed deposit account, money is deposited for a fixed period say six months, one year, five years or even ten years. The money deposited in this account can't be withdrawn before the expiry of period.

The rate of interest paid for fixed deposit vary (changes) according to amount, period and from bank to bank. It enables the depositor to earn a high interest rate and it is more stable source of funds for banks. The share of fixed deposit form the total deposit is very small in the entire period though it is increasing in recent periods. And it reached 6.1 percent in the budget year 2013/14 (Table 4.6).

Table 4.6: Deposit Structure of Commercial Banks in Ethiopia (2008/09-2013/

(In percent)

Particulars	Demand Deposit	Saving Deposit	Fixed Deposit
2008/09	47.8	47.8	4.3
2009/10	46.9	49.0	4.1
2010/11	50.5	46.1	3.4
2011/12	49.3	44.2	6.5
2012/13	49.0	44.9	6.1
2013/14	43.9	50.0	6.1

Source: Own computation based on National Bank of Ethiopia database

4.2. ECONOMETRIC ANALYSIS

4.2.1. UNIT ROOT TEST

To select method of estimation and overcome the problem of spurious regression, the researcher conducted a stationarity test for all variables using Levin-Liu-Chu (LLC) Test before estimating the models. And all the variables are found to be stationary at level. The result of the test is presented in Appendix 3. Therefore, we prefer to use Generalized Least Square (GLS) method rather than (GMM) estimation/Panel VAR.

4.2.2 INTERPRETATION

The econometric model with different specifications was developed based on a panel data set of the sampled eight commercial banks to obtain a general picture of the cost function hence infer the existence and trend of scale economies in the Ethiopian banking industry over the whole sample period 2008/09 QI – 2013/14 QIV. In addition, different models are estimated in different sub-periods in order to see the trend of scale economies. The sub-periods include 2008/09 -2009/10, 2010/11- 2011/12 and 2012/13-2013/14. Moreover, with similar time framework, commercial banks are classified into three groups to see whether economies of scale are differing among Group I (large), Group II (medium) and Group III (small) sized commercial banks[7]. Appendix 5- 8 reports the best fitted model results.

Cost function of Ethiopian Banking Industry

$$\ln(TC_{it}) = \alpha_i + \alpha_{1it}\ln Q_{1it} + \alpha_{2it}\ln Q_{2it} + \beta_{1it}\ln p_{1it} + \beta_{2it}\ln p_{2it} + \beta_{3it}\ln p_{3it} + \varepsilon_{it} \text{.....(2)}$$

Where; TC_{it} = total cost of bank i at time t

Q_{1it} = Loan disbursement of bank i at time t

[7] Detail of banks group classification is presented in appendix 4

Q_{2it} = Birr value of non-traditional banking activity of bank i at time t

P_{1it} = Price of labor of bank i at time t

P_{2it} = Price of capital of bank i at time t

P_{3it} = price of fund of bank i at time t

ε_{it} = random error

α_i, α_{1it}, α_{2it}, β_{1it}, β_{2it}, β_{3it} are the parameters estimated in the model

The cost function in equation (2) is first estimated using Random effect and fixed effect methods. But, both methods failed to pass the post estimation (diagnosis) test of cross-sectional interdependence (Appendix 9). Hence, the cost function for the industry is estimated using Panel Generalized Least Square method. Estimated coefficients of output and price in all models found to be positive and this assure the cost function which is estimated using GLS fulfills the regularity condition posed in the methodology part[8].

Derivation of Positive elasticity of cost to output

Ln (TC) = βLn (Q)

Where Ln (TC) is natural logarithm of total cost

Ln (Q) is natural logarithm of output

Then β is elasticity of cost to output which can be represented as:

β = ∂ln(TC) / ∂ln(Q)

= ∂ (TC)/TC / ∂ (Q)/ Q >>>>>>>> (∂ (TC) / ∂ (Q)) * (Q/TC) ……. (3)

By definition:∂ (TC) / ∂ (Q) = MC and (Q/TC) = 1/AC

Therefore, equation (3) can be re-write as $\boldsymbol{\beta = MC/AC}$

[8]The representative cost function is selected after conducting different regression by substituting different explanatory variables

By definition MC and AC are non-negative values so the value (coefficient of output) is non-negative number.

From this we can infer about Scale economy of a firm.

1) If MC < AC, then $\beta < 1$ >>>>>>> Economies of Scale

2) If MC > AC, then B>1 >>>>>>> Diseconomies of Scale

3) If MC = AC, then $\beta = 1$ >>>>>>> Minimum Efficient Scale of Production

Graphically,

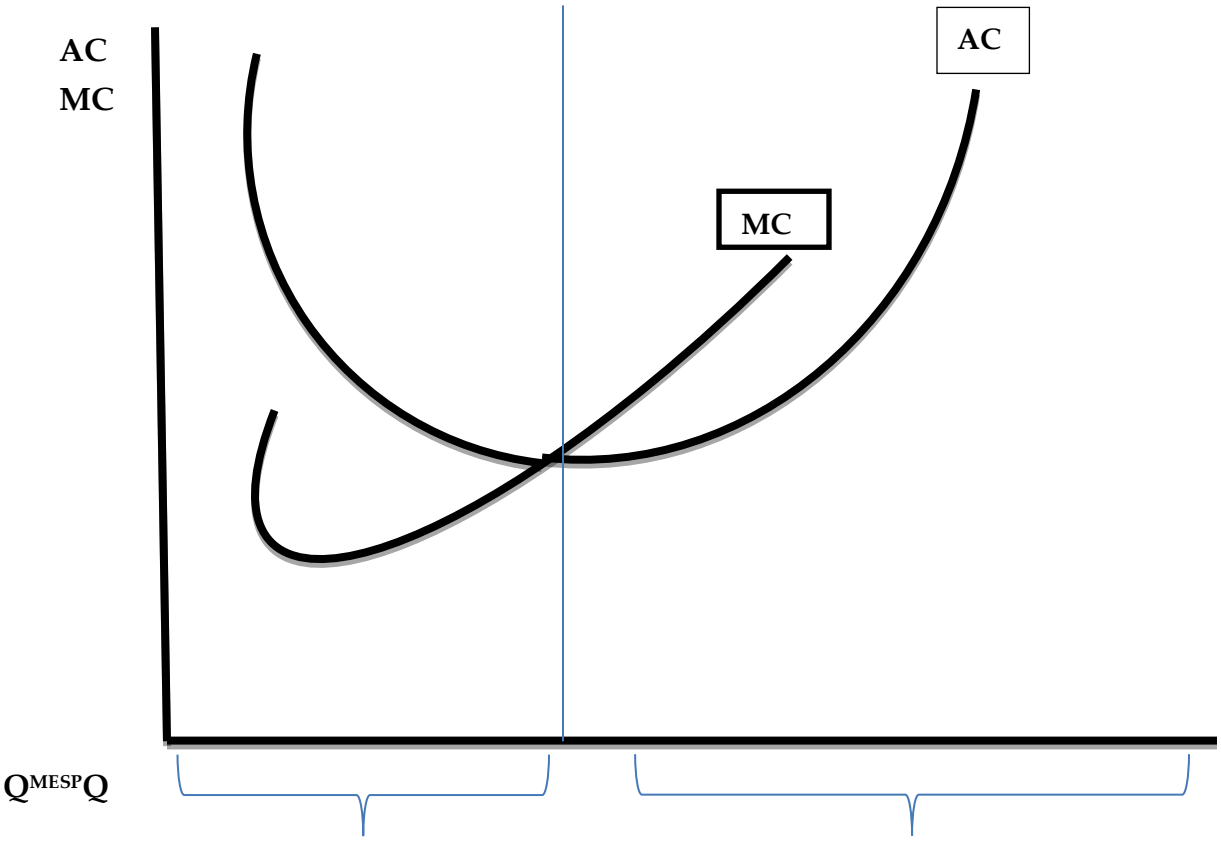


Figure 4.2 Scale economy of a firm

Estimation of Economies of Scale in Ethiopian Commercial Banking Industry

After estimating the cost function, the researcher test for the existence of dis/economies of scale both in the industry and within different groups. This is done by summing the elasticity's of bank cost to output. In other words, by summing the coefficient of bank output in the cost function and test the result against constant returns to scale (minimum efficient production scale). This is done both for the industry and within different bank groups at different time period.

The result revealed the Ethiopian banking industry has been enjoying economies of scale in the whole sample period (Table 9 & 10). Moreover, similar with the industry, all bank groups found to be operating in the economies of scale region though large banks are near to the minimum efficient scale (MC = AC) than medium and small sized bank groups both in static and over-time.(Table 10 & fig 2). And medium-sized banks have relatively higher economies of scale efficiency than large and small banks. In all periods, the result is tested against constant returns to scale and rejected at 1 percent (Appendix 12). The result found is similar withBenston (1965, 1972), Bell and Murphy (1968), which found US banks have significant scale economies for all banks, regardless of size. Regarding the relative difference in level of scale economy the result is similar with Mester (1987), Clark (1988), Humphrey (1990), Berger etal (1993) who found medium-sized banks being slightly more scale efficient than either large or small banks in case of USA baking industry.

Table 4.7: Summary of Estimated Economies of Scale in Ethiopian Banking Industry

Period	Estimated Scale Economy	Test against CRS	Decision
2008/09 - 2009/10	0.56655	Rejected	Economies of Scale
2010/11 - 2011/12	0.85039	Rejected	Economies of Scale
2012/13 - 2013/14	0.90446	Rejected	Economies of Scale
2008/09 - 2013/14	0.80175	Rejected	Economies of Scale

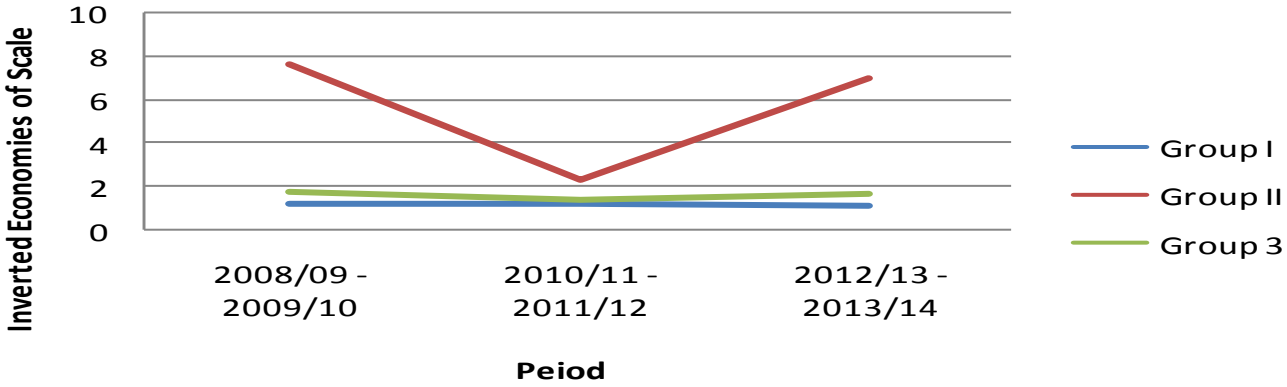
Source : Model 1, 5, 9 and 13

Table 4.8: Summary of Estimated Economies of Scale in different bank group

Bank Group	Period	Estimated Scale Economy	Test against CRS	Decision
Group I	**2008/09 - 2009/10**	0.817	Rejected	Economies of Scale
	2010/11 - 2011/12	0.865	Rejected	Economies of Scale
	2012/13 - 2013/14	0.927	Rejected	Economies of Scale
	2008/09 - 2013/14	0.850	Rejected	Economies of Scale
Group II	**2008/09 - 2009/10**	0.130	Rejected	Economies of Scale
	2010/11 - 2011/12	0.429	Rejected	Economies of Scale
	2012/13 - 2013/14	0.142	Rejected	Economies of Scale
	2008/09 - 2013/14	0.323	Rejected	Economies of Scale
Group III	**2008/09 - 2009/10**	0.582	Rejected	Economies of Scale
	2010/11 - 2011/12	0.740	Rejected	Economies of Scale
	2012/13 - 2013/14	0.601	Rejected	Economies of Scale
	2008/09 - 2013/14	0.600	Rejected	Economies of Scale

Source: Model 2, 3, 4, 6, 7, 8, 10, 11, 12, 14 and 16

Figure 4.3: Trends in Economies of Scale among different bank groups



In addition, the result in model 5 showed that public banks[9] incur higher cost than private banks in producing a unit of output. This can explain by comparing the price of inputs (labor, capital and labor) between public and private banks. In the sample period, the price of labor and capital found higher in public banks whereas price of fund is higher in private banks (Appendex 10). Moreover, in the descriptive part, it is found that Commercial Banks Non-interest expense takes the highest share from the total expense. Therefore, higher labor and capital cost at public banks coupled with highest share of Non-interest expense at commercial banks makes public banks to incur higher cost than private banks in producing a unit of output. D.k. Malhotra (2012) also found that private banks in India are more cost efficient than public banks.

[9]The coefficient of dummy (d1) found to be positive

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1. CONCLUSIONS

The aim of this paper is to empirically estimate and show trend of scale economy in Ethiopian Banking industry. Panel of nine banks for the period spanning from 2008/09 QI to 2013/14 QIV is used for the analysis. Hence, the researcher used both descriptive and econometric analysis in order to analyze the data's collected from different sources. The descriptive analysis mainly look at overview of banking industry in Ethiopia, concentration in the industry, income and expense composition of banks, deposit mobilization & structure and loan disbursement in the industry during the analysis period. On the other hand, the econometric analysis estimate cost function and economies of scale in the industry & bank groups. To do this, the researcher employed Panel Generalize Least Square method to estimate translog-cost function thereby scale economy in the industry. Meanwhile, the effect of bank ownership in cost structure is estimated. Both the descriptive and econometric analysis found the following results.

- The Ethiopian banking industry is characterized by high concentration in all aspects of service though it is declining in recent times.The concentration is declining because the number of banks joined to the industry was increased as the sector is highly profitable.
- Commercial Banks income is composed of interest and non-interest income. In recent period, the share of non-interest income is higher in private banks than public banks. Moreover, newly established banks are more responsive for NBE policy. This is explained in the period of credit cap where their income composition shows a quick shift from interest income to Non-interest income that is from 42.0 to 51.0 percent. Likewise, total expense of commercial banks is composed of interest and non-interest expense. Due to the fact that, commercial

banks deposit is highly composed of a deposit that they did not pay interest which makes price of fund very low, the share of Non-interest expense overwhelms interest expense in the industry.

- The amount of commercial banks output (loan disbursement and fee related activities) and deposit mobilization is increasing overtime. Moreover, in all sample period, commercial banks deposit is highly composed of a type of deposit that they pay insignificant amount of interest. The increase in number of banks, availability of loanable fund and high credit demand from the economy are the reasons for the continuous increment in loan disbursement by commercial banks in Ethiopia.
- The cost structure of the Ethiopian banking industry is well approximated by a two-output and three-input translog cost function. All the estimated cost functions satisfied the regularity condition of non- decreasing in output and price of inputs. Coefficients of output and input price found to be positive.
- In Ethiopian Banking industry there exist economies of scale advantage. Moreover, the trend shows the industry still did not reach the Minimum Efficient Scale of production (Minimum Average cost).
- Group-wise scale economy estimate reveled that all bank groups in Ethiopia enjoyed economies of scale benefit over the whole period with slight difference in their level. Largest banks are near to the minimum efficient scale of production than medium and small banks. Hence, Commercial banks in Ethiopia increasing their size in support of enjoying scale economies not to build-empire with inefficiency. The impact of Public ownership of banks on cost of operation found to be positive. Higher labor and capital cost at public banks coupled with highest share of non-interest expense at commercial banks makes public banks to incur higher cost than private banks in producing a unit of output.

5.2. RECOMMENDATIONS

- ✓ As commercial banks in Ethiopia reap economies of scale in the existing size, the banks should increase their operation size in order to reach the minimum efficient scale of production.
- ✓ As much as possible National Bank of Ethiopia should not restrict commercial banks to expand their size of operation by considering the economic condition of the country.
- ✓ The banks should minimize non-interest expense in banking operation which can be done by having minimum efficient labor force, stationary and related costs. This would decrease per unit production (Average cost of production) thereby increase the level in economies of scale in the industry. In addition, as far as economy of scale is concerned, it would be nice for public banks to adopt private banks experience in minimizing their unit cost of production.

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APPENDIXES

Appendix 1: List of sampled banks

No.	Name of The Bank	Ownership
1	Commercial Bank of Ethioia (CBE)	Government Owned
2	Awash International Bank (AIB)	Private Owned
3	Dashen Bank (DB)	Private Owned
4	Bank of Abyssinia (BoA)	Private Owned
5	Wegagen Bank (WB)	Private Owned
6	United Bank (UB)	Private Owned
7	Nib International Bank (NIB)	Private Owned
8	Cooperative Bank of Oromia (CBO)	Private Owned
9	Lion International Bank (LIB)	Private Owned

Appendix 2: Derivation of Positive elasticity of cost to output

Ln (TC) = βLn (Q)

Where Ln (TC) is natural logarithm of total cost

Ln (Q) is natural logarithm of output

Then β is elasticity of cost to output which can be represented as:

β = ∂ln(TC) / ∂ln(Q)

= ∂ (TC)/TC / ∂ (Q)/ Q >>>>>>>> (∂ (TC) / ∂ (Q)) * (Q/TC) ……. (3)

By definition:∂ (TC) / ∂ (Q) = MC and (Q/TC) = 1/AC

Therefore, equation (3) can be re-write as $\boldsymbol{\beta = MC/AC}$

By definition MC and AC are non-negative values so the value (coefficient of output) is non-negative number.

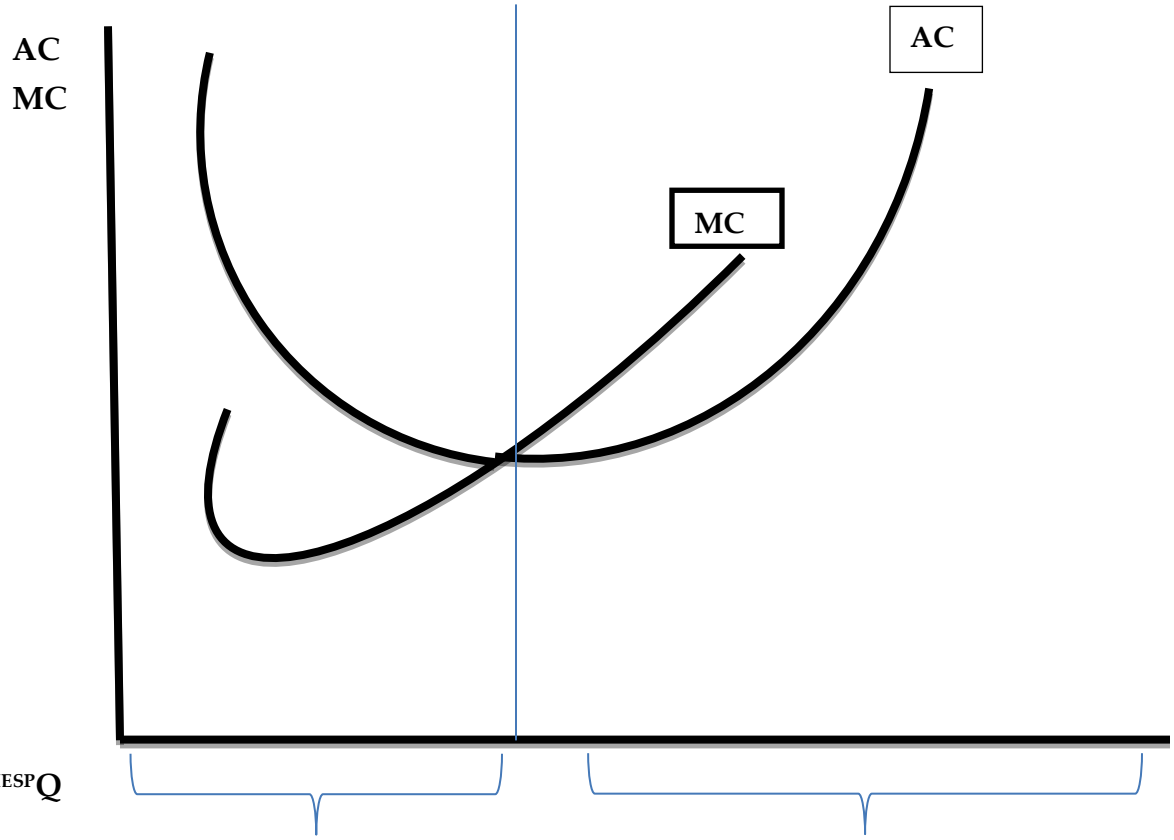
From this we can infer about Scale economy of a firm.

1) If MC < AC, then $\beta < 1$ >>>>>>> Economies of Scale

2) If MC > AC, then B>1 >>>>>>> Diseconomies of Scale

3) If MC = AC, then $\beta = 1$ >>>>>>> Minimum Efficient Scale of Production

Graphically,



Economies of scale (MC < AC)

Diseconomies of scale (MC > AC)

Appendix 3A: Unit Root test result for Total Cost (TC)

Levin-Lin-Chu unit-root test for tc

Ho: Panels contain unit roots — Number of panels = 9
Ha: Panels are stationary — Number of periods = 24

AR parameter: Common — Asymptotics: N/T -> 0
Panel means: Included
Time trend: Included

ADF regressions: 1 lag
LR variance: Bartlett kernel, 9.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-12.9021	
Adjusted t*	-4.4696	0.0000

Appendix 3B: Unit Root test result for Q1

Levin-Lin-Chu unit-root test for q1

Ho: Panels contain unit roots — Number of panels = 9
Ha: Panels are stationary — Number of periods = 24

AR parameter: Common — Asymptotics: N/T -> 0
Panel means: Included
Time trend: Included

ADF regressions: 1 lag
LR variance: Bartlett kernel, 9.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-13.9191	
Adjusted t*	-6.6448	0.0000

Appendix 3C: Unit Root test result for Q2

```
Levin-Lin-Chu unit-root test for q2
```

Ho: Panels contain unit roots	Number of panels = 9
Ha: Panels are stationary	Number of periods = 24
AR parameter: Common	Asymptotics: N/T -> 0
Panel means: Included	
Time trend: Included	

ADF regressions: 1 lag
LR variance: Bartlett kernel, 9.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-9.9958	
Adjusted t*	-2.7555	0.0029

Appendix 3D: Unit Root test result for Price of Labor (P1)

```
Levin-Lin-Chu unit-root test for p1
```

Ho: Panels contain unit roots	Number of panels = 9
Ha: Panels are stationary	Number of periods = 24
AR parameter: Common	Asymptotics: N/T -> 0
Panel means: Included	
Time trend: Included	

ADF regressions: 1 lag
LR variance: Bartlett kernel, 9.00 lags average (chosen by LLC)

	Statistic	p-value
Unadjusted t	-11.7381	
Adjusted t*	-4.9248	0.0000

Appendix 3E: Unit Root test result for Price of Capital (P2)

```
Levin-Lin-Chu unit-root test for p2
```

```
Ho: Panels contain unit roots                Number of panels  =      9
Ha: Panels are stationary                    Number of periods =     24

AR parameter: Common                         Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 9.00 lags average (chosen by LLC)
```

	Statistic	p-value
Unadjusted t	-12.2902	
Adjusted t*	-3.9835	0.0000

Appendix 3F: Unit Root test result for Price of Fund (P3)

```
Levin-Lin-Chu unit-root test for p3
```

```
Ho: Panels contain unit roots                Number of panels  =      9
Ha: Panels are stationary                    Number of periods =     24

AR parameter: Common                         Asymptotics: N/T -> 0
Panel means:  Included
Time trend:   Included

ADF regressions: 1 lag
LR variance:     Bartlett kernel, 9.00 lags average (chosen by LLC)
```

	Statistic	p-value
Unadjusted t	-19.7614	
Adjusted t*	-10.6803	0.0000

Appendix 4: Detail of Banks classification based on their asset size

Appendix 4: Detail of Banks classification based on their Asset size in different period			
Period	**Bank**	**Rank**	**Classified**
2008/09	CBE	1	Group I
	DB	2	Group I
	AIB	3	Group I
	WB	4	Group II
	BoA	5	Group II
	UB	6	Group II
	NIB	7	Group III
	CBO	8	Group III
	LIB	9	Group III
2009/10	CBE	1	Group I
	DB	2	Group I
	AIB	3	Group I
	WB	4	Group II
	BoA	5	Group II
	UB	6	Group II
	NIB	7	Group III
	CBO	8	Group III
	LIB	9	Group III
2010/11	CBE	1	Group I
	DB	2	Group I
	AIB	3	Group I
	WB	4	Group II
	UB	5	Group II
	BoA	6	Group II
	NIB	7	Group III
	CBO	8	Group III
	LIB	9	Group III

Appendix 4: Detail of Banks classification based on their Asset size in different period (Concluded)

Period	Bank	Rank	Classified
2011/12	CBE	1	Group I
	DB	2	Group I
	AIB	3	Group I
	UB	4	Group II
	WB	5	Group II
	BoA	6	Group II
	NIB	7	Group III
	CBO	8	Group III
	LIB	9	Group III
2012/13	CBE	1	Group I
	AIB	2	Group I
	DB	3	Group I
	BoA	4	Group II
	WB	5	Group II
	UB	6	Group II
	NIB	7	Group III
	CBO	8	Group III
	LIB	9	Group III
2013/14	CBE	1	Group I
	AIB	2	Group I
	DB	3	Group I
	UB	4	Group II
	BoA	5	Group II
	WB	6	Group II
	NIB	7	Group III
	CBO	8	Group III
	LIB	9	Group III

Source: Own computation based on Commercial Banks data

Appendix 5: Estimate of Cost function for all sampled Banks

Appendix 5: Estimate of Cost function for all sampled Banks				
	(2008/09 QI-2013/14 QIV)	2008/09 QI -2009/10 QIV	2010/11 QI-2011/12 QIV	2012/13 QI – 2013/14 QIV
	(Model 1)	**(Model 5)**	**(Model 9)**	**(Model 13)**
	TC	**TC**	**TC**	**TC**
q1	0.235***	0.217***	0.173***	0.201***
	(0.0309)	(0.0471)	(0.0510)	(0.0408)
q2	0.567***	0.349***	0.677***	0.704***
	(0.0330)	(0.0430)	(0.0588)	(0.0518)
p1	0.365***	0.329*		0.366***
	(0.0668)	(0.136)		(0.101)
p2	0.112***	0.224***	0.0846+	
	(0.0328)	(0.0475)	(0.0447)	
p3	0.186***	0.157**	0.318***	0.193***
	(0.0415)	(0.0567)	(0.0608)	(0.0583)
d1		0.831***		
		(0.133)		
N	216	72	72	24

Appendix 6: Estimate of Cost function for Banks in Group I

Appendix 6: Estimate of Cost function for Banks in Group I

	(2008/09 QI-2013/14 QIV)	2008/09 QI -2009/10 QIV	2010/11 QI-2011/12 QIV	2012/13 QI – 2013/14 QIV
	(Model 2)	**(Model 6)**	**(Model 10)**	**(Model 14)**
	TC	**TC**	**TC**	**TC**
q1	0.172**	0.306*	0.182+	
	(0.0650)	(0.126)	(0.103)	
q2	0.678***	0.511***	0.683***	0.927***
	(0.0748)	(0.108)	(0.130)	(0.0220)
p1	0.514***	0.531+	0.444+	0.304***
	(0.0958)	(0.273)	(0.242)	(0.0614)
p2	0.120*	0.193+	0.400***	0.0497*
	(0.0535)	(0.107)	(0.108)	(0.0238)
p3	0.116+		0.248*	0.0987**
	(0.0621)		(0.102)	(0.0361)
N	72	24	24	24

Appendix 7: Estimate of Cost function for Banks in Group II

Appendix 7: Estimate of Cost function for Banks in Group II				
	(2008/09 QI-2013/14 QIV)	2008/09 QI -2009/10 QIV	2010/11 QI-2011/12 QIV	2012/13 QI – 2013/14 QIV
	(Model 3)	**(Model 7)**	**(Model 11)**	**(Model 15)**
	TC	**TC**	**TC**	**TC**
q1				0.0603*
				(0.0297)
q2	0.323***	0.130***	0.429***	
	(0.0606)	(0.0364)	(0.104)	
p1	0.704***	0.204+	0.0366	
	(0.109)	(0.105)	(0.227)	
p2	0.251***	0.333***	0.139*	0.225***
	(0.0443)	(0.0537)	(0.0597)	(0.0279)
p3	0.270***	0.0567	0.307***	
	(0.0547)	(0.0416)	(0.0835)	
b				0.0115***
				(0.000963)
N	72	24	24	24

Appendix 8: Estimate of Cost function for Banks in Group III

Appendix 8: Estimate of Cost function for Banks in Group III				
	(2008/09 QI-2013/14 QIV)	2008/09 QI -2009/10 QIV	2010/11 QI-2011/12 QIV	2012/13 QI – 2013/14 QIV
	(Model 4)	**(Model 8)**	**(Model 12)**	**(Model 16)**
	TC	**TC**	**TC**	**TC**
q1	0.164***	0.176*	0.157*	0.206*
	(0.0440)	(0.0881)	(0.0739)	(0.0851)
q2	0.437***	0.406***	0.583***	0.395*
	(0.0487)	(0.0770)	(0.0966)	(0.183)
p1	0.295**	0.0840		0.361+
	(0.107)	(0.303)		(0.202)
p2	0.202***	0.187**		0.384+
	(0.0577)	(0.0681)		(0.223)
p3	0.190**	0.150	0.258**	
	(0.0710)	(0.124)	(0.100)	
N	72	24	24	24

Appendix 9A: Cross-sectional Interdependence (Post-estimation) test result for Random Effect model 1

```
. xtreg tc q1 q2 p1 p2 p3 , re

Random-effects GLS regression                   Number of obs      =       216
Group variable: id                              Number of groups   =         9

R-sq:  within  = 0.8421                         Obs per group: min =        24
       between = 0.9413                                        avg =      24.0
       overall = 0.8780                                        max =        24

                                                Wald chi2(5)       =   1121.13
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

tc	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
q1	.1431346	.0304479	4.70	0.000	.0834578	.2028113
q2	.3966345	.0320435	12.38	0.000	.3338304	.4594387
p1	.6256821	.0591979	10.57	0.000	.5096564	.7417078
p2	.1852122	.0278818	6.64	0.000	.1305649	.2398595
p3	.1988446	.0348128	5.71	0.000	.1306127	.2670764
_cons	.9038682	.7346904	1.23	0.219	-.5360986	2.343835
sigma_u	.13693928					
sigma_e	.2216424					
rho	.27626689	(fraction of variance due to u_i)				

```
. xtcsd, pesaran

Pesaran's test of cross sectional independence =     7.900, Pr = 0.0000
```

Appendix 9B: Cross-sectional Interdependence (Post-estimation) test result for Random Effect model 2

```
. xtreg tc q1 q2 p1 p2  d1 , re

Random-effects GLS regression                   Number of obs      =        72
Group variable: id                              Number of groups   =         3

R-sq:  within  = 0.8209                         Obs per group: min =        24
       between = 0.9993                                        avg =      24.0
       overall = 0.9468                                        max =        24

                                                Wald chi2(5)       =   1175.25
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

tc	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
q1	.0802758	.0595609	1.35	0.178	-.0364615	.197013
q2	.3294678	.0830723	3.97	0.000	.1666491	.4922865
p1	.8185381	.0918605	8.91	0.000	.6384948	.9985813
p2	.2031937	.0455854	4.46	0.000	.1138478	.2925395
d1	.8822253	.1559547	5.66	0.000	.5765596	1.187891
_cons	.6154243	1.325886	0.46	0.643	-1.983265	3.214113
sigma_u	0					
sigma_e	.23297975					
rho	0	(fraction of variance due to u_i)				

```
. xtcsd, pesaran


Pesaran's test of cross sectional independence =     1.872, Pr = 0.0612
```

Appendix 9C: Cross-sectional Interdependence (Post-estimation) test result for Random Effect model 3

```
. xtreg tc  q2 p1 p2 p3  b, re

Random-effects GLS regression                   Number of obs      =        72
Group variable: id                              Number of groups   =         3

R-sq:  within  = 0.8939                         Obs per group: min =        24
       between = 0.0349                                        avg =      24.0
       overall = 0.8701                                        max =        24

                                                Wald chi2(5)       =    442.11
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
          tc |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          q2 |   .2332879   .0458616     5.09   0.000     .1434007     .323175
          p1 |   .1831176   .1023294     1.79   0.074    -.0174443    .3836795
          p2 |   .2682026   .0326556     8.21   0.000     .2041987    .3322064
          p3 |     .09474   .0455284     2.08   0.037     .0055059     .183974
           b |   .0139893   .0017064     8.20   0.000     .0106448    .0173339
       _cons |    8.46343   1.080183     7.84   0.000      6.34631    10.58055
-------------+----------------------------------------------------------------
     sigma_u |           0
     sigma_e |  .15925036
         rho |           0   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. xtcsd, pesaran


Pesaran's test of cross sectional independence =     2.515, Pr = 0.0119
```

Appendix 10: A comparison of price of inputs between Public and Private Banks

Annex 9: Comparsion of price of inputs among Public and Private Banks in Ethiopia						
Period	Public Bank			Private Banks		
	Price of Labor	Price of Capital	Price of Fund	Price of Labor	Price of Capital	Price of Fund
2008/09	8,968.00	333,603.51	0.011	9,241.76	416,940.16	0.014
2009/10	10,542.66	1,055,033.49	0.008	10,654.28	468,749.69	0.014
2010/11	12,107.04	1,678,173.08	0.008	12,236.22	797,286.84	0.015
2011/12	14,238.29	567,867.35	0.009	14,128.01	566,558.10	0.017
2012/13	17,600.54	599,324.52	0.010	17,017.97	590,697.39	0.017
2013/14	31505.8315	774,372.31	0.011	18729.06182	614583.7832	0.018
Period	Public / Private (Ratio)					
	Price of Labor	Price of Capital	Price of Fund			
2008/09	0.97	0.800	0.757			
2009/10	0.99	2.251	0.580	If the ratio is greater than one, then public banks incur higher cost than private banks and vice versa		
2010/11	0.99	2.105	0.539			
2011/12	1.01	1.002	0.524			
2012/13	1.03	1.015	0.575			
2013/14	1.68	1.260	0.615			

Source: Own Computation based on National Bank of Ethiopia and Commercial Banks data

Appendix 11: Ratio of Total expense to Total income of Commercial Banks

(ratio are expressed in percent)

Particulars	2009/10	2010/11	2011/12	2012/13	2013/14
CBE	41.8	48.6	31.3	37.6	46.0
AIB	48.9	47.4	53.8	56.4	57.3
DB	52.5	50.7	48.2	56.1	56.3
BoA	67.6	66.7	69.5	67.4	71.6
WB	52.5	52.5	56.4	58.7	68.9
UB	51.5	63.5	51.2	66.2	73.1
NIB	49.4	50.1	51.1	57.0	64.5
CBO	71.4	64.4	53.1	56.1	52.7
LIB	56.8	68.4	55.2	54.7	65.9

Source: Own computation based on data from Commercial Banks Income Statement

Appendix 12: Constant Returns to Scale (CRS) test result for all models

Constant Returns to scale test for Model 1

```
. test (q1 + q2 = 1)

 ( 1)  q1 + q2 = 1

           chi2(  1) =   77.95
         Prob > chi2 =    0.0000
```

Constant Returns to scale test for Model 2

```
. test (q1 + q2 = 1)

 ( 1)  q1 + q2 = 1

           chi2(  1) =   15.49
         Prob > chi2 =    0.0001
```

Constant Returns to scale test for Model 3

```
. test (q2 = 1)

 ( 1)  q2 = 1

           chi2(  1) =  124.99
         Prob > chi2 =    0.0000
```

Constant Returns to scale test for Model 4

```
. test (q1 + q2 = 1)

 ( 1)  q1 + q2 = 1

           chi2(  1) =   54.82
         Prob > chi2 =    0.0000
```

Constant Returns to scale test for Model 5

```
. test (q1 + q2 = 1)

 ( 1)  q1 + q2 = 1

           chi2(  1) =  105.95
         Prob > chi2 =    0.0000
```

Constant Returns to scale test for Model 6

```
. test (q1 + q2 = 1)

 ( 1)  q1 + q2 = 1

           chi2(  1) =    6.46
         Prob > chi2 =    0.0111
```

Constant Returns to scale test for Model 7

```
. test (q2 = 1)

 ( 1)  q2 = 1

           chi2(  1) =  569.97
         Prob > chi2 =    0.0000
```

Constant Returns to scale test for Model 8

```
. test (q1 + q2 = 1)

 ( 1)  q1 + q2 = 1

           chi2(  1) =   18.92
         Prob > chi2 =    0.0000
```

Constant Returns to scale test for Model 9

```
. test (q1 + q2 = 1)

 ( 1)  q1 + q2 = 1

           chi2(  1) =   19.89
         Prob > chi2 =    0.0000
```

Constant Returns to scale test for Model 10

```
. test (q1 + q2 = 1)

 ( 1)  q1 + q2 = 1

           chi2(  1) =    3.81
         Prob > chi2 =    0.0509
```

Constant Returns to scale test for Model 11

```
. test (q2 = 1)

 ( 1)  q2 = 1

           chi2(  1) =   30.19
         Prob > chi2 =    0.0000
```

Constant Returns to scale test for Model 12

```
. test (q1 + q2 = 1)

 ( 1)  q1 + q2 = 1

           chi2(  1) =   17.96
         Prob > chi2 =    0.0000
```

Constant Returns to scale test for Model 13

```
. test (q1 + q2 = 1)

 ( 1)  q1 + q2 = 1

           chi2(  1) =    7.99
         Prob > chi2 =    0.0047
```

Constant Returns to scale test for Model 14

```
. test (q2 = 1)

 ( 1)  q2 = 1

           chi2(  1) =   10.99
         Prob > chi2 =    0.0009
```

Constant Returns to scale test for Model 15

```
. test (q1 = 1)

 ( 1)  q1 = 1

           chi2(  1) = 1001.99
         Prob > chi2 =    0.0000
```

Constant Returns to scale test for Model 16

```
. test (q1 + q2 = 1)

 ( 1)  q1 + q2 = 1

           chi2(  1) =    3.54
         Prob > chi2 =    0.0599
```

DECLARATION

I, the undersigned, declare that this is my original work and has not been presented for a degree in any other university and that all sources of materials used for the project have been duly acknowledged.

Declared by

Name: RAHEL BELAY MEKONNEN

Signature: _____

Date: _____

Confirmed by Advisor

Name:DUGASSA MULUGETA(PhD)

Signature: _____

Date:_____