UNIVERSITY OF AGDER

Is Being Big...Better?

A study of Norwegian saving banks.

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This Master's Thesis is carried out as a part of the education at the University of Agder and is therefore approved as a part of this education. However, this does not imply that the University answers for the methods that are used or the conclusions that are drawn.

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Abstract

This study examines the relationship between size and financial efficiency, existence of economies of scale in the context of Norwegian saving banking sector in the span of nine years from 2002 to 2010. The study has used longitudinal data which is secondary data in its nature and is obtained from the Norwegian saving banks association. Multiple regressions have been applied in order to find the nature and significance of relationship, and polynomial regression is used to demonstrate the curvilinear relationship. Total assets and deposits are used as a dimension of size; operating expense ratio is used as efficiency measurement.

Our results reveal that there is a complex association between size and efficiency. We observed that operating costs decrease as the size increases, but this phenomenon does not hold continuously and larger banks experience diseconomies of scale. Our findings suggest that with the increase in size the banks enjoy economies of scale, but the larger banks start experiencing diseconomies of scale, and then very large banks start experiencing economies of scale again.

Acknowledgments

We are thankful to our supervisor, Roy Mersland, whose guidance, support and encouragement from the very first day enabled us to develop an understanding of the subject. We would also like to thank our parents and friends whose help and continuous support has helped us a lot to complete our work.

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1. Background & Introduction

There has been a lot about the restructuring of the saving banks in Norway, whether the banks should be restructured in order to improve their efficiency.

The discussion going on now and later on shown by the literature is whether the banks should increase their size to increase efficiency. In other words there is a rising importance of the economies of scale in the banking sector and our study focus on the economies of scale in the Norwegian saving bank sector. The concept of economies of scale has gained importance not only in Norway but throughout the world and every business sector of the economy is looking forward to perform at its best to produce more with the limited input.

In Europe, the banks have experienced a rapid process of restructuring and immense growth. As a result the European banking sector experienced a lot of mergers and acquisitions. These mergers and acquisitions are decided while considering the factors like higher efficiency and reducing the costs through the concepts like economies of scale.

Considering the existing literature about economies of scale in European banks Allen and Rai (1996) claim that scale of economies is common only among the small European banks and large banks enjoy it at a minimum level.

Cavallo and Rossi (2001) explain the increasing size of the European banks and combined productions by them as a result of enjoying the economies of scale. They recommend the small banks to expand their level of production to experience a better cost efficiency and economies of scale. According to their research work economies of scale existed not only in smaller banks but existed in the large banks with the same magnitude. But the banks which are already too huge should focus on output mix diversification rather than the economies of scale. Economies of scale existed across all types of banks including saving banks which are our focus of study. They conclude their study while encouraging the process of mergers and acquisitions in European banking sector which can enable these banks making a better use of economies of scale.

A number of studies describing the economies of scale in the banking sector as the cost of operating a bank play an important role in the operation of a bank. But most of these studies have focused so far on the effective assessment of the costs and scope of the functions (Aly et al, 1990).

In the study for most of the commercial bank mergers the managers refer these to the achievement of the economies of scale. Thus the mergers for most of the banks justify their claim. We know that there are scale economies but it is difficult to measure these. Thus due to that fact, it is very difficult to find the precise results of a study conducted on the production process as it fails to count the factor of risk (Hughes et al, 2001).

1.1 Problem definition

The current developments in the banking sector and the recently experienced financial crisis have raised the importance of economies of scale in the banking sector. The focus of this research study is economies of scale, and it means to enjoy better efficiency with increasing size of the institution. For this study we will consider the relationship between the size and efficiency of the saving bank sector in Norway and the saving banks in general. Whether the size determines the efficiency level of the saving banks, is an important concern while many mergers are going on in the international market. Our study will lead us to determine if being big is better, if it is true then the smaller banks should merge together to achieve bigger size in order to save cost and increase profits.

1.2 Objective of the study

The objective of this study is to examine the relationship between the size of saving institutions and efficiency in the context of Norwegian saving bank sector.

The results can contribute to the debate about Norwegian saving banks, which implies whether the saving banks should increase their size in order to enjoy increasing profits and decreasing operating costs.

1.3 Limitations of the study

This study is conducted about the Norwegian saving banks and we have discussed the matter only in the context of efficiency, so the results of this study may not represent all the aspects for the saving bank sector in Norway.

In this study we have used operating expense ratio as the dependent variable and total assets as the independent variables in our study. As a result we can give recommendations about being efficient which does not necessarily mean being profitable as well.

We have used time specific data for the 9 years from 2002 to 2010.

1.4 Structure of the thesis

Chapter 1

Chapter 1 of the thesis presents an overall introduction of the paper including a short summary, the problem definition, objective and the limitations of the study.

Chapter 2

The 2nd chapter presents an introduction of the sector. It is important in the sense that it provides a detail overview of the industry.

Chapter 3

This is the theory part of the thesis; to define the theory we want to look at in order to investigate our problem. This chapter consists of theory in the form of principles and theorems, and previous studies that have been implemented that can be relevant in respect to the problem.

Chapter 4

Describes the methods we have assumed for study and why we have made some choices regard to the appraisal and data analysis.

Chapter 5

In this chapter we will analyze the collected data and we will present the findings of the work with the data set. One can find both descriptive data and regression models in this chapter.

Chapter 6

The main findings and the discussion part is in Chapter 6. We try to conclude our studies in the light of theories presented above in chapter 3.

2. Money & Banking an Overview

This chapter starts with a general overview of the banking industry and later it discusses the Norwegian Banking system. In addition this chapter attempts to introduce the very origin of money and states how it is developed into modern banking system. Thus the chapter is an overview of the banking industry in general. Our focus of the study is to investigate the existence of economies of scale in the Norwegian saving bank sector. Thus we will highlight some of the aspects of the banking sector in general and then we will discuss the theory in practice.

2.1The origin of Money and Banking

According to Smith (1776) money has become an important tool of commerce due to which goods are bought and sold in the market place

Money has always played an important role in the economic development of the society. It is used as a medium of exchange for different commodities and the members of the society agree that it has value. In the early stages as well when barter system was used for trading there was a need of a strong medium that could help in solving the minor issues occurred during the transactions through barter. Thus money not only helped to solve the complexities of trade but also to allow the producers to specialize in the production.

The roots of the banking sector are very old and can be found in the age of Goldsmiths when they used to keep people's Gold or valuable stuff for safety purpose and then later they have started to issue receipts of the deposits which was later used as money. Thus banking is not a new term in use. The modern Banks perform many functions like the safe deposits of money, advancing loans and liabilities, providing locker facilities and many more services (He et al, 2008).

Money is an important factor of the economy and it circulates freely and is used for investment purposes. On the other hand a Bank is a platform that provides the money with a proper direction and not only invests securely into different investment projects but also

advances loans and debts to the general population in a secure way (Andolfatto & Nosal, 2001).

2.2 The concept of saving

Saving refers to the phenomena where one accumulates funds or carefully invests these funds into durable goods. One can also save his income in the form of lasting goods in that regards. Saving does not greatly disagree with the concept of spending as the process of accumulation is the next step of the purchase (Watkins 1933).

But there is one type of saving that is different to spend and is the collection of money in a pocket or safe. This is called Hoarding and negates the concept of spending. Spending for personal use and in the form of easily spoiled products cannot be counted as saving. But spending in the long lasting products has a small percentage of savings (Watkins 1933).

Saving in a bank or in any other form of marketable securities is somehow different as the depositor does not himself spend that money in any other goods or services but rather an agent (in this case the holding bank) uses that money (Watkins 1933).

Saving is the process of delaying the spending of money and Hoarding that is the accumulation of cash mean to not only delay the spending of money on any of the goods but to also stop in spending in any of the enjoyment purposes (Watkins 1933).

Saving is thus a time lag between the expenditure and the satisfaction gained. If the satisfaction is gained instantly then there is no saving at all but if there is some time between the expenditure and the satisfaction received then there is a saving (Watkins 1933).

2.3 Service and cost relationship for the Banking institutions

To measure the productivity or the output of the financial institutions is important in order to measure the efficiency of these institutions. The productivity of financial institutions is difficult to measure as each bank provides a range of different services ranging from safe keeping of deposits to the modern online banking services provided by the banks now a days. But the concern of the banks now is to provide integrated services that are interlinked so that

the production costs can be reduced or in another way the service cost can be controlled (Colwell & Davis, 1992).

As the world has become more globalized over the years and the role of the financial institutions has become more important, the services provided by these institutions have taken an important place as the competition between the financial institutions and the non-financial institutions has increased. The integration between the departments in institutions such as the marketing, operations and the human resource department also plays an important role in order to achieve the high standards of customer satisfaction (Soterious & Zenios, 1999).

2.4 Commercial and Saving Banks

According the US banking act of 1971 a commercial bank is an institution that not only accepts safe deposits from the customers but also extends loans as well and with that it provides services to the last resort. Commercial bank is different from the money market mutual fund as the money market does not advance loans and different from the finance company as it does not accept demandable deposits (Rajan, 1998).

The commercial banks not only are the creator of money in the economy but also play an important role in the risk portfolio of the banks from an old view perspective and from the neo banking theory the commercial banks act as an intermediary between the Central banks and the investors of money (Gardener, Molyneux et al. 1997)

While operating in the economy the commercial banks play an important role in keeping the constant flow of money in the economy. Even though the commercial banks keep the flow of money under control there is one thing to keep in mind is that the money is not generated by itself or is not granted and the central banks keep a close eye on the money supply in the economy. Functions of commercial banks are to merge and to minimize the risk of money while acting upon the principles of economics (Gardener, Molyneux et al. 1997)

At the start of the nineteenth century “Savings banks certified under the act of 1863” started performing their functions with a great motive. In the Scottish state the banks soon were overtaken by the state and gained popularity among the members of the House of Commons.

But soon the state was not able to take proper care of these institutions Mr. Gladstone presented his idea about the post office bank (Horne, 1947).

Though the performance of the saving banks went down for a while during the evolution of the post office banks but recovered soon and gained popularity and the growth continued until the present century (Horne, 1947).

Daniel Defoe introduced the idea of saving banks. He has introduced various pension plans in which he strongly advised the poor to contribute. In case they meet any disability in the future then they are paid out of this pension fund (Horne, 1947).

At the same time there were many other plans introduced to help and support the poor like various pension plans, friendly societies and then there was a concept of introducing a locker facility having three keys assigned to three different people so that one cannot operate it solely. The funds raised were saved in that box and used when they were needed (Horne, 1947).

There were several schemes introduced during the time and one of these was the weekly contribution scheme at a national Club founded where every person aging from 21 to 30 had to contribute to the fund and then it would get the benefits back in old age. On the other hand the banking system got popularity in England as a method of saving. Thus in 1694 The Bank of England and later in 1695 Scotland bank came into formation (Horne, 1947).

Bernard was a famous name in improving the quality of life of the poor in the country. His major contributions in the development of hospital, school, and fever institution give him a credit for his attention to the poor. His major focus was on the improvement of the health facilities, education and providing employment apprentice for the poor (Horne, 1947).

According to Horne (1947, p.22) “The poor have never had a fair trial”, he wrote “Let useful and practical information be offered to them. Give them time to understand and the choice of adopting it, and I am mistaken if they do not show as much good sense on the subject as any other class of men in the kingdom”.

2.5 Establishment of Norwegian Saving Banks

Since the 19th century Norwegian banking system was based on the following features

1) Strong public sector involvement
2) Weak structure of the private institutions
3) Dependence on the foreign sources of capital

The road to the modern banking system development in Norway is further divided into several phases. From 1814 to 1895 the basic pattern was set then from 1895 to 1935 there has been an upward and a downward shift of the commercial banking. 1935-1980 regulations were set but from 1980-1990's there has been a phase of deregulation (Cassis, Cottrell et al. 1994).

After getting independence from Denmark in 1814 the establishment of the banking system was a part of the plan to set up a platform to gain stability. Keeping that perspective in mind the Bank of Norway was formed in 1816 as a semipublic central bank and had the authority to issue notes. The bank had also provided the citizens with long and short term financing and developed different branches in the country's main cities.

The idea of the saving banks in Norway started around 1820 and then around 1840's more of the similar institutions were established in different parts of the country. The idea behind the establishment was the improvement of the local community (Cassis et al, 1994).

The public sector banks gained popularity until the middle of the nineteenth century. As the public sector banks were engaged in the development of the infrastructure of the country such as the railway and the telegraph services and the other side these banks have utilized the foreign investments in a better way for the domestic needs (Cassis et al, 1994).

The roots of commercial banking in Norway started from Kristiania (Oslo) and Bergen and then in the 1860's and 70's 10 more commercial banks were founded in the main cities. But during that time period the banks acted as the servants of the society and not the masters of the business community (Cassis et al, 1994).

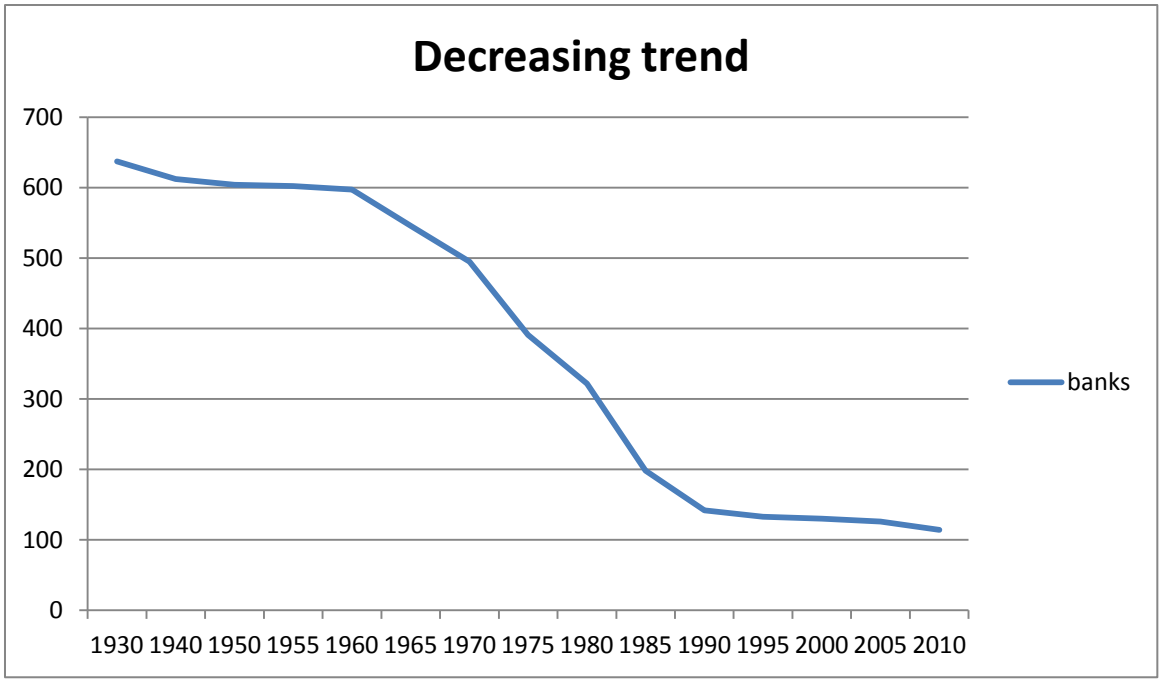
The saving banks played an important role in the second half of the century. The basic purpose of the saving banks was to accumulate deposits from the public and to buy low risk

bonds. In 1840 their operations extended and they served local business needs as well. In 1843 the Aker savings bank was formed with a basic motive to discount bills and to provide businesses with working capital. Norwegian saving banks played an important role in the development of the Norwegian banking system and then they grew faster as compared to the other commercial banks in Europe (Cassis et al, 1994).

Table 1 Decreasing trends of banks in Norway since 1930

Decreasing trend of Norwegian Banks Since 1930							
Year	*Bank*	**Year**	*Bank*	**Year**	*Bank*	**Year**	*Bank*
1930	*637*	**1951**	*604*	**1971**	*471*	**1991**	*140*
1931	*633*	**1952**	*604*	**1972**	*448*	**1992**	*134*
1932	*630*	**1953**	*604*	**1973**	*432*	**1993**	*133*
1933	*629*	**1954**	*603*	**1974**	*418*	**1994**	*132*
1934	*629*	**1955**	*602*	**1975**	*391*	**1995**	*133*
1935	*626*	**1956**	*601*	**1976**	*368*	**1996**	*133*
1936	*620*	**1957**	*599*	**1977**	*359*	**1997**	*133*
1937	*618*	**1958**	*599*	**1978**	*352*	**1998**	*133*
1938	*618*	**1959**	*599*	**1979**	*345*	**1999**	*132*
1939	*617*	**1960**	*597*	**1980**	*322*	**2000**	*130*
1940	*612*	**1961**	*593*	**1981**	*308*	**2001**	*130*
1941	*609*	**1962**	*590*	**1982**	*270*	**2002**	*129*
1942	*607*	**1963**	*586*	**1983**	*253*	**2003**	*129*
1943	*605*	**1964**	*566*	**1984**	*227*	**2004**	*128*
1944	*605*	**1965**	*546*	**1985**	*198*	**2005**	*126*
1945	*605*	**1966**	*533*	**1986**	*192*	**2006**	*126*
1946	*607*	**1967**	*527*	**1987**	*173*	**2007**	*123*
1947	*607*	**1968**	*520*	**1988**	*158*	**2008**	*123*
1948	*605*	**1969**	*510*	**1989**	*149*	**2009**	*119*
1949	*605*	**1970**	*495*	**1990**	*142*	**2010**	*114*

Source: http://www.sparebankforeningen.no/id/16941



The above table and graph show the number of banks operating in Norway since 1930. Since then there has been a major shift in the number of banks. As from the graph we can see that the banks were quite stable from the 1940's until 1962 and there has not been a major shift in terms of decline of banks but then the graph falls down and the reason for that shift is related to a large number of mergers and acquisition in the Norwegian banking industry. The data has been collected from the Norwegian saving bank association web portal and represents a big decrease in the operating banks in Norway as the number of banks in 1930 were 637 and in 2010 the number decreased to 114.

2.6 An illustration from the service industry

A study focusing the services sector in Japan including retail, financial, information and telecommunication sectors. It was observed that the Japan's firms were falling behind in terms of economies of scale and situation was resulting in lesser productivity and competiveness. According to the study it is quite evident that the Japanese firms which were quite smaller than the American service sector firms. In manufacturing sector the different is not very huge considering the number of employees. But in services sector most of the American firms are much larger than the Japanese firms and are having better productivity statistics than Japan. It clearly shows that Japanese service firms are not experiencing the benefits of economies of scale as much as American firm are doing. The author claims that

the slow metabolism and low growth of economy as compare to the American firms are interrelated with low economies of scale in the services sector (Kyoj, 2010).

A study of the insurance service sector of USA shows that insurers are expanding themselves to have the cost advantages as compared to the smaller firms. They believe that being big ensures cost advantages which are necessary to stay competitive in the global market. Economies of scale bring benefit when it increases at a lower rate than the output of the firm.

Studies specially focusing the banking industry have revealed the existence of economies of scale. There are variations among the results but that is most probably because of the difference in the time periods the studies were conducted, different data sets used in analysis, and the different methodological approaches used (Stimpert & Laux, 2011).

In a study conducted in USA which focused the commercial banks which were members of the functional cost program of Boston Federal Reserve Bank, consistent and significant existence of the economies of scale was observed (Benston, 1972).

The same study analyzed the existence of economies of scale in the savings and loan associations, six years of data was used for 3159 associations. Saving and loan associations are very specialized in their operations and offer two basic services which are real estate loans and savings accounts in general. According to the results a consistent pattern of economies of scale was found over the entire set of data which was used for the study (Benston, 1972).

Liberalization of the laws and regulations has opened a new horizon of opportunities for the commercial banking and other financial institutions. Restrictions in many countries are abolished and there are no practical obstacles in the way of interstate banking. While expanding themselves so fast, these institutions are also facing a question about their future structure. In recent times we have observed that some of them expanded and many disappeared as a result of competitive pressure. If we look at the driving forces behind the mergers and acquisitions, the most important of them is economies of scale.

According to an overview of more than a dozen of studies done on economies of scale, it is consistently found across all of them that economies of scale are found at a modest level of output. In case an institution becomes too huge, huge level of operations and output leads to diseconomies of scale (Clark, 1988).

3. Theory of economies of scale

Economies of scale refer to the decline in the long run average cost of the firm as the output increases. Average cost is the total cost invested by the business owners in the production process. But following the accounting rules generally the Dividends and the profits are not included in that cost (SMITH, 1995).

As the firms produce more and more, they just stretch the fixed input cost of the product over a larger quantity of goods produced by just decreasing the unit average cost of production. This ability of the firms to lower the cost of production and to provide services at a lower cost result in higher profits while this situation also creates some barriers to enter the market where the economies of scale are present (Bain, 1954). According to the economists, in the short run the relationship between the average total cost and the output results in a U shaped curve which indicates that the average total cost falls down over a definite range of increasing output and increase again after they reach their minimum (Besanko et al, 2004). Differentiation between short and long term is not related to a specific period of time, but due to the existence of fixed inputs. In the short term some form of input is fixed and cannot be changed easily, without excessive investment. In the long run each input variable and no fixed relationship exists (Nicholson & Snyder, 2007).

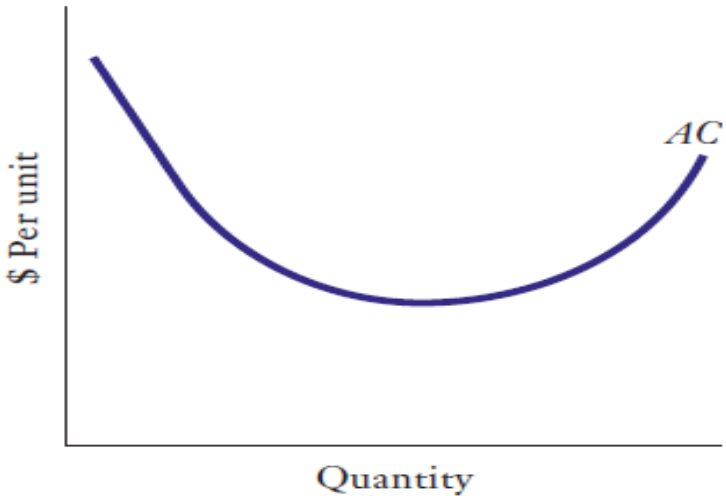


Figure: A U-SHAPED AVERAGE COST CURVE
(Besanko et al, 2004).

According to Besanko et al (2004) in case of a U-shaped average cost curve as shown in the figure above the small and the large firms as compare to the medium size firms will have a higher costs. Sometimes in the short run cycle the production process results in a U-shaped curve, as most of the firms that try to increase the output meet the capacity constraints that drive their cost higher. But it can be adjusted in the long run cycle if the firms can manage to expand their capacity by the setup of the new facilitates.

There are many benefits linked to the economies of scale and are mentioned my several factors (Schere, 1980). While the production of goods and services the firms or organizations can invest into specialized equipment like machinery and new technology that can help the firms to lower the per unit cost of production. Firms also look for the benefits associated to the efficient improvement of these resources, the efforts that can help the firms to increase the output by the efficient procedures. Achieving the economies of scale at the plant level is dependent on the size of the plant which can increase the output of the firms and thus spread the unit cost of production over a large scale of production. By increasing the output the employees also specialize in their field and thus can work efficiently (Stimpert & Laux, 2011)

3.1 Classification of economies of scale

There are two main classifications of economies of scale.

1) Internal economies of scale (InEOS)
2) External economies of scale(ExEOS)

These two terms are used differently by different authors hence the internal economies of scale occur at the firm level while the external economies of scale arise at the industry level (Junius, 1997).

InEOS exist if flexibility of costs with respect to firm yield is less than one. So that means that with an increase in the output of production the unit cost of producing that product falls because of decreasing marginal costs in production. Internal economies have several roots. Dividing the fixed cost over a large degree of manufacturing is an important root. As soon as the workers are to produce a large quantity of product they can specialize better in the production of that product rather than producing the same product in a small quantity.

In case of external economies of scale the firms benefit at the industry or the regional level. The firms share the resources like infrastructure, labor and technical spill over at the industry

level and hence benefit from it. In case of static ExEOS the firms can produce more while in case of dynamic ExEOS the firms increase the growth rate of the productivity level.

3.2 Limits to economies of scale

As most of the studies have shown that bigger is better and the economies of scale are seen in most of the industries but the term scale has another dimension that the firms cannot grow further but they can continue experiencing lowering costs. At that point increasing the firm size can lead to increasing the average costs which ultimately results in diseconomies of scale. Shepherd (1979) has illustrated a number of factors that can lead to diseconomies of scale like fixed factors, administrative and transportation costs.

Fixed factors include the managerial abilities that the managers can perform to increase the efficiency of the firms. As far as the firm size is small the managers can perform better and can control the productivity but this concept changes as the firm size increases and the firms start to experience the diseconomies (Miniter, 1998).

The bureaucracy also plays an important role in increasing the costs for the firms. As the flow of information flows from the top to the bottom there are always a flow in the information passing on which results in increasing costs for the firms. (Arrow, 1964) further explains that there is always a gap in the flow of information from the top the bottom of the hierarchy of an organization.

Then at the end the transportation costs can also lead to diseconomies of scale as the firms start to increase their size according to the geography the transportation costs increase. And as the firm's objective is to reach the customers they have to expand their supply chain which results in increasing average costs leading to diseconomies of scale (Shepherd ,1979).

As we have seen that not only the scale economies of scale exists but also there are also diseconomies of scale as well. (Canback, 2002) has used a huge data set for more than 700 US firms to prove that unit costs increase if there is gap between the information flows in the hierarchy of the company.

3.3 Scale economies and diseconomies in the banking sector

Studies have shown both economies and diseconomies of scale in the banking sector. For example, many observational studies have found that banks have a large-scale financial support. (Benston, 1972) In the data used by commercial banks and savings and loan associations, societies adapt to economies of scale in 1960, show that bigger banks enjoy cost advantages.

(Kim, 1986) In a study of economies of scale of credit unions in the UK, has analyzed the cost functions for multiproduct find that credit unions have modest economies of scale, including their mortgage and investment activities. (Clark, 1988), a detailed review and analysis of the literature available on the economies of scale in financial institutions before 1988, summarized that small businesses can be at an economic cost disadvantage relatively to large firms, more diversified banking services.

Large European banks, especially wide range of financial services, found that the major companies (Vennet, 2002), better than their competitors were more specific. A study by (Bos, 2005) found similar results in the U.S. and Europe to analyze the multi-billion dollar bank. Their results show that large banks reduce costs and increase profits scale, and they have suggested that the expansion of banks geographically is also associated with efficiency gains. Another study focusing on the production specific efficiency of financial companies, (Bossone, 2004) found the existence of economies of scale in these companies, in addition it was also concluded that a number of factors including institutional culture, the risk profile of banks and market concentration so affect real output.

The conclusion of the studies explains that the expansion of the banks will finally reach a specific point when average costs will stop declining and begin to increase.(Benston, Hanweck et al. 1982) model a trans log cost function to estimate the average cost curves U, and their analysis showed that large banks face diseconomies of scale. In similar study, (Clark, 1996) found that the average cost curve for the banks is relatively flat along with diseconomies of scale, and it is found only among the smaller banks. He summarized that the emphasis on cost reduction in large banks can lead to poor decision making and risk-taking, he also concluded that increased levels of production of large bank share generally favorable, but there is little to gain with increasing the production scale. Therefore, his study again

confirms that the minimum size can be effectively achieved relatively small size of the banks, and that the average cost curve for most banks is relatively flat.

In a survey, the Bank branch of a multi-product perspective (Gilligan, Smirlock et al. 1984) found support for the argument about the existence of economies of scale, but without any evidence of economies of in the banking sector on the basis of data in the 1978th In fact, they found the product-specific diseconomies of scale. (Berger, Hanweck et al. 1987). Similarly, small size disadvantages that exist in the banking sector.

The above written literature shows the existence of economies of scale in the banking sector. Given the mixed results from previous studies of economies of scale in the banking sector characterizes this industry and many other ways in which banking companies will continue to evolve in order to improve operational efficiency and further studies of economies of scale to improve the banking sector to exploit, with the next firm size and performance data, it seems justified.

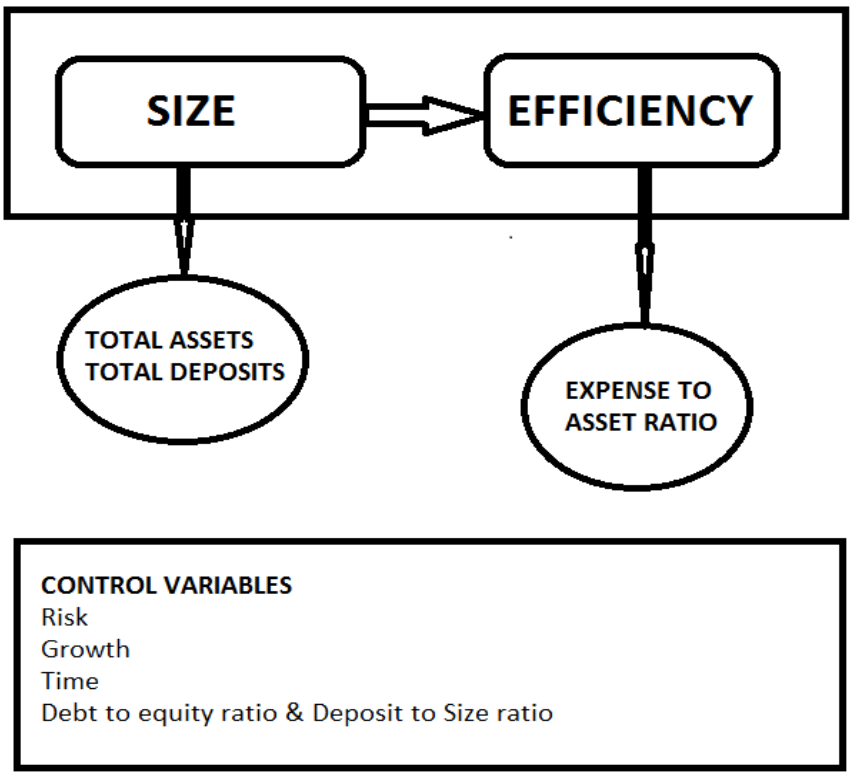
Summary of the results

Author	DATA	FINDINGS
Bain (1954)	USA	Economies of scale found with services at lower cost resulting higher profits and increased efficiency
Stimpert & Laux (2011)	USA	Economies of scale with employee specialization result in increased output and the firms operate efficiently
Junius (1997)	Germany	Workers specialization result in efficiency
Kim (1986)	USA	Existence of economies of scale
Bos (2005)	USA Europe	Economies of scale with increase efficiency found

3.4 Conceptual framework

A conceptual framework illustrates the affiliation and the type of relationships among the concepts. It also describes the relevant concepts in the study and the type of relationship between the concepts.

A theoretical framework is a conceptual model of how relationships are defined between different factors in a logical way to identify the problem. This statement flows logically from the documentation of the previous research in the problem area. But in short a theoretical framework defines the relationship between the variables that are accounted to be an important part to the change of the situation being investigated. The development of such a conceptual framework helps us in a great deal to hypothesize, testing certain relationships and to improve the understanding of the problem area (Sekaran, 2002).



Our conceptual framework basically consists of one dependent, one independent and five control variables. The dependent variable is measured in terms of efficiency of the bank and the process of measuring the efficiency of the firm is in terms of expense to asset ratio.

Efficiency of the firm = $\frac{\text{Operating expense}}{\text{Asset}}$

The independent variable used for the study is the size of a bank measured in terms of total assets and then in terms of total deposits.

Our Control variables are Risk, growth, time, debt to equity and deposit to size ratio.

Variables summary

Dependent Variable	Definitions
Size	Total assets Total deposits (as a 2nd dimension of size)
Independent Variables	
Efficiency EOA	 Operating expenses / Total assets
Control variable	
D/A D/E Risk Growth Time	Deposits / Total assets Deposits / Equity Provision for loan losses / Total assets Log of Total assets in time t / Total assets in time t-1 Dummy variables are used

3.5 Research Hypothesis

The research hypothesis explains a phenomenon or a claim that has not been proven or investigated earlier (Sekaran, 1992). In other words, a hypothesis defines a theory that has to be tested empirically. Hypotheses are developed prior to data collection as part of the research plan. A hypothesis describing the theory we want to test empirically. Based on the proposed definition of theory, literature and the problem that we have discussed earlier we can now propose a hypothesis to be studied further.

Ha0: There is positive relationship between the operating expense ratio and the size of the firm

Ha1: There is negative relationship between the operating expense ratio and the size of the firm

The relationship between size and operating expense of the firm is a very important issue for the overall industry performance, as it denotes the level of cost efficiency. For the firms to grow bigger or not is an important research question and there has been a lot of research on it. According to the studies conducted by (Y., Grabowski et al. 1990) there has been a positive relationship between the size and the efficiency of the firm, so with the increase in size the operating expense ratio decreases. As efficiency plays an important role in the determination of growth or the decline of the firms. In his model he describes a competitive industry in which all firms are maximizing their profits with the same cost function which is arched to output. The firms were thought of observing a difference in their fixed efficiency levels as compared to their earned profits over a period of time. Firm's estimates of their efficiency become more and more perfect with the passage of time and based on that observation firms decide if they have to grow, decline at exit the industry. As the cost is arched, profits increase in terms of efficiency which means that the efficient firms grow and inefficient firms decline. So the relationship between the size of the firm and the efficiency is therefore positive (Jovanovic, 1982).

The research work conducted by (Rhoades, 1998) shows that there is a strong relation between the sizes of a bank compared to its efficiency. His studies included 9 different banks and showed that with an increase in bank size that can be as a result of a merger the banks are better able to control their cost cutting objective. He found out that the largest amount of cost cutting objective was achieved by controlling the operating expenses of the bank in terms of staff reduction, data processing systems and other operational costs. Staff reduction was the major cost cut and accounted 50 % of the total cost.

In another study conducted by (Humphrey, 1990) showed a relationship between the cost and the size of the bank. His studies were focused on economies of scale in banking and he conducted his research on many different points to show how the efficiency of smaller banks is different from the larger banks. One of the factors in his research is that as the bank size increased the cost of operating the bank decreased and thus if the smaller banks wants to achieve the same cost curve as the larger banks have to increase their output. His findings for

the studies were that all banks can achieve the economies of scale but the most efficient banks can perform better than those with inefficient operations. Secondly he found out that the banks can achieve the economies of scale if they can control their total cost and a U shaped cost curve is obtained as a result of economies of scale.

Thus from the above discussion we can see that the size of the banks can help them decreasing their cost which ultimately leads to improve the efficiency of the banks and this is shown by the results later on. Now in order to observe how this relationship continues over an increase in the scale of size, two further hypotheses are made.

Hb0: There is positive relationship between the operating expense ratio and the (size^2) of the firm.

Hb1: There is negative relationship between the operating expense ratio and the (size^2) of the firm.

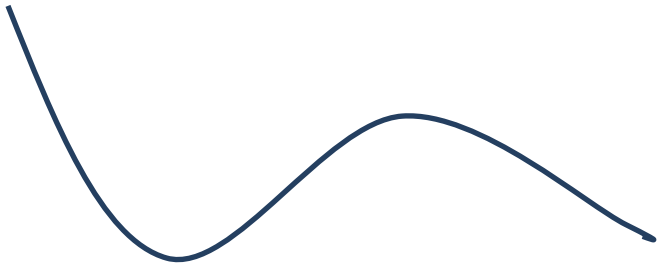
Hc0: There is positive relationship between the operating expense ratio and the (size^3) of the firm

Hc1: There is negative relationship between the operating expense ratio and the (size^3) of the firm

To observe the curvilinear relationship between size and expense ratio, over an increase in the scale of the size, these hypotheses are made. Same methodology is used by (Stimpert & Laux, 2011). Size^2 denotes the larger banks and Size^3 denotes the very large banks. To see the behavior of the dependent variable over the increasing scale of size, operating expense to asset ratio is a function of:

Operating expense ratio = *f* (size, size2, size3)

Trend of economies of scale in the long run



This graph explains the economies of scale over an increase in size in a period of time. At the start all the firms enjoy a cost advantage with an increase in size but after some time the firms no matter what size they have start experiencing diseconomies of scale. And the curve starts having an upward shift showing an increase in cost. But then the third stage is when the curve starts falling again and that is the stage when the firms again enjoy economies of scale.

4. Research Methodology

This chapter presents the type of research methodology we are going to use in this chapter. According to Uma Sekaran (1992, p. 5) "*Research is an organized, systematic, data-based, critical, objective scientific or investigation into a specific problem, undertaken with the purpose of finding answers or solutions to It*" (Uma Sekaran, 1992). So in short research provides the researchers with the basic equipment to solve a particular problem. In this chapter we are going to use the research approach, data type, research design, sample size and the data analyzing methods are included in it.

4.1 Research approach

Choosing the right approach depends on the information we need to answer questions. For this purpose, we must know what information is available and what type of information required for the procedure and find the exact solution to the problem. After we gave an overview of our data needs, and the next step is to choose the method that we use for future work. It's basically a choice between quantitative and qualitative approach (Ghauri & Grønhaug, 2010).

Choosing between the quantitative and qualitative research is not a principal but a strategic choice as one of the methods cannot be called more authentic than the other (Hair, 2007). The selection of the method is very important keeping the problem in mind and the best available resources for that type of research. Availability of data can be one of the most influential ways of selecting the quantitative or qualitative type of research. Statistical methods are used in the quantitative method of research while verbal analytical methods are used in the qualitative research (Sekaran, 1992).

In our study we are using the numbers related to the banking sector in Norway, so it is appropriate to use quantitative method. The set of data collection we have is expressed in numbers and this it is natural to use the quantitative methods.

4.2 Data Type

After the selection of the suitable research approach we have now to decide what type of data we have to use for our study. There are two types of data that are used in research methods. It is very important for the researcher to find out the type of data needed for the research in order to arrive to a satisfied result. Data that is already available in the form of company's information at its web page, published records or any other form of written information such as company's policies, procedures, rules and regulations is called the secondary data as its already available and ready to be collected. In the secondary data collection the researcher does not have to work hard to find the data for the analysis as the data somehow exists in a readymade form. On the other hand sometimes the attitudes of the employees or the customers can only be judged by talking or observing them over a period of time. Such type of data gathering that requires an effort to collect data that is not available and has to be collected by several means of data collection is called the primary data. Uma sekaran(1992, p 59). There are many advantages linked to the use of secondary data. The secondary data helps the researcher in formulating an ideal research question and formulating better hypotheses. It helps in developing better theory are compared to primary data. The secondary data makes the researcher to think more about on the theoretical aims and substantive issues rather than thinking of collecting the new data (Cowton, 1998).

As we are conducting a thorough research on the saving bank sector of Norway the data used for this study will be secondary data as it is much better than the primary data. We are going to collect the data used in this particular research from The Norwegian saving bank associations (Sparebankforeningen).

The data used in our research is secondary data and is taken from The Norwegian saving bank associations (Sparebankforeningen). As the data related to the saving banks is scattered and is very difficult to collect the data we require from other sources thus we have chosen this web portal to collect the data which gives us a very good overview for the last ten years of the Norwegian saving banks. The data provides us details of all the saving banks operations in Norway. In our case there are 114 saving banks shown by the data set available at Sparebankforeningen and with the help of this material we will analyze our research problem.

4.3 Research design

The design of a research is a platform on which the research is based on. It does not only provide research with a proper direction but also places everything in a system (Bryman & Bell, 2007). It is a master plan for our study and determines how we are going to collect and analyze data (Saunders, Lewis et al. 2007). There is not a single research design suitable for every research but there are several research approaches with some advantages and disadvantages (Hair, 2007). The main ingredients of the research design are the decisions regarding the purpose of the study, the type of investigation, the extent to which it is controlled and changed by the researcher, the time limits involved and the units of data analysis are an important parts of the research design (Sekaran, 1992).

In our study we are going to use the descriptive data and the exploratory research design. Exploratory study is carried out when we do not know much about the phenomenon to be studied and there is not much of information available of how the similar type of questions been answered in past. The study is used to better understand the problem as not much of studies been carried on the same kind of problems in past. Exploratory studies are important when some of the facts regarding the research are known and more knowledge is required in order to formulate the framework and these studies are important to have a better control over the problem to be studied and to formulate a better theoretical framework and hypothesis for the studies (Sekaran, 1992).

4.4 Sample

According to Sekaran (1992, p. 266) a sample is a part of the population and includes some of the members selected from the population. Thus some but not all the elements of the population form a sample. So we can simply say that it is part of the population and the choice for choosing a sample for the researcher is to make a fine collection of the elements from a larger population to better summarize his or her results.

Sampling on the other hand defined by Sekaran (1992, p. 266) "*The process of selecting a sufficient number of elements from the population, so that a study of the sample and an understanding of its properties or characteristics would make it possible for us to generalize*

such properties or characteristics to the population elements." Population mean, standard deviation and its variance are called its parameters. In research the purpose of selecting a sample instead of using the entire population is very clear. It is not possible to use the entire population as it can contain a huge number of elements that can take several years and cost a lot of resources to investigate the problem under consideration.

The selection of the data for our research is an important part of the research approach the data set is defined regarding the aims of the study. Sometimes the population is small enough for the researcher to include entirely in the research but if a small population is selected out of bigger data set can help in meeting the objectives of the study (Hair, 2007). The sample chosen for the research much show the characteristics of the population from which it is taken. In this thesis we are going to collect data from the available information on the Norwegian saving banks from The Norwegian saving bank associations (Sparebankforeningen).

4.5 Explanation of variables

A variable is anything that can differ or can change value. The values can change at different times for the same thing or person or at the same time for different things or persons. Examples are motivation and age that can change at different times for different persons (Sekaran, 2002). As defined by Zikmund (2010, p. 119)"A variable is anything that varies or changes from one instance to another." The opposite of a variable is a constant and a constant is the one having a fixed value or does not changes its value thus is not helpful in the research process. Different types of variables used are

1) The dependent variable
2) The independent variabe
3) Control Variables

4.5.1 Dependent Variables

A variable that is dependent on the other variables is a dependent variable. The dependent variables are represented with the letter Y. If a research involves more than one dependent variable then these are represented as Y1 and Y2 (Zikmund et al. 2010). We have taken one dependent variable to explain our case. Operating expense to asset ratio is the dependent variable that explains the efficiency of the bank.

Operating expense to asset ratio

The operating expense to asset ratio indicates the costs which are needed to operate its assets.. The saving banks' assets include cash deposits with the central bank, loans to the customers, commercial bonds, shareholdings, investments in subsidiaries and fixed assets.

In banking industry the ratio of operating expenses to total assets is a standard indicator of unit operating costs (Humphrey et al, 2006). According to their study the operating cost is divided by are used to obtain OEA ratio which thus is calculated as follows

OEA = Operating expenses / total assets

4.5.2 Independent variable

An independent variable is the one that has an effect on the dependent variable or that affects the dependent variable in some way. Such variables are independent in an impression that they are studied outside the process of being studied. The independent variables are not influenced by the dependent variables. Independent variables are represented by the letter X and if there are more than one independent variables then they are represented by X1 and X2 respectively (Zikmundet al. 2010). In our case we are using two independent variables, the Total assets and the total deposits.

Size

Size of the saving banks is measured by number of total assets. Average cost of operations changes if the size of the financial institution changes, as efficiency increases from economies of scale (Humphrey et al, 2006). Cavallo and Rossi (2001) concluded their study with the

findings that increasing size leads to better efficiency and economies of scale , in addition they recommended smaller banks to merge together and make bigger banks in order to be able to enjoy better economies of scale. Achieving biggest possible size doesn't guarantee lower costs in every case, evidence is found that in some cases bigger size can raise the average costs (Stimpert & Laux, 2011).

A study of 3159 saving and loan associations of USA found a consistent pattern of economies of scale throughout the whole set of data, increasing size led to cost saving and efficiency (Benston, 1972).

4.5.3 Control Variables

The effect of the control variables is controlled or held constant to study the pure relationship between dependent and independent variables. These are the variables which can influence the values of the independent variables and can affect the outcome of statistical experiment. Empirical research uses the control variables in order to avoid the attribution of the explanatory power to the variables which are not responsible for the variation in dependent variables (Schindler, 2001).

Risk

Risk is used as one of the control variables in this study because risk of loan losses is an important factor in saving and banking Industry. Risk is introduced as control variable in order to control the difference in impact of risk on different financial institutions (Murray & White, 1983). Risk is proxies by the value of the provision for loan losses normalized by the value of total assets.

Growth

Difference in the rate of growth for different saving banks is controlled by using the control variable GROWTH. Growth is measured as the log of the total assets in one 2010 divided by the total assets in 2009 and so on, it is added to accommodate the impact of short term disequilibrium among the institutions (Murray & White, 1983).

Time

Time is used as control variable in order to control in order to control the change in the number of saving banks over a period of time (Crespí, García-Cestona et, 2004).

Debt to Equity ratio

(Hart & Ahuja, 1996) suggest the inclusion of the debt to equity ratio to control the impact caused by the difference in the capital structure of the institutions.

4.6 Statistical methods

There are various ways available for the researcher to interpret the data he has. Choosing the right technique for the interpretation is the most important thing that will help the researcher to reach its ultimate goal. Different kinds of computer software's help the researchers to test the hypotheses in a very short period of time and the results obtained are very much reliable. So if the researcher knows exactly which methods to use and how to implement these results can be found easily (Zikmund et al 2010, p. 516). To find the relationship between the dependent and the independent variable a multiple regression analysis is used, and the coefficient β shows how much the corresponding explanatory variable Xi has an effect on the response variable Yi. Coefficient β helps in comparing different variables and acts as a standardized regression coefficient. It has a value between -1 to +1. As the larger the absolute value of β is the more relevant are the variables to explain Y. Finding out the significance level is the first step and can be done by finding by using F statistical model. In order to be statistically significant the value should be <0.05 probability that the results are random. So we want to use 5 % of significance level. The absolute value of F should be larger than the critical F-VALUE (Tabachnick & Fidell, 2007).

4.6.1 Sample size

Sample size is the choice of element from a larger population to test the results. The larger the sample size is the more accurate the results are and it's very true. By having samples of different sizes there are many statistical errors associated with these. As far as we increase the sample size it decreases the width of the confidence interval at a given confidence level (Zikmund et al 2010, p. 432). Most of the time the choice of sample size greatly depends on the availability of time and cost so there is a lot to compromise when choosing a sample size with a constraint of time and cost (Bryman & Bell, 2007).

In our study we are using the whole population that is of 114 banks in Norway. Selection of the whole population makes it a lot better for accurate results as shown by the literature above the larger the sample size the better the results of the study thus selecting the whole population for the evaluation would generate more accurate results.

4.6.2 Multicolinearity

According to Zikmund (2010, p. 588) "Multicolinearity in regression refers to how strongly interrelated the independent variables in a model are." When it is too high, the individual parameters estimation seems difficult to interpret. Most of the programs can compute variance inflation factors (VIF) for each variable and as a rule of thumb a VIF more than 5.0 indicated problems with multicolinearity. With the help of the computer software program SPSS diagnostic test for multicolinearity and tolerance value we can find the multicolinearity among the variables used for our research (Tabachnick & Fidell, 2007). In our studies we did not find any multicolinearity as we have checked all the independent variables with multicolinearity diagnostic and the tolerance level of all variables is higher than .01 and VIF is lower than 10 so we can proceed for the regression analysis.

4.6.3 Outliers

It's a value that lies outside the normal range of data. Zikmund (2010, p. 501) at a very high or low score multiple regression analysis is very sensitive to outliers and to find out the existence of outliers a scattered plot can be used (Fox, 1991). With the help of SPSS we can try to find and eliminate the outliers but the most important point here is that it can only identify the most suspicious points from a statically point of view. But these points cannot be deleted automatically (Stevens, 2009). An alternative approach can be used to find out these outliers and how these impact the results. If the results are not major then it will not matter if they are a part of the study or not but if the results of the research is alarming then we might alert the reader about the outcomes (Zikmund, Babin et al. 2010).

4.6.4 Normality

Normality is another tool used for the multiple regression analysis. We have used the normal distribution plot in our case to check the variables against normality (Stevens, 2009). For removing the non-normal distribution different methods are used like reciprocal and natural log process depending on the shape of the distribution.

In our thesis we have used the normal plot to figure out the normality of the variables. We found that the dependent variable is negatively skewed thus we used the transformation of the variables. We also applied the natural log to the dependent variable and after that the plot for the normal distribution showed the same distributed plots. Kolmogorov-Simrnov test in SPSS can also be used to test the normality. We have applied the test and the results shows the sig $p>.05$. It means variables are normally distributed after transformation.

4.6.6 Homoscedasticity

The term assumes that the standard deviation of errors is almost equal to the predicted dependent variables (Stevens, 2009) Heteroscedaticity can arise if some of the variables are skewed and some are not and the transformation of the variables may eliminate it (Field,

2009) we have found that our dependent variables were negatively skewed but they are normal after transformation.

4.7 Polynomial regression

According to Hair (2007, p. 159) a polynomial is "*the transformation of an independent variable to represent a curvilinear relationship with the dependent variable"*. By adding a squared term a single inflection point is found and further point is detected by a cubic term. Further points can also be found with the same technique. Thus the power of the first independent variable (X1) shows the linear component and the square (X2) for the same variable represents the quadratic component. Thus more complicated relationships can be evaluated with the help of these variables. In a simple regression model with a curvilinear model can be explained with the help of the following example.

$$Y_t = \alpha + b_1 x_{1,t} + b_2 x_{1,t}^2 + b_3 x_{2,t}^3 + e$$

There can be a number of nonlinear components which may be used but cubic term is the maximum power used. If there are two or more independent variables used in the regression equation a multivariate polynomial is created (Hair, 2007). In this study the equation will be

$$(\text{Operating expense ratio})_t = \alpha + \beta_1 (\text{Lnsize})_t + \beta_2 (\text{Lnsize\^2})_t + \beta_3 (\text{Lnsize\^3})_t + e$$

Note: Controlled variables include Growth, Risk, and Deposit to asset ratio, Debt to equity ratio and time.

4.8 Regression model

After going through all of the above assumptions the relationship between the dependent and the independent variable will be analyzed by the multiple regression models. The following model is used to analyze the dependent variable in our paper.

$$Y_t = \alpha + \beta_1 X_t + e$$

Considering the variables used in this study the equation will be

$$(\text{Operating expense ratio})_t = \alpha + \beta_1 (\text{Lnsize})_t + e$$

Note: Controlled variables include Growth, risk, Deposit to asset ratio, Debt to equity ratio and time.

4.9 Reliability and Validity

While conducting a research the purpose of every researcher is to get the precise results (Ghauri & Gronhaug, 2010) and this is where reliability and validity comes into mind. Validity measures the internal correctness and accuracy and externally the degree of generalization (Clark, 1988). It is impossible to reach the 100 % of the results as we are never sure of what we have to achieve or what value we want to measure. Validity is of different various forms and as mentioned above the data we have collected is from the valid and accurate resources (from the Norwegian saving bank association). Thus we have used the data available on the 114 banks in Norway to verify the results. Internal validity is very important here as we are trying to find out the cause effect relationship of a few variables (Sekaran, 1992).

Reliability on the other hand refers to the relatedness of our findings with the real situation (Hair, 2007). The data we have used is from the valid sources and is comprised of concrete numbers that is listed on the Norwegian saving bank association portal. But if some of the banks have reported incomplete or incorrect data then it might affect the reliability of the results

4.10 Robust Regression

Robustness is the ability for a statistical technique to perform better even if the other statistical assumptions are violated in one way or the other (Hair, 2007).

Robust regression is an alternative of least square regression model when some of the assumptions in the least square regression model are not fully met then robust regression is used. Some of the assumptions might be violated while statistical regression model is used and transformation process is used to confirm these variables but sometimes the

transformation process will not be able to cancel the leverage of influential outliers. Under these conditions robust regression that resists the influence of outliers may be a very good solution to use. Along with operating expense ratio as dependent variable two size dimensions are used, total assets and deposits. Statistical packages including SAS9.0, STATA7, S-PLUS6.1, E-Views, LIMDEP8 are most common methods used for the robust regression in our paper we have used STATA to analyze and eliminate the outliers (Yaffee, 2002)

5. Analysis

In this chapter, descriptive statistics are described and then bivariate regressions are applied on the available data to see the nature and strength of the relationship between the dependent and independent variables. Afterwards we have used polynomial regression to observe the polynomial trending. Polynomial trending will help us to observe the curvilinear relationship among the variables with a change in the size of predictor variables.

We will then find how significant is the relationship between size and efficiency, and how is it affected by the change in size.

5.1 Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Size (T.A)	1104	100	258861	6371.01	17184.920
Size (D)	1104	88	156569	3972.795	10247.245
EOA(expense to asset)	1104	.006	.046	.017	.0047
RISK R	1104	0	.053	.0101	.00655
D/E (debt to equity)	1104	2.711	40.741	10.028	3.38
Growth	970	.000023	.0203	.0023	.0022
D/A (deposit to asset)	1104	.0156	8.733	.77	.395
Valid N (listwise)	970				

In this chapter we use the descriptive statistics which enables us to see the minimum and maximum values of the variable. Descriptive statistics provide us the mean values of all the variables with which we can further evaluate the effects of the variables. The sample of 114 banks over a period of nine years is collected from the Saving Banks Association of Norway which includes individual balance sheets and profit and loss statements for all the banks.

The sample doesn't include the growth variable for the first t-year because the data is not available for the t-1 year. So the SPSS has excluded the missing values and the parallel values of the other variables accordingly. As a result the valid N size is 970 out of 1104.

From the descriptive statistics we can see the mean values of the size variables, total assets have a mean value of 6371.01 and deposits have a mean value of 3972.795. The pooled sample has 970 valid observations out of 1104 because growth variable can't be calculated for the first year due the limitations of data availability.

Minimum size according to the descriptive statistics is 100 million when we use total assets as measure and 88 million when we use deposits as the measure. Maximum size is 258861 million for total assets and 156569 million for the deposits.

As far as independent variable is concerned the minimum vale is .6% and maximum value is 4.6 % which is almost 8 times of the minimum value.

To check the robustness individual year data was also processed through the descriptive statistics and the tables are given in the appendix.

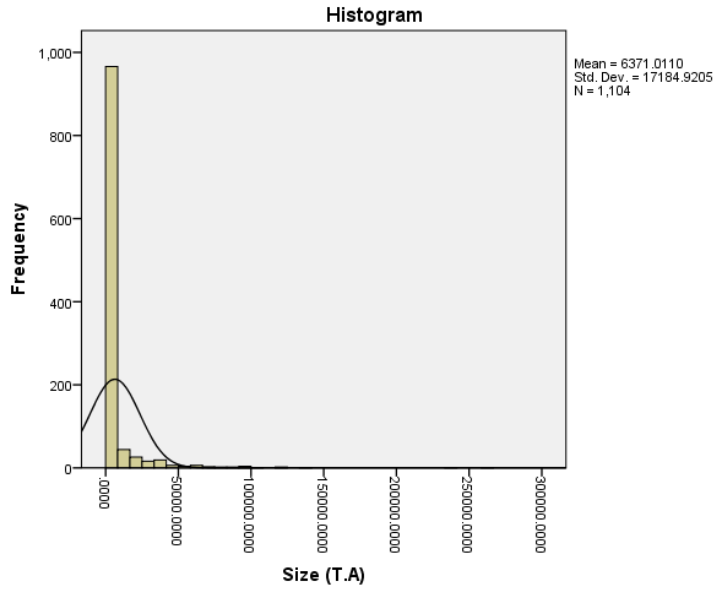
5.1.1 Independent variable, Size

Our data has the whole population for the 9 years which includes the data from very small banks to very large banks. We have not used the selective data so the histograms are not perfectly bell shaped. In addition to that considering the work which has been done in Norwegian banking sector DNB is excluded from the data.

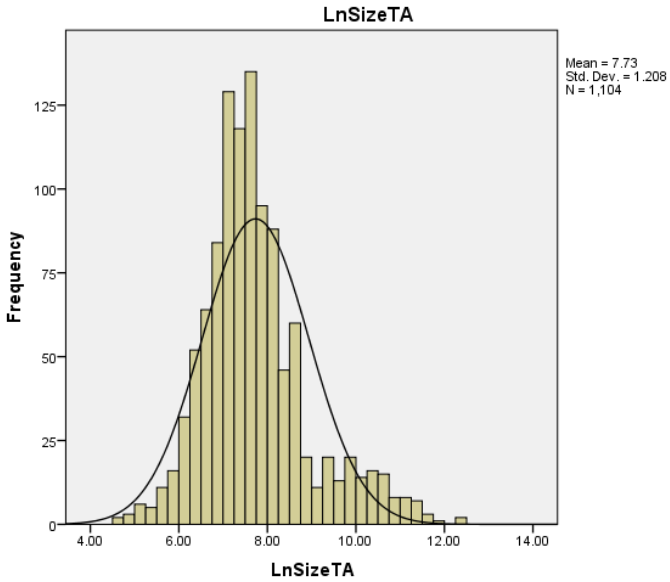
DNB was the biggest and most important outlier in the data set which has almost 40 % share of the market so it can't be treated normally. DNB has never been a traditional saving bank; it always had a huge size as a commercial bank and entered the saving banks sector through merger with some small saving banks.

We transformed the data of both the size variables by taking the natural log of the size variable.

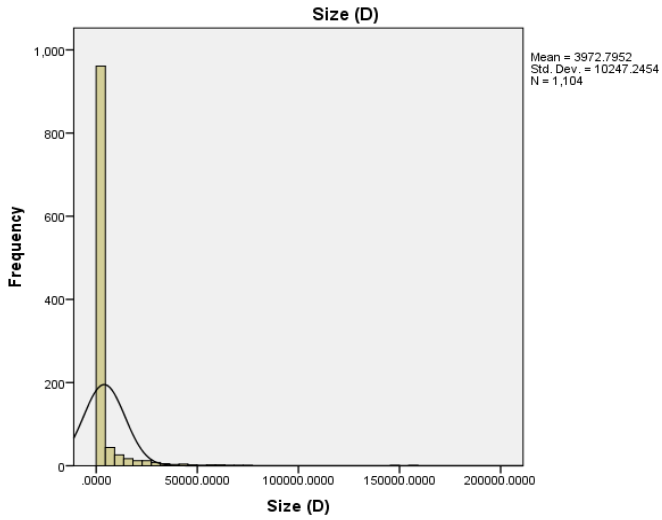
Before transformation



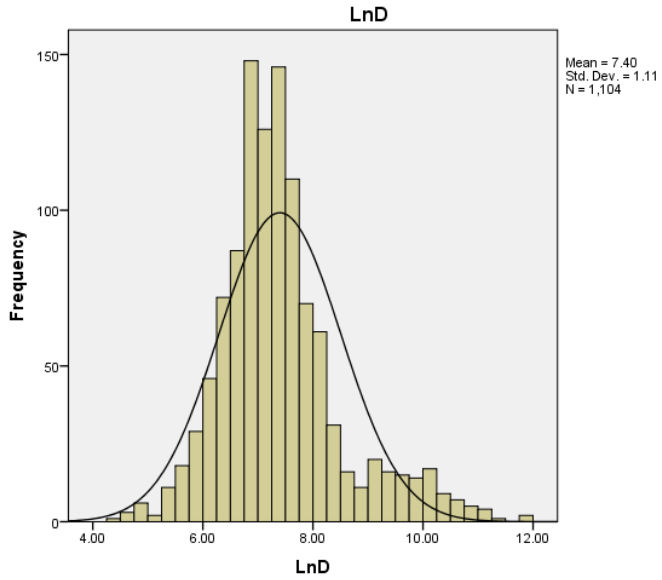
After transformation



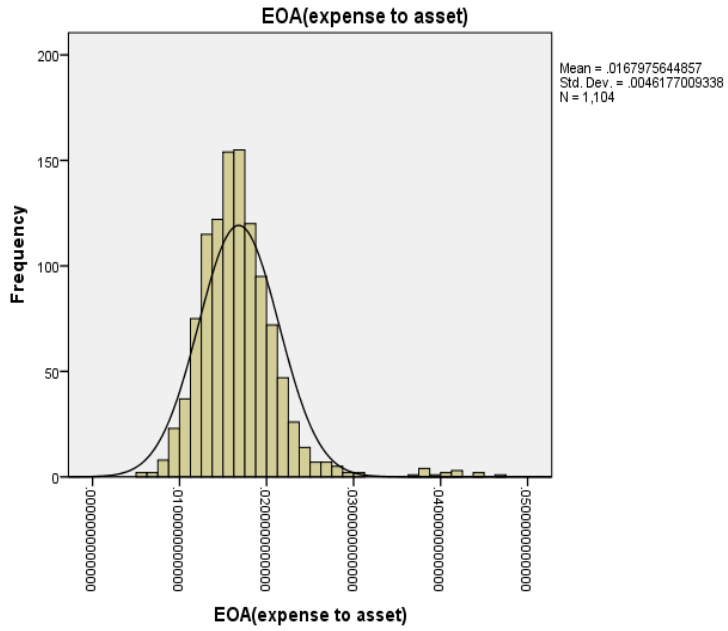
Independent variable, Deposits



After transformation



Dependent variable



The mean value of the operating expense to size ratio is .017 which means that operating expenses are 1.7 % of the average size of the saving bank. The smallest ratio is .6 % and the maximum is 4.6%. The dependent variable is not treated with any transformation.

5.2 Correlation

Correlation is the basic step towards the regression analysis because it helps us to diagnose the relationship between the variables. In addition to the existence it helps us to know the direction of the relationship. Correlation shows the intensity of the relationship between the variables as well. In the end correlation not only explains the significance of the relationship but investigates the multicolinearity as well.

One of the most commonly used tool for finding the correlation is Pearson correlation analysis. The number presented by the Pearson correlation analysis is called correlation coefficient; it ranges from -1 to +1 with zero representing no association at all. The larger the coefficient is the stronger is the level of association.

Total assets as predictor

Table 3: Correlation

		LnSizeTA	EOA(expense to asset)
LnSizeTA	Pearson Correlation	1	-.586**
	Sig. (2-tailed)		.000
	N	1104	1104
EOA(expense to asset)	Pearson Correlation	-.586**	1
	Sig. (2-tailed)	.000	
	N	1104	1104

**. Correlation is significant at the 0.01 level (2-tailed).

In table we can see the relationship between the LnSizeTA (Total assets) and the dependent variable EOA (expense to assets ratio). Relationship between these two variables is investigated by using Pearson correlation coefficient. The table shows that the predictor variable has strong relationship with dependent variable with r = -586, N=1104 at significance level of 0.01 level.

Direction of the relationship can be determined by the sign given with the value of the r, in this case it is –ve, which shows there is a strong and significant negative relationship between total assets and expense to asset ratio.

Deposits as predictor

Table 4: Correlation

		EOA(expense to asset)	LnD
EOA(expense to asset)	Pearson Correlation	1	-.529**
	Sig. (2-tailed)		.000
	N	1104	1104
LnD	Pearson Correlation	-.529**	1
	Sig. (2-tailed)	.000	
	N	1104	1104

**. Correlation is significant at the 0.01 level (2-tailed).

In this table we can see the relationship between the predictor variable LnD (Deposits) and the EOA (expense to asset ratio). Pearson correlation coefficient shows a strong relationship between the variables with r = -.529, N = 1104 which is significant at 0.01 level. The sign with the value of r shows a powerful negative association between the variables. If we compare the results of this table with previous table then we see the relationship of LnD (deposits) with EOA (expense to asset ratio) is relatively weaker as compared to the association of EOA (expense to asset ratio) with LnSizeTA(total assets).

5.3 Regression

OLS (ordinary least squares) regression is used, which is one the most sophisticated types of regression. It is employed between the dependent variable and the two size variables. Therefore two sets of regression are run to study this relationship. Analysis is performed by using SPSS regression and SPSS is used to explore the evaluations of the assumptions. Evaluation results were used to transform the variables to reduce the kurtosis, excluded the

outlier to improve normality, linearity and homoscedasticity. A natural log transformation is used for the independent variables.

There is a lag of one year so there are missing values for GROWTH which is one of the control variables. Growth rate is not available for the first year data because it is calculated for year-t by using data from year t-1. SPSS automatically excluded the missing values list wise. No suppressor variable is found. In visual inspection of the independent variables distribution was not ideally normal, so data was transformed to achieve normality. In OLS regression the study investigates two models; first model is with Total assets as predictor and second is with Deposits as predictor. In OLS regression the effect of control variables is separated and results for them are showed separately.

Table 5 Regression analysis of dependent variable (t-statistics in parenthesis, natural log has been taken of total assets and deposits)

Independent variables	**M1**	**M2**
Total assets	**-0.588**	
	-(22.598)* **	
Deposits		**-0.535**
		-(19.708)* **
Control variables		
Deposit to asset ratio	-0.019	-0.01
	(-.830)	(-19.708)
Debt to equity ratio	-0.028	-0.041
	(-1.106)	(-1.616)
Growth	0.579	0.605
	(16.539)***	(17.489)***
Risk	0.069	0.071
	(2.821)***	(2.904)***
Time	Dummy varaibles are used to control time	
Number of firms	**970**	**970**
R2	**0.286**	**0.345**
Adjusted R2	**0.286**	**0.345**
F-Statistics	388.11	510.68

***Significant at 1% level (two-tailed).
**Significant at 5% level (two-tailed).
*Significant at 10% level (two-tailed).
Standardized beta values are displayed with t-statistics provided in parentheses.

The table shows the results from the regression, the standardized regression coefficient β, adjusted R2 and value of F. In the table, after the independent variables in the first block there are control variables in the second block. Model 1 shows the significance of the relationship between the size dimension (total assets) and the dependent variable EOA (operating expense to asset ratio).Model 2 shows the significance between the deposits and the EOA. R2 of model 1 shows that the predictor variable explains 28.6 % of the effect and R2 of model 2 shows that predictor variable explains 34.5 % effect on the dependent variable.

We can see that the value of the β is significant at a level of P <.05 for model 1, in addition to that the sign is negative so there is a negative significant relationship between total assets and efficiency ratio. As we can see that R2 and adjusted R2 both are .286 for it so it confirms the significance of the predictor variable's effect.

For the model 2 β is significant at a level of P<.o5 and the negative sign shows the nature of direction, which is in opposite direction. Coefficient of determination R2 shows that predictor variable explains 34.5% of the effect; adjusted R2 is 34.5 % as well so there is a strong and significant negative relationship between dependent and independent variable in mode 2.

So with the help of correlation and regression analysis we can test our hypothesis. These diagnostics can also investigate that how strongly the independent variables in the models are contributing to the prediction of dependent variable. For testing the hypothesis, the standardized coefficient β and t value are used. We can even judge the strength of the contribution of the independent variable with the help of β beta value.

According to the values the regression model now will be

$$(\text{Operating expense ratio})_{t} = \alpha_0 - 0.588\ (\text{LnSizeT.A})_t$$

$$(\text{Operating expense ratio})_{t} = \alpha_0 - 0.535\ (\text{LnSizeD})_t$$

Size shows a negative relationship with the efficiency ratio and this is strongly significant relationship. The correlation diagnostic shows that this relationship is highly significant at a .05 level and works in the opposite direction. This result is the same as shown by Humphrey (1990) as he found out a negative relationship between the cost and the total assets of the firm. His main focus of the studies was on the economies of scale and he found out that with an increase in the firm size its total cost decreases. In another study Rhodes (1998) found out

a strong relationship between the size and efficiency of the firm. His studies included 9 different banks and showed that with an increase in bank size that can be as a result of a merger the banks are better able to control their cost cutting objective. They found a negative relationship between the size and efficiency ratio. According to the regression results the null hypothesis is rejected and alternate hypothesis is accepted which is proved in the light of literature as well. In case of Norwegian saving bank the same relationship holds a strong and significant level.

5.4 Polynomial regression

Three separate sets of regression were run to find whether the relationship between size and operating expense ratio is linear or curvilinear, including

(Operating expense ratio) $_t$ = *f* (size, size^2, size^3) $_t$

While the first set of regression tests for the linear relationship between the size and operating to expense ratio. The second and third regressions test for the existence of the curvilinear relationship between size and operating expense ratio, to observe specially whether operating expense ratio increases or decreases at an increasing rate beyond same level of scale.

Regression equations after inserting the values with total assets as independent variable

(Operating expense ratio) $_t$ = .2419 – 6.99 (LnSizeT.A)$_t$

(Operating expense ratio) $_t$ = .2419 + 10.41(LnSizeT.A^2)$_t$

(Operating expense ratio) $_t$ = .2419 – 6.88 (LnSizeT.A^3)$_t$

Regression equations after inserting values with deposits as independent variable

(Operating expense ratio) $_t$ = .2303 – 6.48 (LnSizeD)$_t$

(Operating expense ratio) $_t$ = .2303 + 9.68 (LnSizeD^2)$_t$

(Operating expense ratio) $_t$ = .2303 – 6.70 (LnSizeD^3)$_t$

Table 6: Results of Polynomial regression analysis with deposits as independent variable (t-statistics in parenthesis, natural log has been taken of deposits, deposits^2 and deposits^3)

	EOA	EOA	EOA
Intercept	0.2303	0.2303	0.2303
	(5.23)***	(5.23)***	(5.23)***
Deposits	-6.4897		
	- (5.76) ***		
(Deposits) 2		9.6896	
		(5.74)***	
(Deposits) 3			-6.7087
			- (5.46) ***
Risk	0.0889	0.0889	0.0889
	(5.37)***	(5.37)***	(5.37)***
Growth	1.732	1.732	1.732
	(11.4)***	(11.4)***	(11.4)***
Deposit/Asset	-0.0004	-0.0004	-0.0004
	-(1.50)	-(1.50)	-(1.50)
Debt/Equity	-0.00005	-0.00005	-0.00005
	-1.76	-1.76	-1.76
Time	(Dummy variables are used to control time)		
F statistics	114.87	114.87	114.87
R2	0.5448	0.5448	0.5448
Adjusted R2	0.5401	0.5401	0.5401
* p < .05			
** p < .01			
*** p < .001			

Table 7: Results of Polynomial regression analysis with Total assets as independent variable (t-statistics in parenthesis, natural log has been taken of total assets, total assets^2 and total assets^ 3)

	EOA	EOA	EOA
Intercept	0.24194	0.24194	0.24194
	(5.48)***	(5.48)***	(5.48)***
Total assets	-6.9905		
	- (6.52) ***		
(Total assets) 2		10.415	
		(6.03)***	
(Total assets) 3			-6.887
			- (5.75) ***
Risk	0.0886	0.0886	0.0886
	(5.10)***	(5.10)***	(5.10)***
Growth	0.6811	0.6811	0.6811
	(1.55)***	(1.55)***	(1.55)***
Deposit/Asset	-0.0002	-0.0002	-0.0002
	-0.97	-0.97	-0.97
Debt/Equity	-0.00004	-0.00004	-0.00004
	-1.36	-1.36	-1.36
Time	(Dummy variables are used to control time)		
F statistics	114.8	114.8	114.8
R2	0.5452	0.5452	0.5452
Adjusted R2	0.5404	0.5404	0.5404
* p < .05			
** p < .01			
*** p < .001			

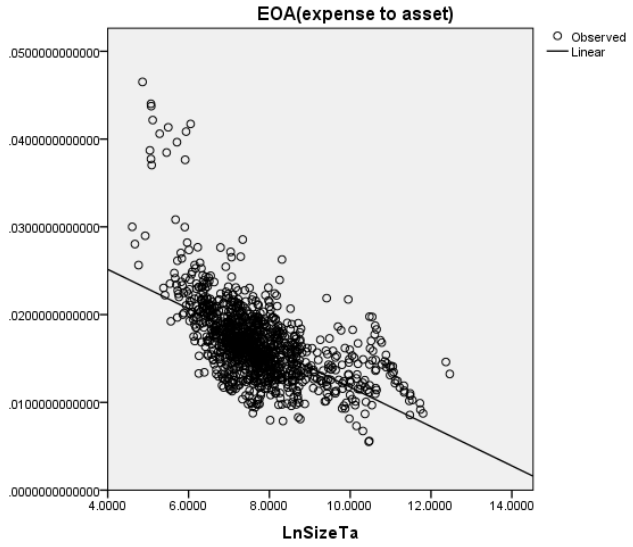
Table 5 summarizes the means, standard deviations, and correlations among the dependent and independent variables. Results of the regression analyses are shown in Tables 2 and 3. Table 6 reports the results of regression analyses using total assets as the size variable, while Table 7 reports the results of regression analyses using total deposits as the size variable.

Table 5 reports the results of the regression analysis using total assets as size variable, while table 6 shows the results of regression analysis using deposits as the size variable.

According to the summary of our results which are shown in the table 5 & 6, there is an interesting set of relationships between bank size, measured as total assets, and operating expense ratio. The table 5 shows a strong linear relationship between total assets and operating expense ratio at size 1.The nature of the relationship is negative. This shows that operating expenses decrease as size increases. If we increase the size of the banks to (Size) 2 then we that operating expense ratio increases as the banks become larger and these banks experience diseconomies of scale. But when the banks become very large banks and reach a level of (Size) 3 the operating expense ratio starts decreasing again.

Table 6 almost shows the same results while using total deposits as the size determinant, the relationship between total deposits and operating expense ratio shows that banks experience significant economies of scale at Size 1, diseconomies of scale at Size2 and economies of scale again at Size3. Following are the graphs for one of the size dimensions.

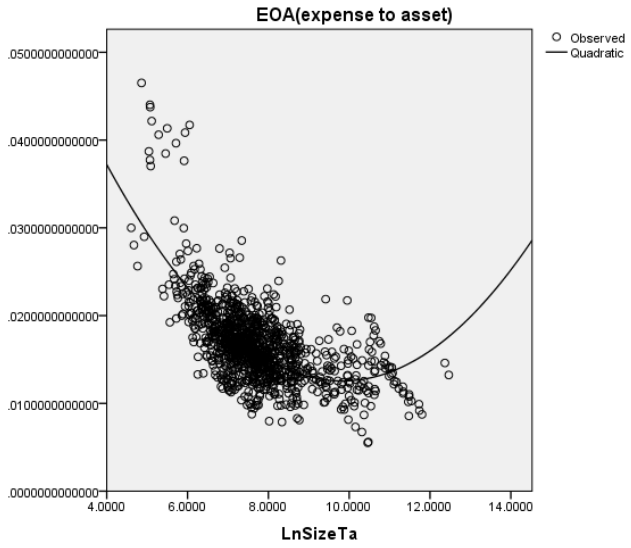
Simple linear



There is an overall trend in the data that operating expense ratio decreases over an increase in size. The detailed descriptive statistics show that the smallest banks have the highest operating expense ratio which is 3 to 4.5 %, in fact all the banks which have highest operating cost ratio are small banks having a size smaller than 400 million. A bank with 128 million

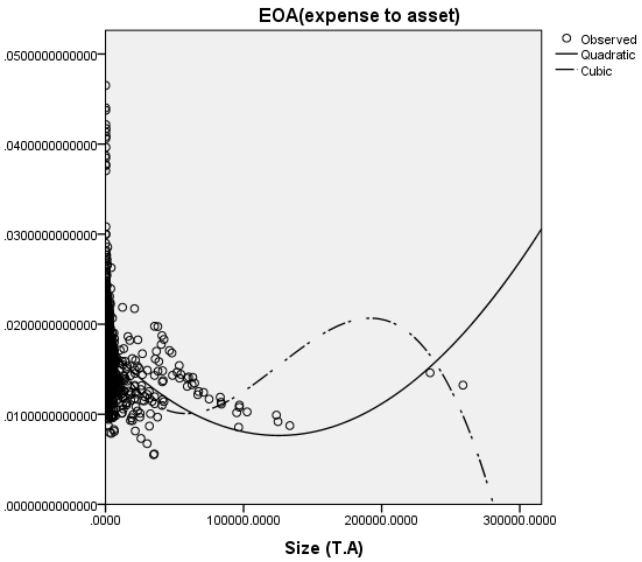
assets has the highest operating expense ratio and then operating expense ratio keeps on declining as the size increases.

Quadratic equation, (Size) 2



This equation in simple terms shows the trend for the medium sized banks. It is very interesting to observe that as compared to small banks, a bank having a size of 35000 million (Sparebanken Pluss) has an ideal operating expense ratio of 0.6 % but then this decrease in operating expense ratio does not continue and a bank having a size of almost 245,000 million(Gjenside Nor) has an operating expense ratio of 1.4%.

Cubic equation, (size) 3



Polynomial regression is used to illustrate an overall trend of the curvilinear relationship, although the cubic equation shows decline in operating costs, it's not possible to pin point an inception point or an ideal size. Another reason for not deciding the inception point with 100 % confidence is that being efficient is not the only dimension for being better. Profitability and return on equity are important factors as well.

The cubic equation illustrates that the very large banks should be good at cost saving as well. Our data set confirms this phenomenon. The statistics about the DNB is not considered in regression analysis, for the reason that it is very large as compared to the rest of the data. But DNB is the only example of huge banks in Norway, so in order to confirm the trend for the very large banks it is a good idea to consider its operating expense ratio. It is interesting to observe that this giant bank has an operating expense ratio of 0.6% the only other bank who has this impressive ratio is Sparebanken Pluss with a size of 35,000 million.

According to our findings we can't recommend an ideal size for the whole market. It is not possible to say that every bank should be bigger than a specific recommended size, but we can give recommendation to the smallest banks. In our opinion which is based on the analysis for operating expense efficiency the banks having size smaller than 400 million are on a serious cost disadvantage. These banks should seriously think about mergers to achieve a size which is better suitable. According to the data if the Cultura Sparebank which has assets of 129 million moves to size of 1000 million its operating costs can decline from 4.5 % to 2.5%. Apart from the size, the background of the bank, the area it operates in, competition and structure of market are important factors as well.

5.5 Robust checks

5.5.1 Single year regression tests

In addition to the pooled sample linear regression we ran the single year regressions as well to check the robustness of our results. SPSS is used to analyze singe year data as well. EOA (efficiency) is regressed over both the dimensions of size which were used in this study. As far as control variables are concerned in single year regressions time was not controlled. The results for every single year are significant at $p < .05$ level and showed a very strong relationship varying β value -.442 and -.597. Value of R2 and adjusted R2 were the same or

even stronger than the pooled regression. Regression for every single year confirms the results of the pooled sample regression analysis. There is a strong negative relationship between dependent and independent variables. So results support the alternate hypothesis in every single year.

The results from the single year regressions provide the robustness for our results. We found our hypothesis significant and strong throughout the data set. So the operating expense ratio decreases with the increase in size. Along with both the dimensions of the size, total assets and deposits, these results hold significantly and strongly. So the operating expenses become lower with an increase in the size of the banks.

5.5.2 Robust regression analysis

Robust regression analysis is used when there is a chance that some of the limitations for the valid results can be violated. Robustness is the ability for a statistical technique to perform better even if the other statistical assumptions are violated in one way or the other (Hair, 2007). These problems can be usually about the presence of Heteroscedaticity or the presence of outliers. We didn't have the problem of Heteroscedaticity at all but in order to make sure that our results are not contaminated with the existence of too many outliers we used the robust regression technique. We used the SPSS software for this purpose; SPSS doesn't have the direct option for the robust regression technique.

This can be done in SPSS by removing the outliers manually. We have used this technique so we removed the outliers in SPSS and ran the test, which is termed as robust because now it is free from all the data impurity problems.

Table 8: Robust Bivariate correlation diagnostics

		LnSizeTA	LnD	EOA(expense to asset)
LnSizeTA	Pearson Correlation	1	.898**	**-.525****
	Sig. (2-tailed)		.000	**.000**
	N	987	920	**954**
LnD	Pearson Correlation	.898**	1	**-.451****
	Sig. (2-tailed)	.000		**.000**
	N	920	995	**963**
EOA(expense to asset)	Pearson Correlation	-.525**	-.451**	**1**
	Sig. (2-tailed)	.000	.000	
	N	954	963	**1071**

If we compare the results of the robust bivariate correlation after the removal of the outliers it is observed that the value of beta for Predictor total assets decrease from -.586 to -.525 and the value of the predictor deposit fell down from .529 to -.451. These results are significant at $p<.05$ level as well. So even after removing all the impurities the statistics confirms the significance and strength of the negative relationship between size and efficiency (operating expense ratio.

Table 9: Robust regression diagnostics (t-statistics in parenthesis, natural log taken of total assets and deposits)

Independent variables	Model 1	Model 2
Total assets	-0.38	
	-(10.461)***	
Deposits		-0.339
		-(9.257)***
Control variables		
Deposit to asset ratio	0.145	0.189
	(3.912)***	(4.820)***
Debt to equity ratio	0.077	0.068
	(2.166)**	(1.874)**
Growth	0.32	0.348
	(4.467)***	(5.389)***
Risk	0.086	0.063
	(2.279)***	(1.704)*
Time	(Dummy variables are used to control time)	
Number of firms	650	
R2	**0.244**	**0.325**
Adjusted R2	**0.243**	**0.324**
F-Statistics	109.429	85.697

***Significant at 1% level (two-tailed).

**Significant at 5% level (two-tailed).

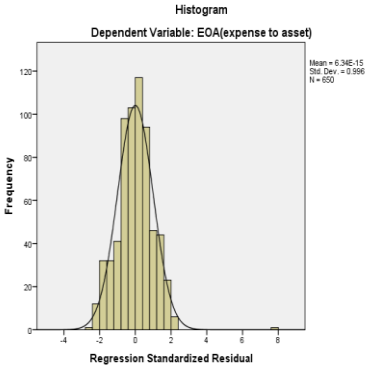
*Significant at 10% level (two-tailed).

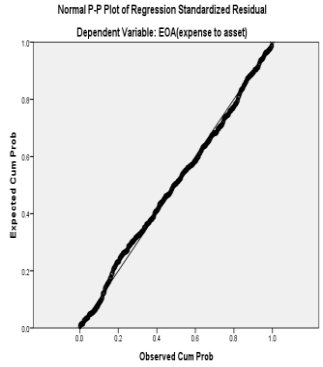
Standardized beta values are displayed with t-statistics provided in parentheses.

A robust regression is applied and SPSS is used for this purpose. Both the independent variables were transformed by taking the natural log. Robust regression was applied 1st using total assets as independent variable and then with deposits as independent variable. Table displays the results of regression, the standardized regression coefficient β, adjusted R2 and value of F.

In the first model, the results show the significance of bivariate relationship between size and efficiency. R2 = 24.4 % shows the overall model variance but the size only explain the variance that is shown in R2 change that is SR2=24.3 % which is significant at p<.05 level. In

the 2nd model SR2= 32.4% which is significant at p<.05 level as well. The robust regression showed the relationship a bit weaker than the OLS regression. Following are the histogram and Q-Q plot outputs from SPSS for robust regression.





The outcome of the robust regression supports the acceptance of alternate hypothesis as well. There isn't any major contradiction found in the previous results and the robust results. So the robust checks confirm the reliability of previous results.

6. Discussion

The purpose of our study was to examine the relationship between the size and efficiency, existence of economies of scale in the context of Norwegian saving bank sector. As there has been a debate about the restructuring of the saving banks in Norway so the results can give some recommendations as per efficiency is concerned. Since 1930 the number of saving banks has decreased from 637 to only 114 saving banks operating in the country (sparebankforeningen). We have found existence of economies of scale in literature about different banking sectors. Economies of scale have gained an importance in the banking and service sector and illustrate to produce more efficiently with minimum cost or in other words to produce more by controlling the cost (SMITH, 1995). It is the process of stretching the fixed input cost of the product over a larger quantity of goods produced This ability of the firms to lower the cost of production and to provide services at a lower cost result in higher profits while this situation also creates some barriers to enter the market where the economies of scale are present (Bain, 1954). This ability of firms to operate at a lower cost not only shows the productive efficiency of the firms but also helps as a barrier for the other firms to enter the market. In the short term the average total cost curve is a U shaped which shows that the average total cost falls down over a definite range of increasing output but then the firms experience a higher cost per output and thus diseconomies of scale are experienced. Economies of scale have many advantages such as the firms can specialize in the production of a specific product or service which leads the firms to lower cost. Economies of scale are further classified as internal and external economies of scale. In internal economies of scale with an increase in output the average production cost of the product falls while in external economies of scale the firm's benefit at industry level while sharing the resources such as labor, technology and infrastructure (Junius, 1997). The studies conducted by (Benston, 1972) on the performance of the banks in 1960 showed that the larger banks enjoyed a cost advantage over the smaller banks. (Bos, 2005) His studies suggested that large banks reduce costs and increase profits scale.

(Stimpert & Laux, 2011) found that there is a positive relationship between size and efficiency but it holds only up to a specific level of size and then it leads to diseconomies of scale. Their study also shows that very large banks enjoy economies of scale which are beyond that size which experiences diseconomies of scale. Our findings are consistent with the results of their study.

According to the statistics the Banks having a size between 100 million and 1000 million (232 banks out of 1104) have an average operating expense ratio of 2.1 %. Banks having a size between 1000 million and 2000 million (336 banks out of a population of 1104) have an average operating expense ratio of 1.7%. Banks having a size between 2000 million and 5000 million (321 banks out of 1104) have an average operating expense ratio of 1.5 %. Banks having a size between 5000 million and 10000 million (88 banks out of 1104) have an average operating expense ratio of 1.4 %. Banks having size between 10000 million and 250000 million have an average operating expense ratio of 1.2 %.

As we have stated earlier that the maximum operating expense ratio is 4.6 % and interestingly it is associated with one of the smallest banks which is Cultura Sparebank and it has a size of just 129 million. On the other hand the lowest operating expense ratio is associated with a comparatively large bank Sparebanken Pluss which has size of 35000 million and has an impressive operating expense ratio of 0.6%. But a comparatively large bank, Gjenside Nor Sparebank with size of over 245,000 million the operating expense ratio is 1.5 %, which is almost double of Sparebanken pluss. The only other bank which has such impressive operating expense ratio like Sparebanken pluss is DNB Nor with the same ratio of 0.6% but a size of almost 1,480,000 million. DNB has been excluded in regression analysis because of its very big size which deemed it as an outlier.

The statistics show that the smallest banks have the highest operating expense ratio, it is interesting to observe that all the banks having operating expense ratio between 3% to 4.5% are smaller than a size of 400 million. It shows that the banks in the slot of smallest size are on a cost disadvantage.

It is not possible for the small banks to merge overnight at a large scale and gain assets of 35000 million. But we are in a position to recommend they can at least merge to move up to the 2nd category of size which is between 1000 and 2000 million, only this shift can bring them a saving of 0.4% (1.7% as compared to 2.1 %). It is important to state that all these statistical results are focused on cost saving, it does not necessarily predict profitability as well.

If we discuss about the ideal operating expense ratio, it is enjoyed by a bank having size of 35000 million. But a larger bank with 250,000 million assets experiences an increase in operating expense ratio up to 1.5 % and then a very large bank of size more than 1,480,000 again experience a very low operating expense ratio of 0.6%. It all supports our findings that

relationship between size and operating expense ratio is curved. Cost saving increases with increase in size but at a certain size scale it decrease, but again at a very large size scale cost saving is enjoyed again.

6.1 Conclusion

The results of this study show that there is a complex relationship between firm size and efficiency. We found out that cost decreases as the bank size increases but this holds only up to a modest level of size. Findings suggest that large banks enjoy economies of scale, then larger banks start experiencing diseconomies of scale and then very large banks start experiencing economies of scale again. Our findings suggest that bigger size is not indefinitely better in terms of cost efficiency. Our results suggest that increase in size is initially related with the decline in costs, but this relationship does not hold as bank size keeps increasing. Regardless of the size measure used, our study demonstrates that saving banks experience the significant economies of scale but only up to a point. The most important implication which can be drawn from this study is that saving banks can enjoy the benefits of scale, but beyond some point diseconomies of scale are experienced.

6.2 Further research

Our findings may not be perfect for making some public policy decisions because we have focused just one aspect among many i.e. efficiency. An efficient firm may not necessarily be profitable firm as well. Further research can be done on a comparison of efficiency and profitability while size scale changes. Financial data doesn't provide information about number of employees or number of customers, so these can also be used as a dimension of size in further studies. Apart from the fact how good a bank is at saving costs, interesting research can be done on, how the equity holders are affected if the scale of size is changed. We found some evidences that smaller banks can offer a better return on equity. Studies show existence of economies and diseconomies of scale but further investigation can be done on discovering the very specific sources of both economies and diseconomies of scale.

Web Page

http://www.sparebankforeningen.no/

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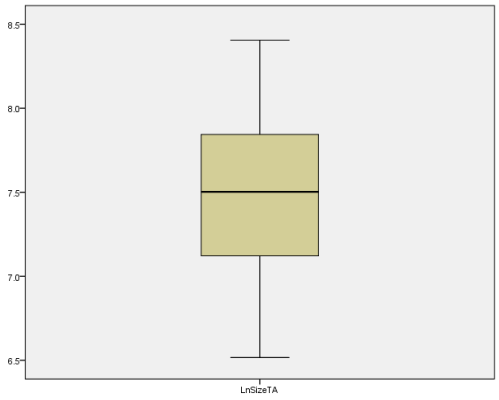
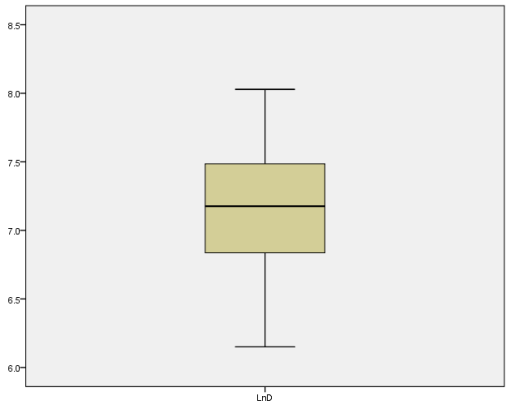
Appendix

Box plots after removing the outliers:

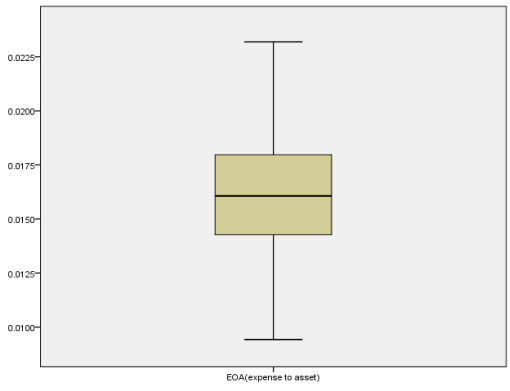
Box plot for Independent variables after removing outliers:





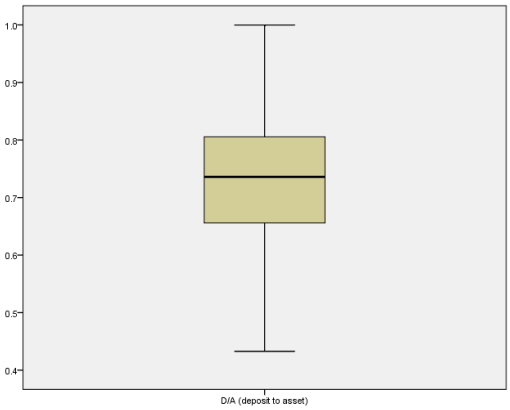
Independent variable:

Box plot of Efficiency variable after removing outliers:

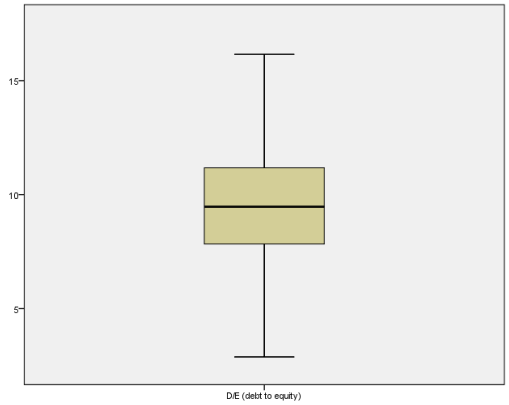


Control variables:

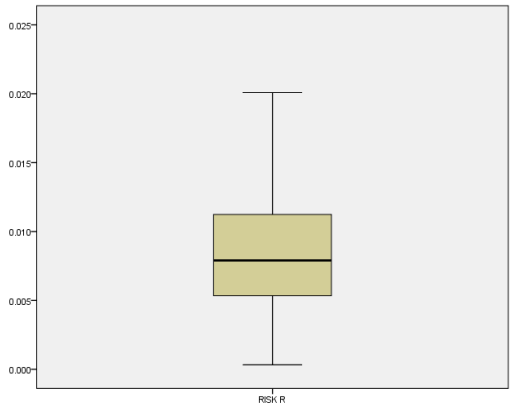
Box plot of Deposit to assets ratio after removal of outliers:



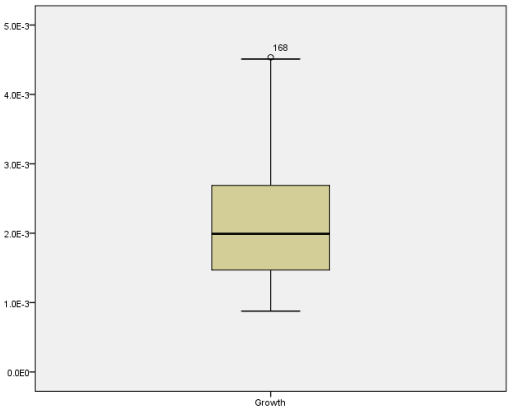
Box plot of Debt to equity ratio after removal of outliers:



Box plot of Risk after removal of outliers:



Box plot of **Growth variable after removal of outliers:**



Descriptives of whole data set:

	N	Minimum	Maximum	Mean		Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Std. Error	Statistic	Std. Error
Size (T.A)	1104	100.0000	258861.0000	6371.011050	517.2053274	17184.9204587	7.545	.074	81.461	.147
Size (D)	1104	88.0000	156569.0000	3972.795195	308.4058455	10247.2454217	7.923	.074	90.922	.147
EOA(expense to asset)	1104	.005512920828 3	.046511627907 0	.016797564485 708	.000138976466 551	.004617700933 750	1.923	.074	8.374	.147
D/A (deposit to asset)	1104	.015671498958 1	8.73333333333 33	.768997202964 971	.011882020311 919	.394797893850 664	10.154	.074	169.849	.147
RISK R	1104	.000000000000	.052859302170	.010096753113 87	.000195902227 933	.006509144485 387	1.655	.074	4.841	.147
D/E (debt to equity)	1104	2.71084337349 4	40.7409804936 99	10.0278566309 4696	.101715901447 556	3.37966293680 9973	1.317	.074	7.211	.147
Growth	970	.000023030308	.020293837777	.002329234223 59	.000070781857 089	.002204488410 975	3.131	.079	16.183	.157
Valid N (listwise)	970									

Correlation both Deposits and assets

Correlations

		Size (T.A)	Size (D)	EOA(expense to asset)	D/A (deposit to asset)	D/E (debt to equity)	RISK R	Growth
Size (T.A)	Pearson Correlation	1	.958**	**-.256****	-.137**	.416**	-.116**	-.313**
	Sig. (2-tailed)		.000	**.000**	.000	.000	.000	.000
	N	1104	1104	1104	1104	1104	1104	970
Size (D)	Pearson Correlation	.958**	1	**-.230****	-.013	.396**	-.083**	-.305**
	Sig. (2-tailed)	.000		**.000**	.678	.000	.006	.000
	N	1104	1104	1104	1104	1104	1104	970
EOA(expense to asset)	Pearson Correlation	-.256**	-.230**	1	.205**	-.261**	.321**	.704**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000
	N	1104	1104	1104	1104	1104	1104	970
D/A (deposit to asset)	Pearson Correlation	-.137**	-.013	.205**	1	-.083**	.149**	.269**
	Sig. (2-tailed)	.000	.678	.000		.006	.000	.000
	N	1104	1104	1104	1104	1104	1104	970
D/E (debt to equity)	Pearson Correlation	.416**	.396**	-.261**	-.083**	1	-.170**	-.337**
	Sig. (2-tailed)	.000	.000	.000	.006		.000	.000
	N	1104	1104	1104	1104	1104	1104	970
RISK R	Pearson Correlation	-.116**	-.083**	.321**	.149**	-.170**	1	.288**
	Sig. (2-tailed)	.000	.006	.000	.000	.000		.000
	N	1104	1104	1104	1104	1104	1104	970
Growth	Pearson Correlation	-.313**	-.305**	.704**	.269**	-.337**	.288**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
	N	970	970	970	970	970	970	970

**. Correlation is significant at the 0.01 level (2-tailed).

Regression with Total assets as predictor of EOA

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.588[a]	.345	.345	.00357916310239	.345	510.681	1	968	.000
				9					
2	.744[b]	.554	.549	.00297071872379	.209	40.739	11	957	.000
				8					

a. Predictors: (Constant), LnSizeTA

b. Predictors: (Constant), LnSizeTA, y5, y6, y7, D/A (deposit to asset), y4, RISK R, y8, y3, D/E (debt to equity), y9, Growth

c. Dependent Variable: EOA(expense to asset)

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.007	1	.007	510.681	.000[a]
	Residual	.012	968	.000		
	Total	.019	969			
2	Regression	.010	12	.001	99.118	.000[b]
	Residual	.008	957	.000		
	Total	.019	969			

a. Predictors: (Constant), LnSizeTA

b. Predictors: (Constant), LnSizeTA, y5, y6, y7, D/A (deposit to asset), y4, RISK R, y8, y3, D/E (debt to equity), y9, Growth

c. Dependent Variable: EOA(expense to asset)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.033	.001		43.942	.000		
	LnSizeTA	-.002	.000	-.588	-22.598	.000	1.000	1.000
2	(Constant)	.017	.001		13.764	.000		
	LnSizeTA	.000	.000	-.068	-1.788	.074	.318	3.146
	RISK R	.049	.017	.069	2.821	.005	.782	1.279
	D/E (debt to equity)	-3.751E-5	.000	-.028	-1.106	.269	.710	1.409
	Growth	1.162	.070	.579	16.539	.000	.380	2.635
	D/A (deposit to asset)	.000	.000	-.019	-.830	.407	.899	1.112
	y3	-.001	.000	-.063	-2.219	.027	.572	1.748
	y4	.000	.000	-.030	-1.044	.297	.567	1.765
	y5	-.001	.000	-.067	-2.287	.022	.546	1.833
	y6	-.002	.000	-.113	-3.827	.000	.538	1.860
	y7	-.002	.000	-.131	-4.470	.000	.541	1.850
	y8	-.002	.000	-.134	-4.579	.000	.540	1.850
	y9	-.003	.000	-.230	-7.777	.000	.533	1.877

a. Dependent Variable: EOA(expense to asset)

Deposits as predictors

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.535[a]	.286	.286	.00373699992222 0	.286	388.411	1	968	.000
2	.744[b]	.553	.547	.00297470069047 1	.267	51.881	11	957	.000

a. Predictors: (Constant), LnD

b. Predictors: (Constant), LnD, y5, D/A (deposit to asset), y6, y7, y4, RISK R, y8, D/E (debt to equity), y3, y9, Growth

c. Dependent Variable: EOA(expense to asset)

ANOVA[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.005	1	.005	388.411	.000[a]
	Residual	.014	968	.000		
	Total	.019	969			
2	Regression	.010	12	.001	98.640	.000[b]
	Residual	.008	957	.000		
	Total	.019	969			

a. Predictors: (Constant), LnD

b. Predictors: (Constant), LnD, y5, D/A (deposit to asset), y6, y7, y4, RISK R, y8, D/E (debt to equity), y3, y9, Growth

c. Dependent Variable: EOA(expense to asset)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.033	.001		39.312	.000		
	LnD	-.002	.000	-.535	-19.708	.000	1.000	1.000
2	(Constant)	.016	.001		13.766	.000		
	LnD	.000	.000	-.028	-.792	.428	.370	2.703
	RISK R	.051	.017	.071	2.904	.004	.784	1.276
	D/E (debt to equity)	-5.362E-5	.000	-.041	-1.616	.106	.743	1.345
	Growth	1.213	.069	.605	17.489	.000	.390	2.561
	D/A (deposit to asset)	.000	.000	-.010	-.404	.686	.843	1.186
	y3	-.001	.000	-.062	-2.184	.029	.572	1.747
	y4	.000	.000	-.029	-1.011	.312	.567	1.765
	y5	-.001	.000	-.065	-2.237	.026	.546	1.831
	y6	-.001	.000	-.112	-3.784	.000	.538	1.859
	y7	-.002	.000	-.130	-4.429	.000	.541	1.849
	y8	-.002	.000	-.134	-4.545	.000	.540	1.850
	y9	-.003	.000	-.229	-7.740	.000	.532	1.879

a. Dependent Variable: EOA(expense to asset)

Single year regression coefficients

2002

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.035	.002		15.082	.000		
	LnSizeTA	-.002	.000	-.504	-6.571	.000	1.000	1.000
2	(Constant)	.034	.003		13.133	.000		
	LnSizeTA	-.002	.000	-.596	-7.300	.000	.847	1.180
	RISK R	.019	.053	.027	.352	.725	.983	1.017
	D/E (debt to equity)	.000	.000	.235	2.883	.005	.845	1.183
	D/A (deposit to asset)	.000	.001	-.013	-.173	.863	.987	1.013

a. Dependent Variable: EOA(expense to asset)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.034	.002		14.863	.000		
	LnD	-.002	.000	-.488	-6.306	.000	1.000	1.000
2	(Constant)	.032	.002		13.284	.000		
	LnD	-.002	.000	-.598	-7.191	.000	.823	1.214
	RISK R	.016	.053	.023	.300	.765	.984	1.016
	D/E (debt to equity)	.000	.000	.228	2.791	.006	.851	1.176
	D/A (deposit to asset)	.002	.001	.120	1.554	.123	.953	1.049

a. Dependent Variable: EOA(expense to asset)

2003

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.032	.002		16.049	.000		
	LnSizeTA	-.002	.000	-.510	-6.628	.000	1.000	1.000
2	(Constant)	.013	.003		3.836	.000		
	LnSizeTA	.000	.000	.132	1.078	.283	.281	3.558
	RISK R	.064	.041	.106	1.565	.120	.909	1.100
	D/E (debt to equity)	.000	.000	-.075	-.915	.362	.622	1.608
	Growth	1.087	.148	.769	7.365	.000	.384	2.604
	D/A (deposit to asset)	.000	.000	-.068	-1.002	.318	.917	1.091

a. Dependent Variable: EOA(expense to asset)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.031	.002		14.477	.000		
	LnD	-.002	.000	-.455	-5.719	.000	1.000	1.000
2	(Constant)	.012	.003		3.856	.000		
	LnD	.001	.000	.171	1.556	.122	.342	2.924
	RISK R	.063	.041	.104	1.558	.122	.927	1.078
	D/E (debt to equity)	.000	.000	-.082	-1.063	.290	.693	1.443
	Growth	1.128	.142	.798	7.950	.000	.411	2.430
	D/A (deposit to asset)	-.001	.000	-.120	-1.641	.103	.781	1.280

a. Dependent Variable: EOA(expense to asset)

2004

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.034	.002		21.907	.000		
	LnSizeTA	-.002	.000	-.551	-10.426	.000	1.000	1.000
2	(Constant)	.014	.003		4.975	.000		
	LnSizeTA	7.547E-5	.000	.020	.230	.818	.281	3.562
	RISK R	.052	.034	.072	1.519	.130	.918	1.089
	D/E (debt to equity)	-3.522E-5	.000	-.024	-.431	.667	.666	1.502
	Growth	1.130	.124	.692	9.091	.000	.356	2.806
	D/A (deposit to asset)	.000	.001	.008	.179	.858	.918	1.089

a. Dependent Variable: EOA(expense to asset)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.034	.002		21.131	.000		
	LnD	-.002	.000	-.537	-10.043	.000	1.000	1.000
2	(Constant)	.013	.002		5.385	.000		
	LnD	.000	.000	.028	.344	.731	.304	3.292
	RISK R	.052	.034	.072	1.519	.130	.918	1.089
	D/E (debt to equity)	-3.941E-5	.000	-.027	-.487	.627	.677	1.476
	Growth	1.141	.124	.699	9.186	.000	.357	2.803
	D/A (deposit to asset)	8.996E-5	.001	.004	.087	.931	.915	1.093

a. Dependent Variable: EOA(expense to asset)

2005

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.036	.002		16.105	.000		
	LnSizeTA	-.002	.000	-.594	-8.186	.000	1.000	1.000
2	(Constant)	.014	.004		3.627	.000		
	LnSizeTA	6.758E-5	.000	.017	.144	.886	.271	3.689
	RISK R	.039	.054	.046	.713	.477	.896	1.116
	D/E (debt to equity)	-8.817E-5	.000	-.057	-.734	.465	.627	1.595
	Growth	1.296	.181	.731	7.161	.000	.358	2.793
	D/A (deposit to asset)	.000	.001	.008	.131	.896	.917	1.090

a. Dependent Variable: EOA(expense to asset)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.036	.002		15.448	.000		
	LnD	-.003	.000	-.580	-7.889	.000	1.000	1.000
2	(Constant)	.014	.004		3.862	.000		
	LnD	.000	.000	.026	.227	.821	.296	3.381
	RISK R	.039	.054	.046	.716	.476	.896	1.116
	D/E (debt to equity)	-9.266E-5	.000	-.059	-.784	.435	.648	1.544
	Growth	1.308	.181	.737	7.241	.000	.360	2.781
	D/A (deposit to asset)	8.550E-5	.001	.004	.068	.946	.924	1.082

a. Dependent Variable: EOA(expense to asset)

2006

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.034	.002		16.821	.000		
	LnSizeTA	-.002	.000	-.618	-8.648	.000	1.000	1.000
2	(Constant)	.008	.004		1.767	.080		
	LnSizeTA	.000	.000	.115	.853	.395	.205	4.879
	RISK R	.062	.054	.075	1.140	.257	.850	1.177
	D/E (debt to equity)	-7.269E-5	.000	-.059	-.739	.461	.581	1.720
	Growth	1.658	.265	.725	6.249	.000	.275	3.634
	D/A (deposit to asset)	.003	.002	.122	1.622	.107	.654	1.529

a. Dependent Variable: EOA(expense to asset)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.035	.002		15.150	.000		
	LnD	-.002	.000	-.583	-7.894	.000	1.000	1.000
2	(Constant)	.009	.004		2.294	.024		
	LnD	.000	.001	.086	.713	.477	.254	3.933
	RISK R	.063	.054	.076	1.153	.251	.850	1.176
	D/E (debt to equity)	-6.435E-5	.000	-.052	-.660	.511	.593	1.686
	Growth	1.637	.274	.716	5.975	.000	.258	3.870
	D/A (deposit to asset)	.002	.002	.095	1.260	.210	.658	1.521

a. Dependent Variable: EOA(expense to asset)

2007

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.032	.002		15.916	.000		
	LnSizeTA	-.002	.000	-.597	-8.117	.000	1.000	1.000
2	(Constant)	.012	.004		3.144	.002		
	LnSizeTA	-8.797E-5	.000	-.026	-.204	.839	.263	3.808
	RISK R	-.004	.043	-.006	-.087	.931	.943	1.060
	D/E (debt to equity)	2.858E-5	.000	.023	.292	.771	.663	1.509
	Growth	1.594	.263	.697	6.071	.000	.319	3.131
	D/A (deposit to asset)	.001	.001	.053	.777	.439	.896	1.116

a. Dependent Variable: EOA(expense to asset)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.032	.002		14.827	.000		
	LnD	-.002	.000	-.571	-7.596	.000	1.000	1.000
2	(Constant)	.012	.004		3.289	.001		
	LnD	-4.333E-5	.000	-.011	-.095	.924	.291	3.442
	RISK R	-.004	.043	-.006	-.093	.926	.944	1.059
	D/E (debt to equity)	2.410E-5	.000	.020	.250	.803	.681	1.468
	Growth	1.616	.265	.706	6.096	.000	.314	3.188
	D/A (deposit to asset)	.001	.001	.058	.857	.393	.904	1.106

a. Dependent Variable: EOA(expense to asset)

2008

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.031	.002		15.419	.000		
	LnSizeTA	-.002	.000	-.594	-7.951	.000	1.000	1.000
2	(Constant)	.013	.004		3.697	.000		
	LnSizeTA	.000	.000	-.033	-.264	.792	.287	3.486
	RISK R	.071	.066	.077	1.083	.281	.857	1.167
	D/E (debt to equity)	-3.658E-5	.000	-.031	-.400	.690	.721	1.386
	Growth	1.692	.300	.677	5.649	.000	.302	3.310
	D/A (deposit to asset)	-.001	.001	-.101	-1.417	.159	.859	1.164

a. Dependent Variable: EOA(expense to asset)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.031	.002		13.904	.000		
	LnD	-.002	.000	-.548	-7.047	.000	1.000	1.000
2	(Constant)	.013	.003		4.102	.000		
	LnD	-7.318E-5	.000	-.020	-.182	.856	.367	2.726
	RISK R	.071	.066	.077	1.084	.281	.851	1.176
	D/E (debt to equity)	-4.024E-5	.000	-.034	-.449	.654	.753	1.328
	Growth	1.713	.290	.685	5.906	.000	.322	3.102
	D/A (deposit to asset)	-.001	.001	-.093	-1.200	.233	.715	1.398

a. Dependent Variable: EOA(expense to asset)

2009

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.030	.002		15.031	.000		
	LnSizeTA	-.002	.000	-.582	-7.680	.000	1.000	1.000
2	(Constant)	.011	.004		3.267	.001		
	LnSizeTA	5.872E-5	.000	.018	.149	.882	.293	3.410
	RISK R	.070	.064	.076	1.099	.274	.904	1.106
	D/E (debt to equity)	-3.625E-5	.000	-.030	-.404	.687	.763	1.310
	Growth	1.990	.332	.726	5.997	.000	.294	3.406
	D/A (deposit to asset)	-.001	.001	-.078	-1.098	.274	.863	1.159

a. Dependent Variable: EOA(expense to asset)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.029	.002		13.423	.000		
	LnD	-.002	.000	-.520	-6.524	.000	1.000	1.000
2	(Constant)	.012	.003		3.897	.000		
	LnD	4.666E-5	.000	.013	.127	.899	.388	2.580
	RISK R	.070	.063	.076	1.108	.270	.908	1.101
	D/E (debt to equity)	-3.484E-5	.000	-.029	-.395	.693	.792	1.262
	Growth	1.980	.309	.722	6.406	.000	.338	2.957
	D/A (deposit to asset)	-.001	.001	-.082	-1.056	.293	.715	1.398

a. Dependent Variable: EOA(expense to asset)

2010

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.027	.002		12.450	.000		
	LnSizeTA	-.002	.000	-.512	-6.276	.000	1.000	1.000
2	(Constant)	.002	.004		.604	.547		
	LnSizeTA	.001	.000	.168	1.386	.169	.318	3.141
	D/E (debt to equity)	3.373E-5	.000	.038	.516	.607	.853	1.172
	Growth	2.178	.342	.756	6.369	.000	.331	3.024
	D/A (deposit to asset)	.005	.002	.193	2.560	.012	.823	1.216

a. Dependent Variable: EOA(expense to asset)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.025	.002		11.184	.000		
	LnD	-.001	.000	-.442	-5.185	.000	1.000	1.000
2	(Constant)	-.005	.006		-.864	.390		
	LnD	-.004	.002	-1.094	-1.690	.094	.011	91.491
	D/E (debt to equity)	2.096E-5	.000	.024	.321	.749	.842	1.188
	Growth	2.139	.340	.742	6.292	.000	.329	3.038
	LnSizeTA	.004	.002	1.342	1.903	.060	.009	108.635
	D/A (deposit to asset)	.013	.005	.535	2.478	.015	.098	10.179

a. Dependent Variable: EOA(expense to asset)

Polynomial

Source	SS	df	MS	Number of obs =	970
				F(10, 959) =	114.79
Model	.010320483	10	.001032048	Prob > F =	0.0000
Residual	.008622027	959	8.9906e-06	R-squared =	0.5448
				Adj R-squared =	0.5401
Total	.01894251	969	.000019549	Root MSE =	.003

var17	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ILnD__1	-648.9752	112.6724	-5.76	0.000	-870.0881	-427.8624
ILnD__2	968.9699	168.6857	5.74	0.000	637.9341	1300.006
ILnD__3	-670.8774	122.817	-5.46	0.000	-911.8985	-429.8563
ILnDa_1	-6.707438	1.381669	-4.85	0.000	-9.418882	-3.995994
ILnD2__1	.3580174	.0769339	4.65	0.000	.2070392	.5089956
ILnD3__1	-.0076042	.001706	-4.46	0.000	-.0109521	-.0042563
IRISK__1	.0889845	.016569	5.37	0.000	.0564689	.1215002
IGrow__1	1.7321	.1511757	11.46	0.000	1.435427	2.028774
Ivar1__1	-.0004713	.0003148	-1.50	0.135	-.0010891	.0001464
Ivar2__1	-.0000592	.0000337	-1.76	0.079	-.0001252	6.88e-06
_cons	.2303085	.0439996	5.23	0.000	.1439619	.3166552

Deviance: -8529.07. Best powers of LnD among 164 models fit: -2 -2 -2.

Source	SS	df	MS	Number of obs =	970
				F(10, 959) =	114.96
Model	.010327228	10	.001032723	Prob > F =	0.0000
Residual	.008615282	959	8.9836e-06	R-squared =	0.5452
				Adj R-squared =	0.5404
Total	.01894251	969	.000019549	Root MSE =	.003

var17	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ILnSi__1	-699.0523	115.625	-6.05	0.000	-925.9595	-472.1451
ILnSi__2	1041.586	172.8385	6.03	0.000	702.4008	1380.771
ILnSi__3	-688.7207	119.7447	-5.75	0.000	-923.7126	-453.7288
ILnSia_1	-6.18585	1.20938	-5.11	0.000	-8.559187	-3.812514
ILnSib_1	.3183767	.0649124	4.90	0.000	.19099	.4457634
ILnSic_1	-.0065207	.0013871	-4.70	0.000	-.0092428	-.0037985
IRISK__1	.0856222	.0167837	5.10	0.000	.0526853	.1185592
IGrow__1	.6811825	.4384985	1.55	0.121	-.1793448	1.54171
Ivar1__1	-.0002468	.0002538	-0.97	0.331	-.0007449	.0002512
Ivar2__1	-.0000465	.0000343	-1.36	0.176	-.0001137	.0000208
_cons	.2419408	.0441379	5.48	0.000	.1553228	.3285587

Deviance: -8529.83. Best powers of LnSizeTa among 164 models fit: -2 -2 -2.