ECONOMIES OF SCALE IN INDIAN COMMERCIAL BANKS (1973 - 1996)

BY

V. SAILAKSHMI

A THESIS SUBMITTED TO THE AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND HIGHER EDUCATION FOR WOMEN (DEEMED UNIVERSITY), COIMBATORE - 641 043, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY IN ECONOMICS

APRIL 2003

DECLARATION

I hereby declare that the matter embodied in the thesis entitled **"ECONOMIES OF SCALE IN INDIAN COMMERCIAL BANKS (1973-1996)"** is the result of investigation carried out by me in the Department of Economics, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore, under the Supervision of **Dr. (Tmt). R.ANNAPOORANI**, M.A., Dip. Ed., M.Phil. (Madras), Ph.D. (Avinashilingam), Reader, Department of Economics, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore, and it has not been submitted for the award of any Degree / Diploma / Associateship / Fellowship of any other University or Institute.

R. Annapoorani 15/4/2003
Signature of the Supervisor

Sevilakshmi. V 15/4/03
Signature of the Candidate

CERTIFICATE

This is to certify that the thesis entitled **"ECONOMIES OF SCALE IN INDIAN COMMERCIAL BANKS (1973-1996)"** submitted to the Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore – 641043, for the award of the Degree of **DOCTOR OF PHILOSOPHY IN ECONOMICS**, is a record of original research work done by **TMT.V.SAILAKSHMI**, M.A., M.Phil., during the period of the study in the Department of Economics, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore, under my supervision and guidance and the thesis has not formed the basis for the award of any Degree / Diploma / Associateship / Fellowship or similar title of any candidate of any University.

R. Annapoorani 15/4/2003

Signature of the Guide

ACKNOWLEDGEMENT

ACKNOWLEDGEMENT

The investigator expresses her reverential and sincere gratitude to Hon Colonel ***Tmt. RAJAMMAL. P. DEVADAS,*** *M.A., M.Sc., Ph.D. (Ohio State) D.Sc, (Madras), Hon.D.H.L. (Oregon State), Hon.D.H.L. (Ohio State), Hon. D.Sc., (C Azad, Agri University, Kanpur), Hon. D.Sc., (University of Ulster, Northern Ireland), Former Chancellor, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore, for her constant motivation and heavenly blessings without which the accomplishment of the study would not have been possible.*

The investigator wishes to place on record her sincere thanks to ***Dr. K. KULANDAIVEL,*** *M.A., M.A (Ohio State), Ph.D (Madras), Chancellor, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore, for providing the timely help and encouragement towards the completion of the study.*

The investigator records her thanks to ***Dr. (Tmt) M. CHANDRAMANI,*** *M.Sc, (Baroda), M.Ed., Ph.D, (Madras), Vice Chancellor, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore, for the encouragement given to carry out the research work.*

The investigator expresses her heartfelt gratitude to ***Dr. (Tmt) SAROJA PRABHAKARAN,*** *M.A., Dip, in Ed., Ph.D., (Mother Teresa), Registrar, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore, for the amenities provided during the course of this investigation.*

The investigator places her deep felt thanks to ***Dr. (Tmt) G.RAMATHILAGAM,*** *M.A., M.Phil., Dip.Ed (Madras), Ph.D (Bharathiar University), Professor and Head of the Department of Economics, Avinashilingam Institute for Home Science and Higher*

Education for Women (Deemed University), Coimbatore, for her dynamic, inspiring and meticulous encouragement given throughout the course of the study and for the valuable suggestions given for the successful completion of the study.

With immense sense of gratitude, the investigator wishes to record her sincere thanks to her guide **Dr. (Tmt) R. ANNAPOORANI,** *M.A., Dip. Ed., M.Phil. (Madras), Ph.D. (Avinashilingam), Reader, Department of Economics, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University), Coimbatore, for her advice, valuable discussions and help at every stage of the study without which the conduct of the study would not have been possible.*

The investigator expresses her deep sense of gratitude to **Dr. N.Jaganathan,** *M.A., M.Ed., M.Phil., Ph.D., P.G.D.E., D.C.P.A., Reader, Post graduate and Research Depatment of Economics, C.B.M. College, Coimbatore, for giving valuable help in carrying out the econometric analysis.*

The researcher expresses her sincere thanks to **BRAHMACHARI ABHAYAMRITA CHAITANYA,** *Correspondent, Amrita Institutions and* **Dr. SANJAY BANERJI,** *BSc. (Engg.), Fellow (IIM-C), Director, Amrita Institute of Management for their kind encouragement and co-operation in completion of this research work.*

The investigator places her deep felt thanks to **Dr. E. MEERA,** *M.Com., Ph.D.,* **Dr. K.P.SOMAN,** *B.Sc. (Engg.), M.Tech., Ph.D. and* **Dr. S KRISHNAMOORTHY,** *M.Sc., Ph.D., Faculty Members of Amrita Institute of Management for their valuable guidance and timely help rendered.*

Her thanks are also due to the **LIBRARIAN AND LIBRARY STAFF** *of National Institute of Bank Management, Pune and Institute of Financial Management and Research, Chennai for their kind assistance and co-operation rendered to the*

investigator during her stay in their institutes for the reference work. This research work could not have been complete but for the periodical help rendered by ***Mr.JYOTHI PRAKASAM, Librarian, Amrita Institute of Management.***

The investigator also expresses her humble gratitude to her ***PARENTS AND FAMILY MEMBERS*** *for their moral support. The investigator expresses her deep sense of gratitude to her husband* ***CAPT.SALVADY*** *but for whose co-operation this work would not have been completed.*

CONTENTS

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

CHAPTER I

INTRODUCTION

The financial sector of the economy is the stimulating force for economic development. There exists a link between the real sector economic stabilization measures and the structural reforms of the financial system. The economic system of many countries reveals that economic development and growth of financial infrastructure go hand in hand. Therefore an efficient and vibrant financial sector will help to achieve the overall goals of economic growth and development. Schumpeter (1911) emphasized the positive influence of the development of the country's financial sector and the level and the rate of growth of per capita income.

Banking sector is an important part of the financial system[1] and in fact the banking sector is the hub of commercial activity. According to Sarkar and Das (1997) a sound banking system is important because of the key roles it plays in the economy – intermediation, maturity transformation, facilitating payment flows, credit allocation etc. Ross (1998) noted a central importance for the banking system in economic growth and highlighted the fact that the banks actually spur future growth by identifying and funding innovation. Desai (1983) remarked that banking sector accounts for significant part of the funds flowing through the financial sector and hence banking sector is credited to the alternative market

---

[1] The segments of the financial system are banking, specialised lending institutions, capital markets, money markets and insurance / investment institutions.
(Source: Loganathan, V. (2000-01), 'Banking reforms in India', Peninsular Economist, Vol.XIII, No.2, p.11).

driven, productive and competitive economy supporting higher investment level and accelerating growth.

In most developing economies, banks act as the main conduit of transfer of surplus funds from the savers of the community to the borrowers of the community for the purpose of productive investment. The importance of commercial banking in directing the activities in the economic system is overwhelming, since most of the economic activities are bank-based. The process of financial intermediation supports increasing capital accumulation through the institutionalization of savings and investment and fosters economic growth. To achieve a high rate of economic growth sustained over a long period, greater efforts will have to be made to increase agricultural and industrial production. For this purpose, bank credit would play a significant role by influencing the types of commodities produced, as well as the quantum of their output. Hence, a well-planned, organized, efficient and viable banking system is a necessary concomitant of economic and social infrastructure in an economy.

The banking sector has shown remarkable response to the needs of the planned economy. Banks are also distinguished from other financial institutions by a unique characteristic of providing a means of payment in non-cash transactions. A developed network of banking can increase the mobility of funds, can change the pattern of investment and enhance overall productivity of investment in the country. In deploying the funds, banks strike a balance between low-yielding, high quality liquid assets and high yielding riskier investments.

The basic economic function of bank intermediation can be broadly classified as, liability-asset transformation, i.e.accepting deposits as a liability and converting them into assets such as loans; size transformation, i.e.providing large loans on the basis of numerous small deposits; maturity transformation, i.e. offering savers alternate forms of deposits according to their liquidity preferences while providing borrowers with loans of desired maturities; and risk transformation, i.e. distributing risks through risk diversification which substantially reduces risk for savers which would prevail while lending directly in the absence of financial transformation (Jadhav and Ajit, 1997).

In performing these tasks, the banks realize the importance of economies of scale. The savings placed at their disposal are employed in numerous and large transactions, adapted to the specific needs of borrowers. In this way they are able to make substantial reduction in cost for both savers and borrowers, who would otherwise have to make individual transactions with each other. Indeed, for the saver/investor, the banks' mediation leads principally to a significant reduction in risk. This is due to the result of risk spreading that the bank accomplishes in reinvesting savings. Moreover, banks as a financial intermediary take over from the saver, a greater share of the risks entailed.

Thus, banks by performing the intermediation function, helps to reduce: search costs, transaction costs, monitoring costs and verification costs (Gertler, 1988). In the absence of intermediation, savers will have to search for investors and these would entail search costs. By offering standardized products and services to depositors and borrowers, banks help to reduce the costs of repetitive

searches, i.e. transaction costs. In the process of deposit taking and lending, banks come to possess informational advantage over other financial intermediaries and hence can reduce agency costs such as monitoring and verification costs.

In India, financial intermediation has largely been synonymous with banking. Despite the growth of a number of savings instruments, bank deposits remain the single largest avenue of household savings. The accelerated rate of mobilization of savings by banks is in keeping with the needs of economic development of the economy. The share of banks in total financial assets was estimated to be 75.2 percent in 2000 (Reserve Bank of India – Annual Report, 2001).

In 1950, the Indian banking system comprised of the Reserve Bank of India[2], Imperial Bank of India, co-operative and exchange banks and Indian joint stock banks. The nationalization of commercial banks[3] in 1969 was a turning point in the history of commercial banking in India. In July 1969, fourteen commercial banks in the private sector each having deposits worth of Rs. 50 crores and above were nationalized. In 1980, six more banks with deposit liability

---

[2]The Reserve Bank of India is the apex financial institution of the country's financial system. The Reserve Bank of India as India's Central bank was established on 1st April 1935 under the Reserve Bank of India Act of 1934.
(Source: Mithani.D.M., (1998), Money Banking and International trade, Himalaya Publishing House, Mumbai, p.413).

[3] Nationalization of commercial banks implied a bold and major step undertaken with the objective of removal of control by a few, provision of adequate credit for agriculture and small scale industries and socio economic development by opening more branches. Source: Venkatasubramaniam.T.V., (2000-01), 'Banking reforms in India', Peninsular Economist, Vol.XIII, No.2, p.24).

of not less than Rs.200 crores were nationalized. In 1993 there was a merger of two nationalized banks. Therefore at present the public sector banks in India comprise of State Bank of India groups (including State Bank of India and seven associates) and nineteen nationalized banks. The private sector banks comprise of thirty banks including nine newly started banks in 1993.

The Indian banking system has made commendable progress in extending its geographical coverage and functional dimension. Between 1969 - 1991, bank deposits as a proportion of Gross Domestic Product had increased from 13 percent to 38 percent and advances as a proportion of Gross Domestic Product had increased from 10 percent to 25 percent and the number of branches increased from 8,260 to 64,980. In recent years, commercial banks in India have widened their role from acceptance of deposits and lending credit to development oriented banking. Banks were actively involved in priority sector lending and the target of 40 percent of credit towards priority sector by 1985 was achieved and maintained till 1990 (Sarkar and Nayak, 1993). However with the liberalisation of the banking sector, the share of priority sector had gone down to 33.7 percent in 1995 (Reserve Bank of India bulletin, 1998). Besides priority sector lending, banks are engaged in several special banking activities in the field of employment and poverty alleviation programme through various schemes like differential interest rates (DIR), Integrated Rural Development Programme (IRDP), Prime Minister's Rozgar Yojana for educated unemployed youth (PMRY) etc.

In response to the need for greater flexibility of operations in a more competitive environment, the Reserve Bank of India constituted a number of committees. Notably, Luther Committee (1977) examined the productivity, efficiency and profitability of nationalized banks for the period 1969 to 1975. The committee analyzed the various issues related to the planning, budgeting and marketing in commercial banks, bank management, information system, criteria for evaluation of bank performance, annual accounts of banks, trend in earnings and expenses of banks, profitability and pricing of banking services.

Before 1991, there was little competition in the banking sector due to regulated interest rate. The financial sector liberalisation attempted since 1991, has allowed more operational flexibility and functional autonomy to banks than hitherto with a view to enhancing their efficiency, productivity and profitability. The broad direction of the policy reform has been towards rationalisation of the administered interest rate structure followed by deregulation of most of the deposit and lending rates, reduction in the governmental pre-emption of banks' funds in the form of cash reserve ratio (CRR) and statutory liquidity ratio (SLR) and relative freedom in branch licensing. Simultaneously, the supervisory mechanism has been strengthened and prudential norms relating to capital adequacy, income recognition, asset classification and provisioning have been put in place. Operational flexibility has infused a great deal of competition among the Indian banks which has been further heightened by introduction of new players in the market. New domestic banks have been allowed entry in the private sector. Establishment of mutual funds both in the public and private

sector as also the growing influence of non-bank financial companies have increased the competition from outside the banking system. In such a milieu, the banking industry has to sustain itself by reaching new heights of efficiency.

Narasimham committee (1991) examined the financial system as a whole in the light of liberalization of the economy. It made a comprehensive review of issues bearing on policies, structures, systems, regulations and supervision of the financial system and made recommendations, which by and large were accepted by the Government of India. The committee's report specified the strategic objective for the financial system as achievement of efficiency through competition. In the more volatile environment, the expected growing competition in the banking industry will bifurcate banks clearly into strong banks and weak banks. (Committee Report on the Financial System, 1991).

The major recommendations of Narasimham Committee were the following:

- Deregulation and rationalization of the interest rate structure;
- Bringing about objectivity and uniformity in the bank rules for income recognition, expense accounting, asset classification,etc. ;
- Raising the standard of disclosure in financial statements and improving transparency in reporting;
- Doing away with direct loans and investments and providing banks the autonomy in management of their balance sheet;
- Eliminating discrimination between private and public sector institutions in terms of entry into specific financial services;

- ❖ Removing the control of the State over the public sector banks and financial institutions by partial or full privatization;
- ❖ Reconstruction of the banking sector with partial reference to the weaker banks and
- ❖ Increase the role of the market and reducing that of the State in the banking system would imply a different quality of regulation of the financial sector institutions.

Based on the recommendations of Narasimham Committee, the Reserve bank of India had formulated banking reforms. It has recently been claimed that, phase I[4] of the banking reforms had now been completed. The Economic Survey 1995-96 had stated that, "The effect of these reforms on the financial health and performance of banks is gradually emerging; the entire range of reforms, aimed at promoting competition within a prudent regulatory regime is beginning to bear fruit".

The increased opportunities for banks provided by deregulation[5] have not only expanded their portfolios, but also introduced new uncertainties and risks in their business. Competition has increased considerably within and outside depository institutions. A large number of depositors lost a substantial part of

---

[4] Phase I of the banking sector reform consist of curative measures aimed at removing the external constraints, having a bearing on the profitability of banks and putting them on the recovery path. It was introduced in 1992 based on the recommendations of the committee on financial system. (Source: Venugopal Reddy (2000), 'Monetary and Financial Sector Reforms in India', UBS Publishers, p.100).

[5] Deregulation is a process of removal or reduction of financial market distortions mainly created by the Government or Central Bank intermediation.
(Source: Ismail Ghafar Abdul (1993), 'Deregulation and bank behaviour in the mixed markets','Asian Economic Review, August, Vol.XXXV, No.2, p.125).

their hard earned savings with non banking financial corporations and it is now the onerous responsibility of the commercial banks to ensure adequate safety of the investment and also proper returns for the investment. The deregulation of the financial sector and the increased competition are expected to enforce the banking firms to become more efficient.

A review of the performance of Indian banking sector in early 1990's revealed that despite the overall progress made by the banking system in geographical functional coverage, it's operational efficiency had been low characterized by low profitability, high and growing non-performing assets and relatively low capital base (Rangarajan, 1991). The Mid Term Appraisal of the Ninth Five Year Plan (1997-2000) document of the Planning Commission noted that the loss by nationalized banks increased from Rs.425 crores in 1994-95 to Rs.2, 574 crores in 1998-99.

Hence, it is necessary to evaluate whether the bank is utilizing it's full capacity so that it can achieve economies of scale. When the banks consider the expansion of their size they have to evaluate the input output relationships. Banks are multi-product firms providing a bundle of financial services relating to their lending and non-lending activities. Banking products, however record certain basic differences from those of manufacturing industries. Each one of the banking product has three dimensions viz., the physical unit as represented by the number of accounts, the size as represented by the rupee amount involved and the time period for which the amount involved stayed with the bank or with

the customer. As the banking product is in the form of services, it is very difficult to reduce the service to a standard unit that can be valued.

The increasing competition force the banks to gain a competitive edge on rivals and take steps to improve or even maintain their market shares and profits. As most banks offer a variety of services, they are compelled to deliver the services to the customers at the lowest possible costs. Therefore, like any other multiple product firm, the output mix is central for bank management.

In conventional banking theory and banking studies, it is maintained that there is an important relationship between cost and size of a bank. In this context, Gramely (1962) observed that, "an increased scale of operations is thought to confer distinct advantages on commercial banks, because it is accompanied by a decline in unit operating cost and an increase in profitability. Banking like other lines of economic activity, is believed to be characterized by economies of scale". Economies of scale in the financial sector manifest in a variety of ways and while banking is becoming more decentralized and diversified in terms of the range of products being offered and the variety of markets being targeted by a single bank, scale of operation is in fact increasing. Size matters, and appears to be reasserting its relevance once again (Sanjaya Baru, 2001).

The survival of banks depends upon the extent of size and product mix efficiencies. According to Clark (1996) in recent years, banks have been granted new powers to expand the scale of their operation. Those banks that adopt the most efficient size and product mix are in a position to exploit the relative cost

advantage and continue to grow. Those banks that adopt a size and product mix that is less cost efficient will not remain as competitively viable institution. Emphasizing the importance of efficiency in commercial banks, Reserve Bank of India in it's report on 'Trend in progress of banking 1999-2000' noted that the forces of competition are compelling banks to optimise resource level, to attain maximum technical efficiency and change the optimum firm size to include the quantity of bank's input and output as to recap the maximum economies of scale. In regulated industries, such as banking, public interest considerations dictate that these structural changes should be subject to viability of the system while at the same time preserving competition and promoting efficiency. Hence, banks must restructure their business and re-examine their strategies, paying particular attention to economies of scale.

Economies of scale have become an issue of interest even to the policy makers on issues like optimal pricing of banking services, credit rationing, monetary control, etc. for which the presence or absence of economies of scale has important implications (Subrahmanyam, 1994). Further the study on economies of scale of commercial banks is important for two reasons:

(i) At the aggregate level, the structural re-organization of the financial system and monetary control implemented by the policy formulators should be based on the study on economies of scale and

(ii) At a less aggregate level, the bankers, by paying particular attention to economies of scale can adopt the most efficient size, optimal pricing of banking services etc.,

In recent period, the researchers have focused attention on analyzing economies of scale in banking. In India, Rangarajan and Mampilly (1972), Jain (1988), Bishnoi (1992), Ray and Sanyal (1995), Chatterjee (1997) etc. have attempted to analyze economies of scale in Indian commercial banks. But these studies analyzed scale economies only for short period of maximum of two years and thereby conclusions were derived and suggestions were made. Humphrey (1987) cautions that scale economy estimates based on one year cross section data may not generalize to other years. Since necessary adoptions to various scales of output cannot be done in short run, economies of scale is a long run concept. As such the current study on "Economies of scale in Indian Commercial Banks (1973-1996)" is a pioneering research study to analyze the scale economies in the long run i.e., for 23 years from 1973 to 1996 for Indian commercial banks.

The current study on "Economies of scale in Indian commercial banks (1973-1996)" is formulated with the following objectives:

A. To study the profile of Indian commercial banks;

B. To estimate scale economy of Indian commercial banks at the plant level and the firm level; and

C. To estimate scale efficiency of Indian commercial banks.

Limitations of the study:

The current study is restricted to analyze economies of scale only at aggregate level for Indian commercial banks. Therefore the conclusions based on the current study are applicable at the macro level. When predictions are to

be made to the individual banks, greater care should be exercised. Further, the study is solely concentrated on the cost domain and hence the conclusions of the study depend upon the specific definition of cost, output and input variables. Above all the study tried to measure only scale economy and scale efficiency though scale expansion leads to allocative and organizational efficiencies.

REVIEW OF LITERATURE

CHAPTER III

REVIEW OF LITERATURE

The review of literature relating to the present study on "Economies of scale in Indian commercial banks (1973 – 1996)" is discussed under the following heads:

A. Definition of economies of scale;

B. Dimensions and sources of economies of scale;

C. Determinants of banking performance;

D. Efficiency of banks and

E. Scale economies in banking.

A. Definition of economies of scale:

According to Chamberlin (1946), the aggregate amount of inputs used, explains the existence of economies of scale. As size increases the inputs change qualitatively as well as quantitatively. Different types of inputs are employed at various scales. Change in quality leads to change in efficiency. In the view of Shah (1986), the concept of economies of scale is derived from the theory of costs. Economies of scale examine the relationship between the size as the cause and cost as the consequence.

Chandler (1990) opined that, firms achieve economies of scale when their operating costs increase at a lower rate than their output. In manufacturing operations, plant volumes must reach a certain minimum level for a firm to achieve economies of scale. Rose (1995) defined economies of scale as doubling of bank output for any one service or package of services which will

result in less than a doubling of bank production costs because of greater efficiencies in using the bank's resources to produce multiple units of the same service package.

B. Dimensions and sources of economies of scale:

Any productive enterprise is called a firm. According to the economic theory, a firm is engaged in an economic activity. It makes use of economic resources which are scarce and which can be put to several uses. Firms engaged in agriculture, manufacturing, mining, trading, consultancy services like banking, insurance, education etc., make use of inputs like men, materials, machinery, money and management in the process of producing output in terms of either goods or services. So, every firm transforms inputs into outputs.

The firm's aim is to maximize the difference between the cost of acquiring factors and the revenue from selling it's product. It will, therefore, be to the advantage of the firm to embark on production, so long as the total value of the product secured is greater than the total value of the factors employed.

In the view of Marshall (1920) there are two types of economies of scale, internal and external economies of scale. Internal economies of scale arise entirely owing to the nature of productive process within the firm itself. Whenever a firm grows in size it reaps certain internal economies. Internal economies are attributable to increase in size or scale of the individual unit of production. On the other hand, the emergence of external economies is traced to the general process of the industrial environment. But the situation of business always play a great part in determining the extent to which it can avail itself of external

economies. As the size of a unit is increased beyond a point, it becomes increasingly difficult to use its resources efficiently and hence diseconomies of scale operate because of complexities in management and difficulties in coordination and control.

Robinson (1958) viewed that a firm is an optimum firm, which has the technique and organizing ability to produce at the lowest cost of production per unit (average cost), when all those costs which must be covered in the long run are included. The optimum scale of the firm is the best size of the producing unit. The establishment of the optimum firm will be, in part, the result of conscious decision by businessmen who are considering how profitably they can invest their resources; in part, it will be outcome of the forces of competition, which tends to eliminate the inefficient and to encourage the efficient. Both these elements play their part because competition only indirectly gives an advantage to the firm with the lowest average long run cost of production. Since capital equipment is long-lived and available in the short period, whether or not it is sufficiently rewarded, economies of capital costs play a little part in short run competition. But in a longer period, capital wears out and must be replaced and investors will consciously seek out that size of firm, which over a period of years offers the best return on their capital.

According to Silberston (1972), there is a relationship between cost and the scale of the firm. The term "scale" in economics generally refers to "size" of an economic unit. Economies of scale / size are related to the efficiency in the use of resources and are reflected in the long run average cost curve (LAC).

According to economic theories, long run average cost curve is generally "U" shaped curve. It shows that as the size of a unit increases, the unit successively uses resources more efficiently up to some specific size, which is known as economies of scale. But most of the evidence suggests that such a curve will be L- shaped i.e. will fall at first and then become horizontal. The point at which the curve becomes horizontal is the optimum or efficient scale. It represents a given rate of output per unit of time, although in constructing the curve such dimensions of scale as total output over time will have to be taken into account. In his view there are three main aspects of the average cost of producing a product (or a group of similar products) viz., time periods, products and units.

A subdivision of time periods dimension of scale are life of plant and equipment and life of each product. Life of plant and equipment is not specific to a particular product. Life of each product refers to the time period over which a product is produced and other things equal, longer life reduces costs per unit of output.

A subdivision of products dimension of scale are total output over time, output per unit of time and standardization between products. Total output over time relates to the savings from spreading initial costs over the output of a product. Output per unit of time refers to the possibilities for mechanization etc. that come from high output per unit of time. Standardization between products is relevant to the savings in design and capital costs that may be obtained from producing similar products, especially if the same equipment can be used for them.

A subdivision of units dimension of scale are plants, firms and industries. Plants dimension relate to the savings that may arise from increase in the scale of plants, e.g. savings in administration. The degree of vertical integration is also relevant, since it affects the possibilities for technical linkage within the plant. Firms dimension relate to savings that may arise from the size of the firm, e.g. in research and also from specialization between plants.

The sources of economies of scale may be classified as, the sources, which affect capital cost, operating cost and which affect both capital cost and operating cost.

The sources which affect the capital cost, are influenced by initial fixed cost and working capital. Initial fixed costs are some of the constant costs. They remain constant whatever be the scale of output of a product, e.g. design costs or research and development costs. The larger the total output over time, the lower would be per unit cost. The use of mass resources leads to economies in stocks. Stock economies may also result if larger output per unit of time allows flow production to replace batch production.

The sources which affect the operating cost, are influenced by greater specialization of labour and it will be possible if scale per unit of time increases, thus reducing operating cost per unit. Operating costs per unit may also be reducing if flow production replaces batch production, because idle time may be less. At large scales of output per unit of time it may be possible to link successive stages of production without sacrificing economies at each stage.

The sources which affect both capital and operating costs, are influenced by increased size of plant. Capital costs may not go up proportionately with scale. The amount of initial outlay on research and development or selling expenses may behave in similar way. It may rise, but not proportionately. Operating costs per unit of output may fall because the costs of operating a plant may not rise proportionately with it's size and hence with its output.

As output per unit of time (and also total output over time) increases, more specialized plant and equipment may become economical, i.e. the sum of capital and operating costs may fall. At higher scales of output, capital costs as well as operating costs per unit may be lower with more specialized techniques. As a whole, the sources of economies of scale are related to economies arising within a plant, while the dimensions of the scale are related to firms, industries and also plants.

According to Rangarajan and Mampilly (1972), economies of scale generally arise from increased utilization of machine capacity, fairly large amount of fixed expenses in the production activity, specialization of labour in the production process resulting in greater rates of output, extra efficiency of plant or equipment at higher volume of activity and favourable prices being obtained on bulk purchases of raw materials.

C. Determinants of banking performance:

Commercial banks performance has been the primary concern of management, savers, investors and economic planners. The performance of the

commercial banks could be determined in terms of profitability, productivity, financial management, etc.

Haslem (1968) analyzed the differential effects of management and other selected variables on commercial bank profitability and the operating relationships through which these effects are transmitted and relative profitability determined. The study showed that of all the variables tested, management, size, location and time were significant. Each variable significantly affected relative profitability and the majority of operating relationships determine profitability.

Desai (1983) attempted to obtain the spectrum of relative performance of ten major non-nationalized scheduled commercial banks. The study estimated four fundamental ratios viz., interest earned to working funds, interest paid to working funds, cost of service to working funds and spread for the period 1972-1981 in respect of all the banks selected for the study. The study found that spread, which is steadily narrowing down each year is totally inadequate to meet the cost of services and there was large gap between the working funds and loanable funds. The study suggested that lending policy needs to be oriented towards capacity and performance of individual banks.

Subrahmanyam (1984) attempted a bilateral productivity comparison for the 28 public sector banks in India. The study found that variation in factor intensity relatives were much more pronounced than those in managerial productivity relatives in the period 1971-73 to 1987-89. It also revealed that, sharp decline occurred in those two relatives resulting in similar sharp decline in staff productivity also across banks. This implies that managerial capacity of the

public sector banks in India was far from being fully utilized. Therefore there is considerable scope and need for restructuring the managerial and organizational functions in the Indian public sector banks towards extracting higher performance not only from the managerial cadre but also from other resources of banks.

Chakraborty (1986) made an attempt to assess empirically the relative performance of scheduled commercial banks as a group and of each nationalized scheduled commercial bank during 1980 to 1982. For each group of banks and then for each bank in the group of nationalized banks, Herfindahls' index had been computed in order to measure the inequality in sharing gross profit, net profit earnings and expenses. The performance had been assessed in three different ways (i.e) in absolute term, per bank and per employee. The study concluded that the banks need to improve their relative performance in sharing earnings from fund business as well as from other sources and they should be more effective in reducing expenses per office.

Angadi (1987) tried to identify explicit and implicit costs as well as endogenous and exogenous factors affecting banks' profitability in India for the year 1982 and 1985. A decomposition analysis of the performance of public sector banks in India indicated that the growth of operating earnings had not kept pace with the growth of interest expenses and operating costs. Two important implicit costs that could be conceived were solvency costs and opportunity costs on equity possessed by the banks. The study found that the economic profit of 14 public sector banks was negative in 1985. The remaining public sector banks,

which had earned positive profit during 1985, showed a wide variation in their performance.

Kamaih et al. (1988) undertook a thorough investigation of the performance of bank branches with the help of a set of branch-level indicators. Branches were formed into pairs of groups based on location, profit performance, deposit-mix and deposit mobilization. Profit making branches were distinctly identified with high savings to total deposits ratio. For effective monitoring of branches, the study suggested six branch level indicators. The study recommended that it is essential to maintain a good deposit-mix to control average interest cost of deposits.

Singh (1989) discussed the various factors responsible for decline in bank profitability in India. As per the study, there is a need for improving income on advances by improving the health of loan assets, reduction in the ratio of non-performing assets and by improving cash management and investment management by reducing the cash balances to the barest minimum in the liquid-assets mix. There is a possibility of maximizing yield on investment by proper selection of securities.

Nyong (1990) attempted to test the quiet life hypothesis in banking for the cross section of Nigerian commercial banks. The study used simultaneous equation model in which bank profitability, risk and asset and liability composition variables were jointly determined. The results indicated that Federal Government controlled banks were better profit maximizers and relatively more efficient than State-owned banks.

Hassan and Hossin (1992) analyzed the performance and viability of private sector commercial banks vis-à-vis nationalized commercial banks in Bangladesh. The study compared the performance of banks by using accounting performance measures. As per this study, private sector banks have been found to be more profitable and more operationally efficient as compared to nationalized banks. Even though private sector banks were found to be deficient in mobilizing funds to priority sectors, it had been argued that these private banks will accomplish the goals once restrictive banking regulations are changed and privatizing of the economy takes place.

Abdulla (1994) attempted to analyze the determinants of performance of the Bahraini commercial banks between 1984 and 1991. It tested two accounting measures of banks' performance: return on assets (ROA) and return on equity (ROE). The study indicated that gulf crisis, loan to deposit ratio, operating costs and the bank's size were inversely related to return on assets and return on equity. Further it was found that, loan to total assets ratio, individual deposits to total deposits ratio, shareholders equity to total assets ratio and Government ownership in the banks' stock were directly related to the banks' profitability.

Batra (1996) examined the impact of policy constraints on the profitability of Indian scheduled commercial banks for the period 1955-87 using a profit function. The study provided a comparative view on pre and post nationalization periods of Indian banking. The study revealed that the frequent use of policy instruments (statutory liquidity ratio and cash reserve ratio) to pre-empt bank funds for Government use had significant impact on banks' operational efficiency.

According to the study, there was a spectacular rate of growth of deposits and ensuing costs in terms of higher rates of interest and shifts in maturity pattern towards longer-term deposits, but the branch expansion in the rural areas had not been remunerative.

Clark and Siems (1997) used a traditional set of inputs and outputs in a profit function model utilizing the thick frontier approach. The study found that there was statistically significant profit diseconomies and profit expansion path subadditivity to an asset size of approximately $ 500 million. In particular, the profit elasticity results revealed that expanding output while holding asset mix constant did not increase profit at nearly the same rate. However, when product mix is allowed to vary, the profit expansion path subadditivity results suggested that increasing size up to approximately $ 500 million in assets appeared to provide a profitability advantage.

Sarkar and Das (1999) aimed to study and compare the relative performance of the Indian public sector banks during 1994-95 and 1995-96 using human development index. The analysis revealed that performance of banks was better in 1994-95 and 1995-96. The disparities among banks performance indices was more in 1995-96 when there were lower growth rates in deposits, credit and investments. The study categorized the banks into high performing and low performing banks.

Mittal (2000) examined the financial performance of regional rural banks in India after the formulation of policy initiatives taken by the Central bank to improve their efficiency, competitiveness, profitability and viability. The study

found that these reforms were showing better results. There was a substantial improvement in the ratio of operating profit to total assets, net profit ratio and profitability. The study suggested that capital base of the regional rural banks must be strengthened.

D. Efficiency of banks:

Kwast and Rose (1982) used statistical cost accounting techniques to examine the relationship between bank profitability and operating efficiency. The study focussed on large banks with the domestic deposits of above $ 500 million for comparing a sample of relatively profitable banks against a matched group of much less profitable banks over the period 1970 to 1977. After allowing for regional supply and demand factors, the high and low profit banks were identified on the basis of market-rates of return on individual assets and liabilities. As per the study, there was virtually no evidence that the high-earnings banks experience lower operating costs on some liabilities but the opposite was true with respect to selected asset items. It revealed that there was no compelling evidence that high-profit banks were characterized by greater operating efficiency than their low earnings counter parts.

Sherman and Gold (1985) used data envelopment analysis, for locating inefficient branches by explicitly considering the mix of services provided and the resource used to provide bank services. The study analyzed operating efficiency of U.S. savings bank with 14 branches. It found that out of 14 branches, four branches were found to be inefficient and two of them were the smallest in terms of total transactions and none of the five largest branches was identified as

inefficient. One of the highly profitable branches was noted as inefficient. The study suggested that the question of scale economies needs to be redefined to consider transaction volume as well as the mix of transactions for a narrow time frame to analyze branch efficiency.

Aly et al. (1990) applied a non-parametric frontier approach to calculate the overall efficiency and pure technical, allocative and scale efficiency for a sample of 322 independent banks for 1986. The results indicated low level of overall efficiency and the main source of inefficiency was technical in nature. The study revealed that technical efficiency was negatively related to product diversity and pure technical efficiency was positively related to size of the banks.

Rao and Latha (1990) made an attempt to analyze operating efficiency in public sector enterprises during 1975-76 and 1985-86. The efficiency was evaluated in terms of capital-output ratios, productivity indices, operating-cost responsiveness ratios and shifts in the pattern of input utilization. The study found that the size of capital employed in order to produce one unit of output was an important indicator of capital productivity in an enterprise and the capital-output ratios were high in public sector enterprises. It also revealed that factor productivities of capital and labour would indicate the efficiency of operations with respect to the production function. It was found that operating costs ratios were widely fluctuating beyond unity in six years during the study period.

Berger and Humphrey (1991) measured and analysed inefficiencies for all U.S banks in 1984. Inefficiencies were measured relative to a 'thick frontier' cost function and were found to dominate measured scale and product mix

economies. The study found that most inefficiencies were operational in nature, involving the overuse of physical inputs and technical inefficiencies dominated allocative inefficiencies.

Berger et al (1993) analysed about how well banks from different countries and different sizes may be prepared to meet the more intense competition of a common European banking market. Data Envelopment Analysis had been applied to the banking industries of the three Nordic countries - Finland, Norway and Sweden. The study found that the efficiency spreads between banks were most important in Finland and Norway and least important in Sweden. It revealed that most of the banks on the Nordic best practice frontier were Swedish and Norwegian average bank was more efficient than the average Finnish bank.

Berger et al (1993) derived input and output inefficiencies from a profit function for U.S banks. Inefficiencies were decomposed into allocative and technical components by using shadow prices. Larger banks were found to be more efficient than smaller banks, which may offset scale diseconomies found elsewhere. The study also found that inefficiencies in US banking were quite large. The industry appeared to lose about half of its potential profits due to inefficiency.

Ferrier et al. (1993) in their attempt on analysing the efficiency of commercial banks defined a new measure of economies of diversification to examine the cost effect of product line expansion. The study explained a non-parametric frontier technique, applied to a set of 468 U.S. depositary institutions operating in 1984. As per the study, there was a large degree of technical

inefficiency, a lesser degree of scale inefficiency and diseconomies of diversification. The study suggested that a large potential benefit of increased competition would be the likely reduction of the overall level of inefficiency found in the banking industry as banks were forced to use inputs more efficiently. Diseconomies of diversification and inefficiency due to the over utilization of resource were found to be more important determinants of bank costs.

Kaparakis et al. (1994) tried to compare the efficiency of large sized banks with small sized banks. The study adopted translog cost function for 548 U.S. banks with total assets above $ 50 million, in 1986. The study concluded that banks generally become less efficient with increasing size. The study identified the factors causing differences in efficiency across banks as the operation of a branch network and a higher ratio of equity capital to total assets. The study concluded that the emergence of a banking system dominated by large banks might be socially benefited if other benefits associated with large scale banking exceed the costs.

Subrahmanyam (1994) undertook a theoretical investigation of the methodological issues involved in the measurement and comparison of efficiency levels in commercial banks at the aggregate level. It tried to explain how the log quadratic production function framework could be adopted to explain productivity differences across banks.

Subrahmanyam and Swami (1994) attempted to investigate the impact of management efficiency on the output performance of a bank. The study tried to account for output differences between bank groups (14 large and 13 small

Indian commercial banks) during 1974-76 in terms of measured neutral and non-neutral technological parameters and input levels. The parameter estimates of the production function exhibited variation in neutral as well as non-neutral efficiencies in the underlying production technologies of the bank groups. This variation due to neutral efficiency was due to the contribution of the management factor since poor management required more inputs to achieve a given level of output.

Mitchell and Onvural (1996) provided new evidence of bank cost efficiency. The study used large bank data to estimate cost equations. The cost functions were estimated for two different years (1986 and 1990) with different asset base to investigate the stability of the industry cost function. The study used "intermediation" approach with output variables as commercial and industrial loans, real estate loans, consumer's loans and deposits and input variables as price of labour, capital, purchased funds and deposits. The study concluded that the estimated measures revealed no gains for changing the scale of production and no cost difference between providing a given output bundle in a single bank and in some combination of banks.

Noulas and Ketter (1996) examined the technical and scale efficiency of 18 Indian public sector banks for 1993 using a non-parametric production frontier approach. According to the study technical efficiency was achieved when a firm produces the maximum level of output from the available inputs. Scale efficiency was achieved when a firm produces the level of output at which the average cost of production is the least. For the measurement of technical efficiency the study

used data envelopment analysis. The study estimated the pure technical inefficiency as 1.5 percent and scale inefficiency as 2.25 percent. It also found that, none of the banks operated under decreasing returns to scale and majority of them operated under increasing returns to scale. Thus, increasing the scale of operations can further enhance the efficiency of Indian public sector banks.

Andera Resti (1997) tested two approaches viz. econometric technique and data envelopment analysis to evaluate the cost efficiency on a common panel of 270 Italian banks. The study suggested that econometric and linear programming results do not differ significantly, when based on the same data and conceptual framework. According to the study, the efficiency scores showed a high variance and the study revealed that there was a direct relationship between productive efficiency and asset quality. Further the efficiency of Italian banks did not increase over the period 1988-1992.

Berger et al. (1997) attempted to study the efficiency of bank branches of 760 branches of a large U.S. Commercial bank for the years 1989, 1990 and 1991. Fourier flexible and translog cost function models were estimated separately for each of the three years by using both the intermediation and production approaches. Both approaches found that most branches were below efficient scale and scale efficiency losses were attributable to most branches being too small. X- inefficiencies were quite large over 20 percent of operating costs.

Berger and Deyoung (1997) examined the relationship among loan quality, cost efficiency and bank capital. According to the study, the problem

loans precede reductions in measured cost efficiency, the measured cost efficiency precedes reductions in problem loans and reductions in capital at thinly capitalized banks precede increases in problem loans. The study concluded that the cost efficiency may be important indicator of future problem loans and problem banks.

Clark and Thomas (1997) investigated the impact of off-balance sheet banking products and services on the measurement of efficiency and competitive viability of the U.S. banking industry. The study utilized the parameters of production cost, economic cost and profit functions. Based on these parameters, the study constructed estimates of inefficiency, scale economies and competitive viability for a number of alternative size classifications. The results indicated that including a measure of off-balance sheet activity in the cost and profit functions is statistically significant. However, differences in the derived estimates of inefficiency, scale economies and expansion path subadditivity with addition of a measure of off-balance sheet activities were generally of small consequence qualitatively.

Das (1997) used a non-parametric frontier methodology to derive several efficiency measures for 65 major banks of India for the year 1995. The main objectives were to measure the overall efficiency of Indian banking firms, decomposition of overall efficiency into price efficiency, technical efficiency and scale efficiency and to study whether there were significant differences in efficiency between different bank groups. The results indicated that banks in India, as a whole were characterized by relatively low level of overall efficiency

and were in general more technically than allocatively efficient. Thus banks of India were marked with under utilization and wastage of resources. Most of the technical inefficiencies observed were not scale related. However, there was no significant difference in any of the efficiency measures between public and private sector banks.

Grifell and Lovell (1997) examined the productivity change separately for the Spanish commercial and savings bank sectors for the period 1986-1993. The study observed that the commercial banks have a slightly lower rate of productivity growth, but a slightly higher rate of potential productivity growth. This phenomenon was attributed to differences in both managerial efficiency and institutional efficiency, to differences in the rate of technical progress and to the adverse impact of diseconomies of scale in the commercial banking sector.

Humphrey and Pulley (1997) analysed about banks' responses to deregulation. The study used a profit function to separate statistically, the internal-bank initiated adjustments to deregulation from the external changes in banks' business environment. The results based on profit function indicated that large banks (assets over $ 500 million) bore the brunt of adjusting to deregulation. They adjusted deposit and loan output prices and use of labour and capital inputs to minimize the negative impact on profits from deregulation costs. Further the effects of changes in business environment on the level of deposit and loan outputs and the prices of inputs were minimal. In contrast, smaller banks (with assets between $ 100 and $ 500 million) initiated few important

adjustments in response to deregulation and relied only on an improved business environment to stabilize profitability.

Peristiani (1997) attempted to examine whether merger improve the scale efficiency of United States Banks. The study utilized the translog flexible functional form to estimate the cost structure of banks and derive measures of efficiency. The study estimated the translog cost function for each year using call report information from 1984 to 1990. The study noted that there was more variation in scale efficiency among the different size groups. As per the study the optimal scale efficiency size lies in the neighbourhood of $ 800 million and that small banks and large institutions were considerably more scale inefficient relative to other institutions. Further the study found that the measure of efficiency were correlated with financial variables like return on assets and non interest expenses ratio.

Sarkar and Das (1997) attempted a study on "Development of composite index of banking efficiency" for the Indian banks. It analyzed the inter bank differences in the efficiency of banking sector with respect to profitability, productivity and financial management for the year 1994-95. The study formulated efficiency index based on 15 indicators, using principal component analysis. The results showed that there was a wide variation in efficiency and performance among the banks according to their ownership pattern. The performance of public sector banks was relatively poor compared to other bank-groups. Vivas (1997) estimated profit efficiency using the thick frontier approach by the standard profit function. By estimating the alternative profit function the

study found that the profit inefficiency of Spanish savings banks averaged at 28 percent.

Wheelock and Wilson (1999) examined the extent to which technical progress of the average bank relative to the efficient frontier accounted for changes in productivity. The study tried to provide a comparison for estimates of total factor productivity based on parametric techniques for U.S. banks during 1984-1993. The study found that during the study period, banks of all sizes experienced decline in technical efficiency. This implies that minority of banks in each size category were pushing the technology forward, while the majority of banks failed to keep up with technological change.

Al-tunbas et al. (2001) attempted to evaluate whether cost and profit inefficiencies differ between broad mix of ownership forms – private, public and mutual. The study estimated separate cost and alternative profit frontiers for the three different ownership types : private commercial banks, public savings banks and mutual cooperative banks. For definition of inputs and outputs, the study chose the intermediation approach as suggested by Sealey and Lindley (1977) where the inputs, labour, physical capital and deposits were used to produce earning assets. The study included outputs as mortgage loans, public sector loans, other loans and other earning assets. The study estimated inefficiency by using the stochastic – frontier and distribution free approaches. The study used banks balance sheet and income statement data for sample Germany banks between 1989 and 1996 as obtained from the London based internal bank credit analysis. The study found that there was wide spread variation in scale efficiency

between banks of different size groups and average scale efficiency was estimated as 9 percent using the stochastic frontier method and around 6 percent using the distribution free approach. The study also noted that the large commercial banks revealed greater economies than their smaller counter parts.

Vennet (2002) attempted to analyze the cost and profit efficiency of financial conglomerates and universal bank in Europe by using translog cost function. According to the study the overall average cost inefficiency for the entire sample of European banks was of the order of 30 percent for the traditional intermediation outputs and around 20 percent for the output mix including traditional and non-traditional activities. Further the study noted that specialized banks were more efficient in traditional intermediation activities (a significant difference of 2.6 points), while conglomerates appeared to be slightly better managed when non-traditional activities were included (the efficiency difference was 2.3 with a t-statistic of 2.08). As per the study, cost efficiency was largely unrelated to size.

E. Scale economies in banking:

Adar et al. (1971) in the study on "Output mix and jointness in production in the banking firm" attempted to deal with the problem of economies of scale and optimal output mix of a multiple-product firm production function. The study found that possible existence of jointness in production was relevant for decision-making in the banking industry.

Rangarajan and Mampilly (1972) attempted to investigate the existence of economies of scale in banking industries and relationship between the total

operating costs of banks and the size of banks. The least square method was used to estimate the total cost function separately for 1967 and 1968 for 30 banks of India. According to the study, the minimum point on the average cost curve indicates the required size to take full advantage of the scale economies. The cost curves that had been derived were based on the past behaviour of banks. The study suggested that the conclusions derived regarding the size of the least-cost bank should be based on the assumption that there would be no change in the technology and administrative structure in bank operations.

Sawhney and Dipietro (1979) used survivor technique to identify economies of scale in eight branch banking in the U.S. banking industry. The results showed that small banks were inefficient. The implication of the analysis was that branching augmented market power and it recommended that branch banking should be promoted only if there is gain from scale economies.

Gilligan et al (1984) examined the multi-product nature of the banking firm by utilising the translog cost function. The study found that product – specific scale economies do not exist beyond small bank sizes. As bank size expands beyond $ 25 million deposits, diseconomies of scale set in. The study suggested mergers between smaller banks to improve the economies of scale.

Gilligan and Smirlock (1984) utilized the translog cost function to test the proposition that the bank's production function is characterised by jointness. The cross-section analysis for the years 1973 to 1978 indicated that bank productions, in fact, were characterised by jointness. The estimates indicated

that scale economies characterised bank production at only small bank sizes and that the cost structure of large banks is characterised by diseconomies of scale.

Nelson (1985) estimated a model of bank costs based on a theory of the branch cost function for 431 banks grouped under eight different size ranges for the year 1979. The study showed that convenient branch location was important to banking customers and found that banks did not necessarily operate branches at minimum average cost. It estimated a statistical branch cost function by including branch output variables. The empirical results suggested substantial economies of scale at the branch level but no economies from expansion by branching.

Shah (1986) in his study on " Empirical relationship between size and costs at branch level" proposed to test the hypothesis of economies of scale by examining empirically the size-cost relationship at branch level, in 141 rural and 80 urban branches of Bank of Baroda in Gujarat in 1979. The study noted that operational efficiency of rural and urban branches had to be improved by controlling operational cost. The results showed that as size of branches in terms of volume of business increases in rural and urban area, unit-operating cost had a tendency to decline. It concluded that there is further scope of economies of scale and increasing efficiency of rural and urban branches.

Berger et al (1987) developed a methodology for evaluating the competitive viability of firms in multi-product industries and applied to 1983 US banking data. The scale, scope and product mix economy results taken as a whole suggested that banks in branching states may survive the increased

competitive pressure from deregulation with a minimum of required behavioural changes. The study observed that large unit state banks have failed primarily due to over extended office sizes and recommended that those banks have to alter their output configurations to reduce average office sizes subsequent to branching deregulation.

Jain (1988) attempted to provide an empirical evidence for economies of scale in banking industry and various branches in different population groups. The study found that the average cost curve is generally "L" shaped for individual banks. As per the study, economies of scale for banks were illustrated in terms of business per employee. It was found that economies of scale operate in the case of individual banks and larger the size of the bank better is the scope for economies of scale. Further it revealed that interest paid on deposits and establishment expenses were significant factors determining the economies of scale both at branch level and at bank level.

Ghaffar and Habibullah (1990) made an attempt to determine the possible existence of economies of scale in Malaysian banking sector for 1985 and 1986. The study used cost function approach. For that purpose bank output was proxied by the sum of loans and advances and deposits and total cost was proxied by subtracting net profit from total revenue. The equation was estimated by using ordinary least squares. The study concluded that the foreign banking sector in Malaysia exhibited scale economies, and as scale increases, cost per unit of output decreases.

Noulas et al. (1990) examined the cost function for large banks with a view find out whether concentrated banking industry result in lower costs due to sca economies. The study estimated a translog variable cost function with four output four variable inputs and a quasi – fixed input for the banks with assets in excess of $ billion (a total of 308 banks). The study rejected the hypotheses of short run and lor run constant returns to scale. As per the study, banks with $ 1-3 billion in asse exhibited scale economies and diseconomies set in between $ 3-6 billion and continu through larger bank sizes. The study also examined the degree of input substitutabilit and found that all variable inputs emerged as pair wise substitutes and labour an capital had the highest degree of substitutability among all inputs. Further, it reveale that all input demands were inelastic implying that banks face some restrictions in th use of liability management. The main limitation of the study was that it was based o data for a single year and as such the findings were tentative.

Gropper (1991) tested whether scale economies exist beyond some small leve of output for US banks during 1979 – 1986. The study used intermediation approac and for estimating the cost function, the prices of inputs labour, capital and fund were estimated over a range of branch banking states and unit banking states. Th increased degree of scale economies was due to the fact that recent regulatory an technical changes gave larger banks a cost advantage and also reduced overall numbe of banking firms.

Bishnoi (1992) attempted to examine the hypothesis that economie of scale are small and diminish with increase in size and they vary witl

organizational structure. The hypothesis was examined with reference to 27 public sector and 21 private sector Indian commercial banks. The amount of deposits was used as an indicator of bank size because deposits accounted for 90 percent of total liabilities in bank balance sheet and 41 percent of total bank's operating cost was spent on deposit mobilization. The study reported that though public sector banks and private sector banks differed in size and organizational structure the economies of scale available to both these groups were more or less equal. In respect of branch economies, both the groups enjoyed equal advantages.

Kim (1992) analyzed the existing methods of estimating the translog production function and provided a general framework that allowed for variable returns to scale. The model was based on the inverse input demand function and a non-homothetic production technology. The results of the study revealed that neither homotheticity nor constant returns to scale is a proper description of the underlying production technology.

Pulley and Braunstein (1992) proposed a composite cost function by combining a quadratic output structure with a log-quadratic input price structure for examining economies of scope, subadditivity and other important properties of multi product firms. The sample consisted of 1988 data from 205 banks having assets greater than $ 1 billion in 1988. As per the study, banks were considered to produce loan outputs and the study found that large banks enjoyed very little in the way of scale advantages.

Elavia and Bansal (1993) examined the cost-output relationships in the Indian banking industry. By using profit function approach, the study examined whether economies of scale exist in the banking industry. The study found that the Indian banking system as a whole enjoyed economies of scale. It also revealed that the business (output) of banks could be increased without adverse impact on costs. The limitation of the study was that input and output prices were measured only in terms of averages.

Narayanasamy and Babu (1993) studied the hypothesis of economies of scale for regional rural banks (Pandyan Grama Bank) in 1984. The objective was to examine empirically the relationship between size and cost on the one hand and size and earnings on the other. The results substantiated the hypothesis of economies of scale at branch level. The study found that many branches were making only marginal profits. Hence the study suggested that the branch might concentrate on measures for improving profits by strengthening capital base, control of staff unproductivity, better credit management, proper end-use control, supervision and follow-up, proper accountability and reduction of non-performing assets to maintain spread.

Clark and Speaker (1994) provided new evidence on the extent of economies of scale and scope in the banking industry. It used a generalized translog statistical cost function for 402 banks in 1989. The study found the presence of statistically significant relatively large economies of scale for all size classifications. The study also observed that, there appeared to be economies from joint production of selected product pairs but these efficiencies appeared to

be offset by diseconomies in the production of others. The results of the study did not provide support for the existence of natural monopoly in the commercial banking industry. The study recommended that many smaller banks could improve their productive efficiency through increase in size.

Subrahmanyam (1994) showed a methodologically new approach to the theory of banking firm by treating both loans and deposits as output in a transformation function in the measurement of scale economies. The study found that deposits should be treated as input because, banks pay a positive price (interest) to buy funds and no loans can be made without the flow of funds into banks through deposits. The study shed light on the impact of scale economies on the efficiency and productivity growth of the financial firm.

Ray and Sanyal (1995) analyzed the scale economy among Indian nationalized commercial banks for 1989-90. The objectives of the study were to find out whether Indian nationalized commercial banks enjoy operational efficiencies through scale expansion and whether the expansion of services via new branching was cost efficient to the service expansion at existing branches. The study defined a bank's output by its total deposit, loans and advances and investment in corporate bodies. Branching service was identified as a distinct output measured in terms of number of branches and interest expenses were excluded from total costs. Translog function was used to estimate the scale and scope economy. The study found that an overall scale expansion of sample bank was highly cost efficient and the degree of scale economies varied inversely with the asset size of banks. The study revealed that the expansion of output at

existing branches was more cost efficient than the expansion of output via new branching. Further for a moderate scale of expansion, a substantial output expansion programme was cost efficient when a branch expansion programme accompanied it. The main limitation of the study was that it used only one year cross section data, solely concentrated on the cost domain and neglected the revenue domain and organizational efficiencies.

Clark (1996) attempted a study on scale economy and competitive viability in banking. In his view, there had been relationship between bank size and efficiency. The study was based on the data relating to U.S. commercial banking organizations for the year 1988 to 1991. In each of four years, banks were placed in the size quartiles. In each size quartile, only those banks with average costs in the lowest average cost quartile were retained. This procedure was implemented for both production costs and economic costs. Economic cost is a combination of operating cost and interest cost. To increase the number of degrees of freedom available to estimate the parameters of the cost function data, the data for four years were pooled providing complete data on 440 banks organizations. The study estimated scale economy based on the estimates computed from the mean values of all independent variables for each of the same ten size classifications along with the parameters from the estimated composite cost function. In all instances the estimated values of scale were greater than one and statistically significant. The study found that the combined effects of change in scale and output mix appeared to increase efficiency upto $ 6 billion dollars of total assets. The study proved that expansion path subadditivity estimates for banking organizations operating along the production

cost thick frontier remained positive and average approximation was 1 percent for movements across adjacent size classification between $ 3 billion and $ 20 billion of total assets. The expansion path subadditivity estimates for those banking organizations operating along the economic cost thick frontiers averaged slightly more than 1 percent and declined steadily across the corresponding size classifications. As per the study, economic cost inefficiency was estimated to be small (approximately 3 percent) and largely invariant with size. But, production cost inefficiency was found to be considerably larger (approximately 9 percent) and increased with size.

Chatterjee (1997) used translog cost function to analyse scale economies of Indian commercial banks for 1994-95. As per the study, total advances and investments (in value terms) were taken as output and labour, fixed capital and purchased funds (deposits plus borrowings) were taken as inputs. The total costs included establishment expenses and interest expenses (on deposits and borrowings). Price of labour was determined by the ratio of establishment expenditure to the total number of employees irrespective of their grades. Price of capital was determined by the ratio of the sum of expenditure on rent, repair and depreciation to the total value of assets. Price of purchased fund was determined by the ratio of total interest expenses to the aggregate amount of deposits and borrowings. The number of branches was included as a control variable in the cost function.

The translog model fitted to the cost function was as follows

$$\ln C = a_o + \Sigma a_i \ln y_i + \Sigma b_j \ln P_j + \tfrac{1}{2} \Sigma \Sigma C_{ir} \ln y_i \ln y_r + \tfrac{1}{2} \Sigma \Sigma d_{js} \ln P_j \ln P_s + \Sigma \Sigma f_{ij} \ln y_i \ln P_j + g_o \ln B + \Sigma g_i \ln y_i \ln B + \Sigma h_j \ln P_j \ln B + \tfrac{1}{2} k \Sigma \ln B \ln B + u \quad \ldots.(1)$$

where C= Total cost including interest expenses;

y_i's = The output indicators ; i=1,2.....;

P_j 's = The input prices j = 1, 2, 3;

B = Number of branches and

u = Error term

The symmetry condition required $C_{ir} = C_{ri}$ for all i, r and $d_{js} = d_{sj}$ for all j,s ....(2)

The linear homogeneity of the cost function in input prices imposed the following condition on the parameters.

$$\Sigma b_j = 1 \quad \ldots.(3a)$$

$$\Sigma d_{js} = 0 \text{ for } j = 1,2, \quad \ldots.(3b)$$

$$\Sigma f_{ij} = 0 \text{ for } i= 1,2, \quad \ldots.(3c)$$

$$\Sigma h_j = 0 \quad \ldots.(3d)$$

The independent variables were normalized with respect to their means before taking logarithms. The cost function was augmented by the input share equations as follows.

By Shepherd's Lemma, factor demand equation for input j is

$$X_j = \partial C / \partial P_j \quad \ldots\ldots(4)$$

So that $\partial \ln C / \partial \ln P_j = P_j X_j / C$, the share of jth input (S_j) in the cost.

$$\text{But } \partial \ln C / \partial \ln P_j = b_j + \Sigma d_{js} \ln P_s + \Sigma f_{ij} \ln y_i + h_j \ln B \quad \ldots..(5)$$

Thus,

$$S_j = b_j + \Sigma d_{js} \ln P_s + \Sigma f_{ij} \ln y_i + h_j \ln B \text{ for } j = 1,2,3 \quad \ldots\ldots(6)$$

This together with the cost function formed the system of equations to be solved and these equations were simultaneously solved through seemingly unrelated regression (SUR) technique.

After obtaining the parameter estimates, Ray scale economies (RSCE) were measured as elasticity of cost with respect to output keeping product mix constant. The estimated Ray scale economy measures showed that under constant output-mix, most of the banks in India would have cost efficiency gains if they expand their business at the existing branches. However, if new branches were opened to handle the increased business, only the small and medium sized private sector banks will gain cost efficiency. The study recommended the policy of merger and regrouping among the small sized banks in order to reap the maximum benefit of scale economies.

Das (1997) investigated whether economies of scale exist in the Indian public sector banks and examined the possibility of deriving the least cost size for these banks for 1994-95 and 1995-96. By using a cubic cost function the study attempted to derive and estimate the marginal and average cost functions. The 'U' shaped marginal cost curves indicated that scale economies existed in all the 27 public sector banks and it was difficult to infer about the point where the average cost curve rose. The study revealed that large size banks enjoyed certain non-pecuniary benefits like greater placing power in the international market, commanding greater confidence and trust of the customers and greater

freedom to introduce newer products. Hence the determination of the optimal size of a bank should take into account the strategies followed by banks. The study inferred that scale economies were highly correlated with technical break through that banks are making nowadays.

Clifford (1998) presented the first empirical analysis of the cost structure of the U.S. mortgage industry. By using a sample of mortgage banks originating and servicing loans between 1990-1992, the study estimated a stochastic cost frontier model. As per the study, estimates of ray scale economy and expansion path scale economy showed evidence of substantial scale economies in the industry which were not exhausted even at the largest output sizes.

Joseph and Loretta (1998) formulated the standard cost model to account for the role of financial capital in banking and used 1989 and 1990 data for the sample of 286 banks in United States of America. The study computed scale economies without assuming that the bank chooses a level of capitalization that minimizes cost and found evidence of substantial scale economies.

Tseng (1999) examined whether scale and scope economies exist among California banks. The study used both translog and quadratic cost functions. As per the study, based on the quadratic cost functions, only federal funds sold clearly demonstrated significant scale economies and when translog cost function was specified, the results remained mixed.

A careful perusal of the existing literature on economies of scale of commercial banks revealed that the research efforts had been directed at estimating scale economy and identifying the factors contributing for economies

of scale . But there are wide variations in the management and business operations among different bank groups especially in Indian commercial banks, viz., public sector banks and private sector banks. Inter bank group comparison of scale economy measures is of great interest to the bankers as well as policy makers in India. Hence the current study on " Economies of scale in Indian commercial banks (1973-1996)" tried to measure the scale economy of Indian public sector and private sector banks.

METHODOLOGY

CHAPTER III

METHODOLOGY

The methodology relating to the current study on 'Economies of scale in Indian commercial banks - (1973 – 1996)' is discussed under the following headings:

A. Selection of the banks for the study;

B. Database of the study;

C. Period of the study;

D. Approach used in the study;

E. Concepts used;

F. Hypotheses framed;

G. Theoretical framework;

H. Model estimation and

I. Tabulation and analysis of data.

A. Selection of the banks for the study:

In India, the commercial banking system comprises of scheduled[6] and non-scheduled commercial banks. [Public sector banks, private sector banks and regional rural banks[7] are the three groups of scheduled commercial banks in India].

---

[6] Scheduled commercial banks are those commercial banks, which are included in the Second Schedule of the Reserve Bank of India Act of 1934. As per the Reserve Bank of India Act of 1934, a commercial bank to qualify for inclusion in the Second Schedule must have a minimum paid up capital and total reserves of Rs.5 lakhs. (Source: Reserve Bank of India Bulletin, 2001-02, p.82).

[7] Regional rural banks are state sponsored, regional based and rural oriented commercial banks introduced in the Indian banking system in 1975 (Source: Ibid, p.84).

The current study relates to scheduled public sector banks and private sector banks in India. The scheduled public sector banks comprise of the State Bank of India, its associate banks and nationalized commercial banks. Table I provides the list of public sector banks in India.

TABLE I

LIST OF PUBLIC SECTOR BANKS IN INDIA

S.No	Name of the bank
1	Allahabad Bank
2	Andhra Bank
3	Bank of Baroda
4	Bank of India
5	Bank of Maharastra
6	Canara Bank
7	Central Bank of India
8	Corporation Bank
9	Dena Bank
10	Indian Bank
11	Indian Overseas Bank
12	New Bank of India
13	Oriental Bank of Commerce
14	Punjab National Bank
15	Punjab and Sind Bank
16	State Bank of Bikaner and Jaipur
17	State Bank of Hyderabad
18	State Bank of India
19	State Bank of Indore
20	State Bank of Patiala
21	State Bank of Mysore
22	State Bank of Saurashtra
23	State Bank of Travancore
24	Syndicate Bank
25	Union Bank of India
26	United Bank of India
27	United Commercial Bank
28	Vijaya Bank

Of these 28 banks – Andhra Bank, Vijaya Bank, Corporation Bank, Punjab and Sind Bank, Oriental Bank of Commerce and New Bank of India were nationalised only in March 1980 and other fourteen banks were nationalised in July 1969. Since reference period of the current study starts from 1973 the study could not include the six banks which were nationalised in 1980. Table II presents the list of public sector banks included in the study.

TABLE II

LIST OF PUBLIC SECTOR BANKS INCLUDED IN THE STUDY

S.No	Name of the Bank
1	Allahabad Bank
2	Bank of Baroda
3	Bank of India
4	Bank of Maharastra
5	Canara Bank
6	Central Bank of India
7	Dena Bank
8	Indian Bank
9	Indian Overseas Bank
10	Punjab National Bank
11	State Bank of Bikaner and Jaipur
12	State Bank of India
13	State Bank of Hyderabad
14	State Bank of Indore
15	State Bank of Mysore
16	State Bank of Patiala
17	State Bank of Saurashtra
18	State Bank of Travancore
19	Syndicate Bank
20	Union Bank of India
21	United Bank of India
22	United Commercial Bank

The private sector banks in India comprises of thirty banks including nine newly started banks in 1993. Table III presents the list of private sector banks in India.

TABLE III

LIST OF PRIVATE SECTOR BANKS IN INDIA

S.No	Name of the Bank
1	Bharat Overseas Bank Limited
2	City Union Bank Limited
3	Lord Krishna Bank Limited
4	Tamilnadu Mercantile Bank Limited
5	The Bank of Rajasthan Limited
6	The Banares State Bank Limited
7	The Catholic Syrian Bank Limited
8	The Dhanalakshmi Bank Limited
9	The Federal Bank Limited
10	The Bareilly Corporation Bank Limited
11	The Jammu and Kashmir Bank Limited
12	The Karnataka Bank Limited
13	The Karur Vysya Bank Limited
14	The Lakshmi Vilas Bank Limited
15	The Nainital Bank Limited
16	The Nedungadi Bank Limited
17	The Ratnakar Bank Limited
18	The Sangli Bank Limited
19	The South Indian Bank Limited
20	The United Western Bank Limited
21	The Vysya Bank Limited
22	SBI Commercial and International Bank Limited
23	Bank of Punjab Limited
24	Centurion Bank Limited
25	Global Trust Bank
26	HDFC Bank
27	ICICI Bank
28	IDBI Bank
29	Indus and Ind Bank Limited
30	UTI Bank

Of these banks, nine banks – SBI commercial and international bank limited, Bank of Punjab Limited, Centurion Bank Limited, Global Trust Bank, HDFC Bank, ICICI Bank, IDBI Bank, Indus and Ind Bank Limited and UTI Bank were the new private sector banks established in 1993. Since at the time of data collection, the published information was available only for one year (1994-95) for these banks, the study could not include the newly started private sector banks. As such, the study covered twenty one old private sector banks and Table IV provides the list of private sector banks included in the study.

TABLE IV

LIST OF PRIVATE SECTOR BANKS INCLUDED IN THE STUDY

S.No	Name of the Bank
1	Bharat Overseas Bank Limited
2	City Union Bank Limited
3	Banares State Bank Limited
4	Lord Krishna Bank Limited
5	Tamilnadu Mercantile Bank Limited
6	The Bank of Rajasthan Limited
7	The Catholic Syrian Bank Limited
8	The Dhanalakshmi Bank Limited
9	The Federal Bank Limited
10	The Bareilly Corporation Bank Limited
11	The Jammu and Kashmir Bank Limited
12	The Karnataka Bank Limited
13	The Karur Vysya Bank Limited
14	The Lakshmi Vilas Bank Limited
15	The Nainital Bank Limited
16	The Nedungadi Bank Limited
17	The Ratnakar Bank Limited
18	The Sangli Bank Limited
19	The South Indian Bank Limited
20	The United Western Bank Limited
21	The Vysya Bank Limited

The current study excluded foreign banks, since in India, the foreign banks have played an active role only after liberalisation process. Between 1973-1980, the number of foreign banks existing was only 12 and only between 1992-1999, 20 new foreign banks began operations in India (Monthly Public Opinion Survey, 2000). Further, the percentage share of foreign banks in total assets, credits, investments and number of branches of scheduled commercial banks in India had been limited. In 1989, foreign banks accounted only for 5.24 percent of the total deposits, 7.69 percent of total credits, 3.96 percent of total investments and 0.31 percent of number of the branches of all scheduled commercial banks. In 2000-01, foreign banks constituted only 7.9 percent of the total assets of scheduled commercial banks (Mathew Joseph, 2002). Further, the branch network of foreign banks had been extremely limited and they were mainly concentrated in metropolitan cities like New Delhi, Mumbai, Calcutta, Chennai, etc. Unlike Indian public sector and private sector banks, foreign banks till March 1989 were not involved in priority sector lending. Moreover between 1979 and 1986 the annual compound growth rate of employment in foreign banks was only 0.7 percent as against 6.7 percent in the public sector banks (Nag and Shivaswamy,1990).

The study covered public sector banks and private sector banks due to the fact that at the end of March 2000, of the total assets of all scheduled commercial banks, public sector banks constituted about 80 percent and private sector banks constituted 12.5 percent (Report on Trend and Progress of Banking, 1999-2000). In this context, Reddy (2002), Deputy Governor of the Reserve Bank of India

stated that it is meaningless to compare domestic banks, a category accounting for over 90 percent of the banking activities with a small segment of foreign banks.

B. Database of the study:

The study was based on the data relating to assets, advances, investments, deposits, borrowings, employees, fixed capital, operating expenses, interest paid and number of branches of public sector and private sector banks in India.

The data relating to variables required for the study were compiled from the following publications of the Reserve Bank of India and the Indian Banks' Association.

I. Publications of the Reserve Bank of India

1. Report on Currency and Finance
2. Reserve Bank of India Monthly Bulletin
3. Reserve Bank of India, Annual Report
4. Report on Trend and Progress of Banking in India.

II. Publications of Indian Banks Association

1. Financial Analysis
2. The Performance Highlights

From these reports, the monetary values of the variables were obtained. In the current study, to account for inflation, the monetary values of the variables were converted into real values by using Gross National Product (GNP) deflator. The study had used GNP deflator since it is an index of the price of all goods and

services including capital goods entering into Gross National Product. As Doti and Aditi (1988) remarked, Gross National Product deflator is a highly aggregated index of price changes and Wallace (1970) remarked, division of the current dollar estimates by the constant dollar estimates yields an implicit index of overall rate of price change.

The Gross National Product deflator is obtained as follows

$$\left[\frac{\text{Gross National Product at current prices}}{\text{Gross National Product at constant prices}}\right] \times 100.$$

The data of Gross National Product at current prices and Gross National Product at constant prices (1993-94 prices) for the reference period were compiled from Economic Survey published by Government of India. This method of finding out the real values was adopted by Ganti Subrahmanyam (1995) in formulating a direct translog model of Indian household sector financial portfolios and Rouseau and Wachtel (1998) in the analysis of financial intermediation and economic performance.

C. Period of the study:

The study was related to the period 1973-1996 since it was marked by significant developments in Indian banking system. The period 1973–1980 represented the first phase of nationalisation which was significant with the implementation of the social requirement set out by the Reserve Bank of India and Government of India in terms of priority sector advances and branch growth. The period 1980-1990 was of considerable importance with the second phase of nationalisation. The period 1991-1996 was remarkable with the implementation

of financial sector reforms and new credit policy measures[8] which were introduced as per the recommendations of Narsimham Committee (1991).

D. Approach used in the study:

In general, two approaches are used to examine the viability of the banking industry: the production approach and intermediation approach. Humphrey (1985) made a useful distinction between the production approach and intermediation approach to bank behaviour.

The production approach views banks as producing demand deposits, time deposits and savings deposits, commercial loans, real estate loans and instalment loan using capital, labour and materials. In this case, the number of accounts provide the appropriate measure of bank output. As per this approach, the interest expenses are not included in the total cost and hence the total cost include only operating costs incurred in the production of output. Gilligan and Smirlock (1984), Gilligan, Smirlock and Mernhall (1984) and Ferrier and Lovell (1990) based their analysis on production approach.

The intermediation approach treats banks as collector of funds which are then intermediated into loans and other assets. The monetary value of deposit accounts and loans is the appropriate measure of bank output. As per this

---

[8] The new credit policy measures introduced in 1996 consist of
(1) Reduction in cash reserve ratio from 15 percent to 3 to 5 percent
(2) Allowing banks to lend at interest rate below their prime lending rate
(3) Phased reduction in the bank rate, etc.
(Source: Talwar, S.P, (2000), 'March to the new millenium by Indian banks' in Ongoing developments in banking and financial sector', ed by Raj Kapila and Uma Kapila, Academic foundation, New Delhi, p.14).

approach, operating costs plus interest costs provide the appropriate measure of total cost.

Since the intermediation approach is concerned with the overall cost, it is appropriate for studying the economic viability of banks. It is also appropriate when the sample contains large banks which found a large share of their assets from non deposit sources (Kaparakis et al, 1994).

Murray and White (1983), Kim (1986), Glass and McKillop (1992), Ray and Sanyal (1995), Chatterjee (1997), Wheelock and Wilson (1999) adopted intermediation approach. Berger, Hannah and Humphrey (1987) used intermediation approach in their analysis of competitive viability in banks. In the current study, intermediation approach is used and the total cost is defined as the sum of operating costs and interest costs.

E. Concepts used:

i) Assets:

The assets of the commercial banks comprise of fixed assets, balance with the Reserve Bank of India, money at call and short notice, advances and investments and other assets.

ii) Advances:

Advances of commercial banks includes over drafts, bills purchased, cash credit and term loans.

iii) Investments:

Investments of the commercial banks include investment in government securities, shares, bonds, debentures, subsidiaries, joint ventures and other approved securities.

iv) Purchased funds:

Purchased funds are total resources which include aggregate deposits and borrowings.

v) Aggregate deposits:

Aggregate deposits include deposits from public (current, saving and fixed) and deposits from banks (current and fixed). It includes the total of all demand and time deposits. A high deposit figure signifies bank's equity, branch networth and deposit mobilisation strength.

vi) Borrowings:

Borrowings of the commercial banks includes borrowings from the Reserve Bank of India, borrowings from other banks and borrowings from other institutions and agencies.

vii) Employees:

Employees of the commercial banks denotes the total number of employees, which includes officers, clerks and subordinates both part time and full time.

viii) Fixed Capital:

Fixed capital of the commercial banks comprises of investments in office building, office equipments, computer, furniture, etc.

ix) Branches:

The branches of the commercial banks include rural, semi rural and urban and metropolitan branches. Extension counters, service branches, regional collection centres and administrative offices are excluded, while counting the number of branches.

x) Total Cost:

The total cost for commercial banks includes operating expenses, interest cost and provisions and contingencies. Operating expenses of the commercial banks include payment for employees, rental charges, taxes, printing, stationary and postal charges, advertisement and publicity charges, auditor's fees, expenses on depreciation of bank property, fees, repairs and maintenance, insurance, business travels, etc. Interest cost includes the interest on deposits, interest on borrowings from the Reserve Bank of India and other banks.

xi) Inputs and Outputs:

Inputs are the resources consumed in producing the goods and services by an organisation. Outputs are the goods and services produced by an organisation that are usable, saleable and of acceptable quality.

There had been major controversy in banking literature about output and inputs. Mester (1987) and Clark (1996) considered the bank's output to be its advances and investment. However, Bell and Murphy (1968), Benston (1965), (1972), Longbrake and Heslem (1975) and Benston et al (1982) treated deposits as an output. They argued that depositors derive such benefits as liquidity, security and portfolio services which continue to be a major part of the technical

output of a banking firm. However, Aly et al (1990) considered bank asset as an output. Following Mester (1987) and Clark (1996), the current study considered advances and investments as bank's output.

Generally labour, capital and purchased funds are considered as inputs. Labour is measured by the number of full time equivalent employees on the payroll at the end of each period. Physical capital is measured by the book value of premises, furniture, equipment and fixed assets. Purchased funds includes time and savings deposits and borrowings. There has been controversy about treating deposits as an input. Klein (1971), Pingle (1973), Sealey and Lindley (1977), Shafter and Holdsworth (1983), Subrahmanyam (1984) and Hughes and Mester (1993) argued that deposits must be treated as input because banks pay a positive price (interest) to buy funds and no loans and investments can be made without the flow of funds into banks through deposits. Ray and Sanyal (1995) and Chatterjee (1997) considered labour, fixed capital and purchased funds as inputs. Following them the current study considered labour, fixed capital and purchased funds (deposits and borrowings) as inputs.

xii) Bank size:

It is necessary to understand the concept of size in the context of banking. Total deposits, total loans and advances, total assets and total number of branches have been used as the criteria for bank size. Rangarajan and Mampilly (1972), Amal and Jacowiski (1989), Lawrence (1989), Aly et al (1990) used total deposits as a criteria for size. Researchers like McAllister and McMarcus (1993), Kaparakis, Miller and Noulas (1994), Clark (1996), Mitchell and Onvural (1996),

Hughes and Mester (1998) and Kishan and Opiela (2000) considered assets as an indicator of the size of commercial banks. Following them, the current study considered assets as an indicator of the size of commercial banks.

F. Hypotheses framed:

The current study formulated the following hypotheses:

(i) Economies of scale do not exist in Indian commercial banks and they are not scale efficient; and

(ii) There is no difference in scale economy between Indian public sector banks and private sector banks.

G. Theoretical framework:

(i) Scale economy:

Scale economy represents the percentage change in bank's operating cost on account of a percentage change in the bank output. If we consider a bank uses inputs $x = (x_1,....x_n) \varepsilon R^n_t$ available at fixed prices $w = (w_1,....w_n) \varepsilon R^n_t$ to produce outputs $Q = (Q_1,....Q_n) \varepsilon R^m_t$, the producer is assumed to strive to produce outputs Q at mimimum cost. If the minimum total cost function C(Q, w), which we refer to as the cost frontier, is translog, then we may write the producer's observed (log) total cost and observed input cost shares as

$$\ln (w^j, x)_s = \alpha_o + \sum_{i=1}^{n} \alpha_i \ln Q_{is} + \sum_{i=1}^{n} \beta_i \ln w_{is} + \tfrac{1}{2} \sum_{i=1}^{n}\sum_{j=1}^{n} \alpha_{ij} \ln Q_{is} \ln Q_{js} + \tfrac{1}{2} \sum_{i=1}^{n}\sum_{j=1}^{n} \beta_{ij} \ln w_{is} \ln w_{js} + \sum_{i=1}^{n}\sum_{j=1}^{n} \delta_{ij} \ln Q_{is} \ln w_{js} \quad ....(7)$$

$$(w_j . x_j / w' . x) = [\beta_j + \sum_{k=1}^{n} \beta_{jk} . \ln w_{ks} + \sum_{i=1}^{n} \delta_{ij} . \ln Q_{is}] \quad ....(8)$$

where w', $x = \sum_{i=1}^{n} (w_j . x_i)$, s = 1,.....S indexes produces, and j indexes inputs. All producers share a common cost frontier, and so by Shepherd's Lemma, share common efficient cost share equations (Ferrier and Lovell, 1990).

Economies of scale are measured as $= \Sigma \frac{\partial \ln C}{\partial \ln Q} = \Sigma \frac{\partial \ln C (Q, x)}{\partial \ln Q}$ ....(9)

In the estimation of scale economy there is a need for regulating the variable of branching. If branching is treated as constant in the estimation, it represents scale economies at the firm level and if it is treated as a variable in the estimation, it gives an idea of scale economies at the plant level (Noulas, Ray and Miller,1990). Following them the current study tried to measure the plant level scale economy through inclusion of branch variable in the cost function and firm level scale economy by excluding the same from the cost equation.

There are two concepts of scale economy – ray scale economy and expansion path scale economy. Ray scale economy indicates how total cost behaves as the scale of the firm expands but the output mix remains constant. Ray scale economy exist when the total cost of production increases at a decreasing rate as the level of the output expands (Moschandreas, 1994).

Ray scale economy is measured by the following formula

$$RSE = \Sigma \frac{\partial \ln TC}{\partial \ln Q_i} \quad \text{....(10)}$$

where TC denotes the total cost, and Q_i is the total output of ith commodity.

If ray scale economy measure is less than the unit value, it represents scale economies and when the measure is greater than the unit value, it indicates scale diseconomies (Benston et al, 1983).

Berger et al (1987) developed a new measure of scale economy called Expansion Path Scale Economy (EPSCE), which captures the impact of changing scale and product mix simultaneously by changing the mean output levels of representative banks in successive size classes as expansion path.

If the output bundle Q^A is expanded to Q^B then,

$$EPSCE=\Sigma \left[\frac{(Q_i^B - Q_i^A)}{Q_i^B} \quad \frac{C(Q)^B}{C(Q)^B - C(Q)^A} \quad \frac{\partial \ln C(Q)^B}{\partial \ln Q_i^B} \right] \qquad ....(11)$$

Where $Q^A = [Q_1^A, Q_2^A]$ and $Q^B = [Q_1^B, Q_2^B]$ are the output bundles on expansion path AB and $C(Q^A)$ and $C(Q^B)$ are the costs associated with the output. If EPSCE $(Q^A, Q^B) < 1$ there is scale economy on segment AB, while EPSCE $(Q^A, Q^B) > 1$ indicates diseconomies.

ii) Scale efficiency:

According to Koopmans (1951), a firm is efficient if it is not possible to increase any output without reducing atleast one output given the inputs, or a reduction in the use of any input is not possible without increasing some other inputs.

According to Farrell (1957) inefficiency is defined as the failure to achieve maximum possible output from the chosen combination of inputs. Assuming that the production function is characterized by constant returns to scale, Farrell

(1957) observed that the input per unit of output value for firms would lie on or above the unit isoquant.

In Farrell's view a firm is output efficient if it produces maximum output from a given quantity of measurable inputs. Farrell's measure of output inefficiency of firm 'i' is

$$Q_i = a_i f(x_i) \quad 0 < a_i < 1 \qquad \ldots.(12)$$

Where a_i is a firm specific parameter measuring the degree to which observed output Q_i is less than frontier output.

Farrell method requires normative criterion (i.e) cost minimization or profit maximization to judge individual observations. Different observations are then compared to these normative efficient reference sets. Farrell's approach is based on the technology set consisting of input-output vectors which was reformulated as a mathematical programming problem by Charnes et al (1978).

Fare, Grosskopf and Lovell (1994) suggest that a measure of scale efficiency compares the distance between the input requirement set for the given observations and the boundary of the input requirement set associated with constant returns to scale.

To calculate this measure, Fare, Grosskopf and Lovell suggest the construction of two functions which map inputs and outputs onto the real number line.

$$F(Q, x) = \text{minimise } (\lambda \in R_t / \lambda_x \in V(Q)^t \text{ and} \qquad \ldots.(13)$$

$$W(Q,x) = \text{minimise } \{\lambda / \lambda \in R_t / \lambda_x \in V Q^c\} \qquad \ldots.(14)$$

where $Q \in R_t$ represents a vector of output; $X \in R_t$ represents a vector of input. $V(Q)^t$ represents the subset of all input vectors which yield atleast Q and $V(Q)^c$ is input requirement under the constant returns to scale.

The measure of scale efficiency is defined as the ratio of minimum costs to observed costs (Das, 1997) and hence it is defined as

$$S(Q, x) = W(Q, x) / F(Q, x) \quad \text{....(15)}$$

If $S(Q, x) = 1$, the observed input combination is consistent with cost minimisation and hence the observation is scale efficient . If $S(Q, x) < 1$, the observation is scale inefficient.

H. Model estimation:

i) Estimation of scale economy:

The current study had used econometric technique and formulated the cost function to measure scale economy. As quoted by Morrison et al (1999), the cost function models explicitly represent the underlying factors causing movements along short and long run cost curves and responses to exogenous changes in these functional relationship from technical changes or other explicitly defined external factors. Such models allow a more complete evaluation of producer behaviour through a wide range of input specific substitution pattern.

There are many forms of cost function – quadratic cost function, cubic cost function, translog cost function. The current study had used translog cost function (Transcedental logarithmic cost function) due to its superiority.

The translog cost function represents a very general production structure which is non homothetic and has no restriction on elasticity of substitution. As

1. $F(Q, x) = \min \lambda z \{ \lambda / z M \geq y ; z N \leq \lambda_x \Sigma z_i = 1; z_i \quad 0 \}$ and ....(47)
2. $W(Q, x) = \min \lambda z \{ \lambda / z N \geq y ; z N \leq \lambda_x ; z_i \quad 0 \}$ for each observation ....(48)

The above linear programme is solved by following data envelopment analysis.

In banking, some researchers have applied data envelopment analysis to study the efficiency of banks. Sherman and Ladino (1995) have attempted a study on managing bank productivity using data envelopment analysis. Athenassopoulos (1998) have used data envelopment analysis model for assessing the market and cost efficiency of large scale bank branch networks. Pastor et al (1997) used the non parametric technique to a cross section of 427 banks in 8 developed countries to assess the efficiency.

Das (1999) had used in his study data envelopment analysis to estimate scale efficiency in banking. Following this, the current study assumes that there are 'n' DMU's (n banks) to be evaluated. Each decision making unit (DMU) consumes varying amounts of 'x' inputs (labor, fixed capital and purchased funds) to produce 'Q' different outputs (advances and investments). Specifically DMU_j – consumes amount x_{ij} of input i and produces amount of Q_{rj} of output r. The study assumes as in Charnes, Cooper and Thrail (1986) that $x_{ij} > 0$ and $Q_{rj} > 0$ and further that each DMU has atleast one positive input and positive output value.

The essential characteristic of the CCR construction is the reduction of the multiple-output / multiple-input situation for each DMU to that of a single virtual output and virtual input. For a particular DMU the ratio of the single virtual output

to single virtual input provides a measure of efficiency. In mathematical programming, this ratio which is to be maximised forms the objective function for the particular DMU being evaluated, so that symbolically

$$\underset{u,v}{\text{Max}}\ h_o(u,v) = \sum_r u_r Q_{ro} / \sum_i v_i x_{io}$$

Where Q_{ro} = Observed output value of decision making unit o;

x_{io} = Observed input value of decision making unit o;

u_r, v_i = weights to be determined for the output and input.

The mathematical programming problem for Charnes, Cooper and Rhodes (CCR) (input oriented) ratio form is

$$\underset{u,v}{\text{Max}} \sum_r u_r Q_{ro} / \sum_i v_i x_{io}$$

$$\sum_r u_r Q_{rj} / \sum_i v_i x_{ij} \leq 1 \text{ for } j = 0, 1, \ldots\ldots n, \text{ and} \qquad \ldots.(49)$$

$$u_r , v_i \geq 0.$$

Since the ratio form yields an infinite number of solutions, we can define an equivalent relation which partitions the set of feasible solutions into equivalence classes. The transformation developed by Charnes and Cooper (1962) for linear fractional programming selects a representative solution (i.e) the solution (u,v) for which $v^T x_o = 1$ from each equivalence class and yields the equivalent linear programming problem. The change of variables to (μ, v) is a result of transformation.

$$\underset{u,v}{\text{Max}}\ z = \mu^T Q_o \qquad \ldots.(50)$$

Subject to

$$v^T x_o = 1,$$

$$\mu^T Q - v^T X \leq 0,$$

Similarly, EPSCE were also estimated at the plant level and firm level by including and excluding the branch variable in the cost function. They were denoted by EPSCEP and EPSCEF respectively.

ii) Estimation of scale efficiency:

The current study tried to measure scale efficiency by using non parametric method. The non parametric method initiated as Data Envelopment Analysis (DEA) by Charnes, Cooper and Rhodes (1978, 1981) builds in the individual firm evaluation of Farrell (1957).

Data envelopment analysis compares the actual operating results of each service unit with those of all other service units and identifies the less-productive units- those that are operating inefficiently. It identifies the best-productive units (those that are not less efficient than other units being evaluated) and measures the magnitude of inefficiency of the less productive units compared to the best-practice units. DEA uniquely obtain these insights by explicitly considering the volume and mix of resources used and the volume and mix of services provided by each service unit. The best-productive units are relatively efficient and are identified by a DEA productivity rating of 100 percent. The inefficient units are identified by a productivity rating of less than 100 percent. Using only the observed output and input data for each of the decision making unit the model estimates an expost measure of how efficient each unit is in converting inputs into outputs (Sherman and Ladino, 1995).

The measure of scale efficiency requires the solution of linear programming problem.

Driswell and Boisvert (1991) remarked the translog function is preferred for its better technical performance. Previous research on the cost structure of commercial banks conclude in favour of translog cost function. Lawrence (1989), Noulas, Ray and Miller (1990) rejects both the more restrictive Cobb Douglas specification and the more flexible Box – Cox transformation in favour of the translog cost function. In the view of Kaparakis, Miller and Noulas (1994), translog cost function is superior for two reasons – it imposes virtually no restriction on the first and second order effects, and it can also be viewed as a second order logarithmic approximation to an arbitrary continuous transformation surface.

The translog functional form of the cost function was first adopted by Christensen, Jorgenson and Lage (1975). Griffin and Gregory (1976) used translog model to find out the energy substitution responses. Pindyck (1979) formulated the translog cost function in his study on international comparison of input substitution and industrial demand for energy.

In banking, most of the studies since 1980s have used translog function to represent bank's cost structure which allows multiple outputs to enter as separate variables. Zardkoohi and Koleri (1994), Subrahmanyam (1995), Ray and Sanyal (1995), Chatterjee (1997), Berger et al (1997), Peristiani (1997) and Altunbas (2001) have used translog cost function to estimate scale economies.

Model formulated in the current study:

Following Chatterjee (1997), the current study formulated the following translog cost function to find out the scale economy of Indian commercial banks.

Translog cost function at the firm level:

$$\ln C = a_o + \beta_{Q1} \ln Q_1 + \beta_{Q2} \ln Q_2 + \beta_L \ln P_L + \beta_K \ln P_K + \beta_F \ln P_F + \tfrac{1}{2} \beta_{Q1Q1} \ln (Q_1)^2$$
$$+ \beta_{Q1Q2} \ln (Q_1 Q_2) + \tfrac{1}{2} \beta_{Q2Q2} \ln (Q_2)^2 + \tfrac{1}{2} \beta_{LL} \ln (P_L)^2 + \beta_{LK} \ln (P_L P_K)$$
$$+ \beta_{LF} \ln (P_L P_F) + \tfrac{1}{2} \beta_{KK} \ln (P_K)^2 + \beta_{KF} \ln (P_K P_F) + \tfrac{1}{2} \beta_{FF} \ln (P_F)^2$$
$$+ \beta_{Q1L} \ln (Q_1 P_L) + \beta_{Q1K} \ln (Q_1 P_K) + \beta_{Q1F} \ln (Q_1 P_F) + \beta_{Q2L} \ln (Q_2 P_L)$$
$$+ \beta_{Q2K} \ln (Q_2 P_K) + \beta_{Q2F} \ln (Q_2 P_F) + u \qquad \ldots.(16)$$

Translog cost function at the plant level:

With the inclusion of branches, the formulated translog function is as follows

$$\ln C = a_o + \beta_{Q1} \ln Q_1 + \beta_{Q2} \ln Q_2 + \beta_L \ln P_L + \beta_K \ln P_K + \beta_F \ln P_F + \tfrac{1}{2} \beta_{Q1Q1} \ln (Q_1)^2$$
$$+ \beta_{Q1Q2} \ln (Q_1 Q_2) + \tfrac{1}{2} \beta_{Q2Q2} \ln (Q_2)^2 + \tfrac{1}{2} \beta_{LL} \ln (P_L)^2 + \beta_{LK} \ln (P_L P_K)$$
$$+ \beta_{LF} \ln (P_L P_F) + \tfrac{1}{2} \beta_{KK} \ln (P_K)^2 + \beta_{KF} \ln (P_K P_F) + \tfrac{1}{2} \beta_{FF} \ln (P_F)^2$$
$$+ \beta_{Q1L} \ln (Q_1 P_L) + \beta_{Q1K} \ln (Q_1 P_K) + \beta_{Q1F} \ln (Q_1 P_F) + \beta_{Q2L} \ln (Q_2 P_L)$$
$$+ \beta_{Q2K} \ln (Q_2 P_K) + \beta_{Q2F} \ln (Q_2 P_F) + \beta_B \ln B + \beta_{Q1B} \ln (Q_1 B) + \beta_{Q2B} \ln (Q_2 B)$$
$$+ \beta_{LB} \ln (P_L B) + \beta_{KB} \ln (P_K B) + \beta_{FB} \ln (P_F B) + \tfrac{1}{2} k \ln (B)^2 + u \qquad \ldots.(17)$$

where

C = Total cost which includes operating expenses and interest expenses (Deflated value measured in crores of rupees);

Q_1 = Total advances (Deflated value measured in crores of rupees);

Q_2 = Total Investments (Deflated value measured in crores of rupees);

L = Number of employees (measured in number);

K = Fixed capital (Deflated value measured in crores of rupees);

F = Purchased funds (Deposits and borrowings) (Deflated value measured in crores of rupees);

P_L = Price of labour which was obtained as the ratio of establishment expenses by the number of employees (Deflated value measured in crores of rupees);

P_K = Price of capital which was determined as the ratio of the sum of expenditure on rent, premises, furniture and equipment by the value of premises, furniture and equipment, (Deflated value measured in crores of rupees); (Discussion about the measurement of price of capital is given in Appendix I);

P_F = Price of purchased funds which was determined by the ratio of total interest expenses by aggregate deposits and borrowings (measured in crores of rupees).

B = Number of branches and

u = Error term

The symmetry condition required are, $\beta_{LK} = \beta_{KL}$, $\beta_{LF} = \beta_{FL}$, $\beta_{KF} = \beta_{FK}$ ....(18)

Further, linear homogeneity of the cost function in input prices imposed the following conditions on the parameters.

$$\beta_L + \beta_K + \beta_F = 1 \quad \text{....(19)}$$

$$\beta_{LL} + \beta_{KK} + \beta_{FF} = 0 \quad \text{....(20)}$$

$$\beta_{LQ1} + \beta_{LQ2} + \beta_{KQ1} + \beta_{KQ2} + \beta_{FQ1} + \beta_{FQ2} = 0 \quad \text{....(21)}$$

$$\beta_{LB} + \beta_{KB} + \beta_{FB} = 0 \quad \text{....(22)}$$

Linear homogenity of the cost function in output imposed the following restrictions

$$B_{Q1Q1} + \beta_{Q1Q2} + \beta_{Q2Q2} = 0 \quad \text{....(23)}$$

$$\beta_{Q1L} + \beta_{Q1K} + \beta_{Q1F} + \beta_{Q2L} + \beta_{Q2K} + \beta_{Q2F} = 0 \quad \text{....(24)}$$

$$B_{Q1B} + \beta_{Q1B} = 0 \quad \text{....(25)}$$

All the independent variables were normalized with respect to their means before taking logarithms.

The cost function was augmented by the input share equations as follows

Share equation at the firm level:

$$S_L=\beta_L+\beta_{LL} \ln P_L + \beta_{LK} \ln P_K + \beta_{LF} \ln P_F + \beta_{Q1} \ln Q_1 + \beta_{Q2} \ln Q_2 \quad \text{.....(26)}$$

$$S_K = \beta_K+\beta_{KK} \ln P_K + \beta_{KL} \ln P_L + \beta_{KF} \ln P_F + \beta_{Q1} \ln Q_1 + \beta_{Q2} \ln Q_2 \quad \text{....(27)}$$

$$S_F = \beta_F +\beta_{FF} \ln P_F + \beta_{FL} \ln P_L+ \beta_{FK} \ln P_K + \beta_{Q1} \ln Q_1 + \beta_{Q2} \ln Q_2 \quad \text{....(28)}$$

Share equation at the plant level:

$$S_L=\beta_L+\beta_{LL} \ln P_L + \beta_{LK} \ln P_K + \beta_{LF} \ln P_F + \beta_{LB} \ln B + \beta_{Q1} \ln Q_1 + \beta_{Q2} \ln Q_2 \quad \text{....(29)}$$

$$S_K = \beta_K+\beta_{KK} \ln P_K + \beta_{KL} \ln P_L + \beta_{KF} \ln P_F + \beta_{KB} \ln B + \beta_{Q1} \ln Q_1 + \beta_{Q2} \ln Q_2 \quad \text{....(30)}$$

$$S_F = \beta_F +\beta_{FF} \ln P_F + \beta_{FL} \ln P_L+ \beta_{FK} \ln P_K + \beta_{FB} \ln B + \beta_{Q1} \ln Q_1 + \beta_{Q2} \ln Q_2 \quad \text{....(31)}$$

These equations were simultaneously solved through seemingly unrelated regression (SUR) technique.

Allen's partial elasticity of substitution between inputs were also calculated in terms of the translog cost function, these measures become

$$\sigma_{LL} = [\beta_{LL} + S_L (S_L - 1)] / S_L^2 \quad \text{....(32)}$$

$$\sigma_{LK} = (\beta_{LK} + S_L S_K) / S_L S_K \quad \text{....(33)}$$

$$\sigma_{FL} = (\beta_{FL} + S_F S_L) / S_F S_L \quad \text{....(34)}$$

$$\sigma_{KK} = [\beta_{KK} + S_K (S_K - 1)] / S_K^2 \quad \text{....(35)}$$

$$\sigma_{FK} = (\beta_{FK} + S_F S_K) / S_F S_K \quad \text{....(36)}$$

$$\sigma_{FF} = [\beta_{FF} + S_F (S_F - 1)] / S_F^2 \quad \text{....(37)}$$

where $\sigma_{ij} = \sigma_{ji}$

Based on Allen's partial elasticities, own and cross price elasticity of demand for inputs (η_{ij}) were calculated. In this case $\eta_{ij} \neq \eta_{ji}$. They were defined as follows

$$\eta_{LL} = \sigma_{LL} S_L \quad \text{....(38)}$$

$$\eta_{KL} = \sigma_{KL} S_L \quad \text{....(39)}$$

$$\eta_{LK} = \sigma_{LK} S_K \quad \text{....(40)}$$

$$\eta_{LF} = \sigma_{LF} S_F \quad \text{....(41)}$$

$$\eta_{KK} = \sigma_{KK} S_K \quad \text{.....(42)}$$

$$\eta_{KF} = \sigma_{KF} S_F \quad \text{....(43)}$$

$$\eta_{FF} = \sigma_{FF} S_F \quad \text{....(44)}$$

$$\eta_{FL} = \sigma_{FL} S_L \quad \text{....(45)}$$

$$\eta_{FK} = \sigma_{FK} S_K \quad \text{....(46)}$$

The parameter estimates of the translog function for different size groups of public sector banks and private sector banks were estimated through likelihood method with the help of the computer software SAS 4.1 version. The multicollinearity of the variables chosen for estimating the translog function were tested through zero order correlation coefficient.

The current study tried to impose two restrictions on the parameter estimates of the translog cost function. Restriction I related to the linear

$\mu^T \geq 0$

$v^T \geq 0$

where Q = output

x = input

The dual linear programming problem is

$$\underset{\Phi, \lambda}{\text{Minimise}}\ \Phi \qquad \ldots.(51)$$

Subject to

$$Q\lambda \geq Q_0,$$

$$\Phi X_o - X\lambda \geq 0,$$

Φ free, $\lambda \geq 0$.

The optimal solution 'Φ' yields an efficient score for particular DMU and the process was repeated for each DMU. DMU's for which 'Φ'< 1 are scale inefficient while DMU's for which 'Φ'= 1 are scale efficient.

The efficiency estimates were calculated using the assumption of constant returns to scale for the reference technology. As pointed out by Fare et al (1994) this technology has some useful feature in that it captures the notion of maximal average product (consistent with the minimum point on a long run 'U' shaped average cost curve) which provides a benchmark for identifying optimal scale.

In the current study, an attempt is made to assess the efficiency of banks in different size groups with the objective of finding out the potential superiority of one size cluster of bank group over the other. For this data envelopment analysis problem was formulated and solved for each decision making unit representing a particular group.

CHAPTER IV

RESULTS AND DISCUSSION

The results of the study relating to 'Economies of scale in Indian commercial banks (1973 – 1996)' is discussed under the following headings:

A. Profile of commercial banks in India;

B. Scale economy of commercial banks in India; and

C. Scale efficiency of commercial banks in India.

A. PROFILE OF COMMERCIAL BANKS IN INDIA:

The profile of commercial banks in India provides the background information for analysing the scale economy of commercial banks in India. In the current study, total assets is considered as an indicator of the size of banks and scale economy is estimated by considering advances and investments as output, purchased funds (deposits and borrowings), labour, fixed capital as inputs and branches as a control variable. Hence the study attempted to analyse the profile of commercial banks in terms of total assets, advances, investments, deposits, borrowings, employees, fixed capital, branches and total costs.

(i) Total assets of commercial banks in India:

The ultimate goal of a commercial bank is to achieve scale economy through reduction in cost. The cost reduction in commercial banks depends upon efficient asset management. The asset portfolio represents the varied nature of the bank functions and it indicates the manner in which the funds entrusted to the bank are employed.

RESULTS AND DISCUSSION

(Khubchandani, 2000). According to Narasimham Committee (1997) an asset is considered to be non performing if the interest on it is due for a period exceeding 180 days as on the balance sheet date.

Every commercial bank has to maintain adequate liquid assets. The Banking Regulation Act, 1949 has identified the liquid assets as cash in hand, net current account balances with notified banks, cash with notified banks, cash with the Reserve Bank of India and investment in unencumbered Government and other approved securities. After 1969, the Reserve Bank of India increased the requirement of statutory liquidity ratio [9] (SLR) from 25 percent to 32 percent in 1973, to 34 percent in 1978, to 35 percent in 1981, to 36 percent in 1984, to 38 percent in 1988-89, and to 38.5 percent in 1991-92. This has not only reduced the capacity of commercial banks to grant loans and advances to business and industry but also adversely affected the profitability of banks because the rate of interest received on Government securities was lower than the market related rate of interest (Loganathan, 2001).

Table V provides information on total assets of commercial banks in India during 1973-1996.

---

[9] According to Banking Regulation Act, 1949, banks had to keep a certain proportion of their total demand and time deposit liabilities in liquid assets. This requirement is known as statutory liquidity ratio.
(Source: Mithani.D.M. (1998), Money, Banking and International trade, Himalaya Publishing House, p.215).

In the reference period, the number of small sized public sector banks (having the asset size of below Rs. 20 crores) had declined. However, the number of large sized banks (having the asset size of Rs. 140 – 200 crores and above Rs. 200 crores) had increased.

Table VII depicts the distribution of sample cases of private sector banks in India by asset size.

In the reference period, the assets of public sector banks in nominal terms increased from Rs. 11,532 crores to Rs. 4,66,471 crores. This implies that in rupee value, the assets of commercial banks in India had increased by 40 times. In real terms, the assets of public sector banks in India increased from Rs.706.62 crores to Rs. 4189.61 crores representing 6 times increase.

The assets of private sector banks increased from Rs.370 crores in 1973 to Rs. 36,077 crores in 1996 in nominal term representing 97 times increase. In real term, the assets of private sector banks in India increased from Rs. 22.67 crores to Rs. 324.03 crores. This implies that the real value of assets of private sector banks had increased by 14 times.

From 1973 – 1996, there had been less variation in the assets of public sector banks as compared to private sector banks since the estimated coefficient of variation in the assets of public sector banks both in nominal terms (92.13 percent) and in real terms (50.34 percent) was lower than that of private sector banks (123.02 percent and 75.54 percent respectively).

Since the current study considered assets as an indicator of the size of commercial banks it tried to analyse the trend in the number of commercial banks in various size groups in the reference period. Following from Clark (1996) and Mester (1987) the current study classified the sample banks into different size groups based on their assets. In each of the reference period of the study, the banks were placed in various size groups. The size groups of the public sector banks were below Rs.20 crores, Rs.20-60 crores, Rs.60-100 crores, Rs.100-140 crores, Rs.140-200 crores and above Rs.200 crores. The public sector banks having the asset

TABLE V

TOTAL ASSETS OF COMMERCIAL BANKS IN INDIA (1973-1996)

(Rupees in crores)

Year	Public Sector Banks		Private Sector Banks	
	Nominal term	Real term	Nominal term	Real term
(1)	(2)	(3)	(4)	(5)
1973	11532.00	706.62	370.00	22.67
1974	13720.00	713.10	460.00	23.91
1975	16923.00	753.81	594.00	26.46
1976	21354.00	911.78	763.00	32.58
1977	26600.00	1075.62	994.00	40.19
1978	33254.00	1311.79	1360.00	53.65
1979	40609.00	1383.61	1632.00	55.60
1980	49042.00	1498.38	2024.00	61.84
1981	60223.00	1668.69	2396.00	66.39
1982	71319.00	1834.34	2609.00	67.10
1983	81877.00	1934.25	3369.00	79.59
1984	96990.00	2132.59	4066.00	89.40
1985	114414.00	2346.95	4771.00	97.87
1986	133214.00	2559.35	5741.00	110.30
1987	156559.00	2644.58	6608.00	111.62
1988-89*	206700.00	3098.95	7904.00	118.50
1989-90	243181.00	3645.89	9365.00	140.40
1990-91	275475.00	3736.27	11286.00	153.07
1991-92	296184.00	3529.36	14289.00	170.27
1992-93	333823.00	3654.73	18225.00	199.53
1993-94	350385.00	3503.85	23401.00	234.01
1994-95	402240.00	3671.75	32680.00	298.31
1995-96	466471.00	4189.61	36077.00	324.03
Average	152264.74	2282.86	8303.65	112.06
Coefficient of Variation (in percent)	92.13	50.34	123.02	75.54

* 1988-89 Data relating to January 1988 to March 1989.

Source :Columns 2 & 4: (a) Statistical tables relating to banks in India-Reserve Bank of India, for the period 1973-1995-96.

(b) Financial Analysis of Banks-Indian Banks Association for the period 1973-1995-96

Columns 3 & 5 were calculated by deflating the values given in columns 2 & 4.

The assets of the commercial banks comprise of share capital, cash in hand, money at call and short notice, bills discounted, advances, investments, fixed capital and fixed assets. Cash in hand is an important asset which bank holds inorder to meet the routine needs of day to day withdrawals of deposits by customers. Money at call and short notice is short term loans to the speculator in stock exchange for a period of one to seven days. They are highly liquid. Banks also invest a considerable portion of their funds in commercial bills which are short dated usually of three months. Loans and advances provided by commercial banks to individuals, traders, businessmen and industrialists also form an important item of assets. Investment by commercial banks in approved securities is a major component of the assets of commercial banks. The fixed assets of commercial banks comprise of equipment, office building, computer, furniture etc. It includes all the goods new or used that have a normal economic life of more than one year. In the view of Ferrier and Lovell (1990) and Clark (1996) fixed assets denote the book value of bank premises, furniture, equipment etc.

The assets of commercial banks are classified into four categories as standard assets, sub standard assets, doubtful assets and loss assets. Standard asset is one in respect of which no default in repayment of principal or payment of interest is perceived. Substandard assets are those which had been classified as non performing asset for more than one year and doubtful assets are those which have remained as non performing asset exceeding two years. Loss asset is non performing asset with the little realizable value of amount outstanding

homogeneity of the cost function in input prices and Restriction II related to linear homogeneity of the cost function in outputs.

The validity of these restrictions were tested statistically through likelihood ratio (LR) test. To test the validity of apriori restriction, LR test obtains the following test statistic

$$\lambda = 2 (ULLF - RLLF)$$

where ULLF and RLLF are respectively unrestricted log likelihood function and restricted log likelihood function. The test statistic λ follows the chi square distribution with degrees of freedom equal to the number of restrictions imposed. If a priori restrictions were valid, the restricted and unrestricted log likelihood function should not be different in which case λ will be zero. If it is not the case, the two likelihood functions will diverge (Gujarati, 1995). Since λ follows a chi square distribution the current study tried to find out whether the divergence is statistically significant at 1 percent or 5 percent level of significance. If the calculated chi square value is significant, the hypothesis of linearity of the cost function is rejected.

After obtaining the parameter estimates of the translog cost function, Ray scale economies (RSCE) were measured as elasticity of cost with respect to output keeping product mix constant. The ray scale economies were measured for different size groups of public sector and private sector banks and for the whole public sector and private sector banks at the plant level and firm level.

The scale efficiency measures through data envelopment analysis was obtained by using the computer software Ideas 1.01 version.

Besides the translog cost function and data envelopment analysis, the current study had calculated averages and coefficient of variation for the analysis of data.

I. Tabulation and analysis of data:

The data are tabulated, presented and analysed in the following chapter on 'Results and Discussion'.

size of below Rs.20 crores (100 cases) and Rs.20-60 crores (177 cases) were considered as small banks. The public sector banks having the asset size of Rs.60-100 crores (82 cases) and Rs.100-140 crores (49 cases) were considered as medium sized banks. Those banks having the asset size of Rs.140-200 crores (46 cases) and above Rs.200 crores (52 cases) were considered as large banks.

There was a greater variation in the assets of public sector banks and private sector banks. The average assets of the public sector banks in real term was Rs.2,282.86 crores while the average assets of private sector banks in real term was only Rs.112.06 crores. In this context Das (1997) opined that private sector banks are generally small in size and there is a large degree of variation in the assets of public sector and private sector banks. As such, the current study attempted a separate size wise classification of private sector banks based on their assets.

The size groups of the private sector banks were below Rs.4 crores, Rs.4-8 crores, Rs.8-12 crores, Rs.12-16 crores and above Rs. 16 crores. The private sector banks having the asset size of below Rs.4 crores (283 cases) and Rs.4-8 crores (107 cases) were considered as small banks. The private sector banks having the assets size of Rs.8-12 crores (42 cases) were considered as medium sized banks. The private sector banks having the asset size of Rs.12-16 crores (23 cases) and above Rs. 16 crores (28 cases) were considered as large banks. Table VI represents the distribution of sample cases of public sector banks in India by asset size.

TABLE VI

DISTRIBUTION OF SAMPLE CASES OF PUBLIC SECTOR BANKS IN INDIA BY ASSET SIZE

Year	Asset size (Rupees in Crores)					
	<20	20-60	60-100	100-140	140-200	>200
1973	11	8	2	0	1	0
1974	11	8	2	0	1	0
1975	12	9	0	0	1	0
1976	12	7	2	0	0	1
1977	7	10	4	0	0	1
1978	7	8	5	1	0	1
1979	7	8	4	2	0	1
1980	7	7	4	3	0	1
1981	6	7	4	4	0	1
1982	5	7	5	4	0	1
1983	3	9	4	3	2	1
1984	3	7	6	2	3	1
1985	3	7	5	1	5	1
1986	3	7	5	1	4	2
1987	2	7	5	2	4	2
1988-89*	1	8	3	4	3	3
1989-90	0	9	2	3	2	6
1990-91	0	9	1	4	2	6
1991-92	0	9	2	3	3	5
1992-93	0	9	1	3	4	5
1993-94	0	8	3	5	2	4
1994-95	0	6	5	3	4	4
1995-96	0	3	8	1	5	5

* 1988-89 data relating to January 1988 to March 1989

TABLE VII

DISTRIBUTION OF SAMPLE CASES OF PRIVATE SECTOR BANKS IN INDIA BY ASSET SIZE

Year	Asset size (Rupees in Crores)				
	<4	4-8	8-12	12-16	>16
1973	21	0	0	0	0
1974	21	0	0	0	0
1975	21	0	0	0	0
1976	21	0	0	0	0
1977	18	3	0	0	0
1978	16	5	0	0	0
1979	13	8	0	0	0
1980	13	8	0	0	0
1981	13	7	1	0	0
1982	13	7	1	0	0
1983	12	7	2	0	0
1984	12	5	4	0	0
1985	12	5	3	1	0
1986	11	6	2	2	0
1987	10	6	3	2	0
1988-89*	10	6	3	2	0
1989-90	8	5	4	2	2
1990-91	8	5	4	2	2
1991-92	8	5	4	1	3
1992-93	8	5	3	1	4
1993-94	7	4	3	3	4
1994-95	4	5	2	4	6
1995-96	3	5	3	3	7

* 1988-89 data relating to January 1988 to March 1989

Table VII makes it clear that, from 1973-1996, there had been an improvement in the assets of the private sector banks. Further, in the reference period, the number of small private sector banks (having the asset size of below Rs. 4 crores and Rs.4-8 crores) had declined. However, the number of large banks (having the asset size of Rs. 12-16 crores and above Rs. 16 crores) had increased.

(ii) Advances of commercial banks in India:

Advances are an important component of assets of commercial banks and as on March 31st 2001 for the scheduled commercial banks in India, the bulk of loans and advances formed 40 percent of assets (Rajwade, 2002). Advances is the most profitable employment of the funds since a major part of bank income is earned from interest on funds so lent. An ideal advance is one which is granted to reliable customers for approved purpose and repayment will be made within a reasonable time period.

There are many systems of lending by commercial banks like cash credit system, loan system and purchase and discounting of bills. The advances provided by commercial banks is classified into secured and unsecured advances. Secured advance means loans made on the security of transferable assets like land, buildings, machinery, goods and documents of title to goods. Such loans provide absolute safety to a banker by creating charge on the assets in favour of him. According to the Banking Regulation Act of 1949, a secured advance is made on the security of assets, the market value of which is not at

any time less than the amount of such advances. However, unsecured advance[10] does not provide safety to the banker.

Table VIII helps to explain advances of commercial banks in India during the period 1973-1996.

---

[10] Advances granted to customers of integrity without demanding tangible security is known as unsecured advances.
(Source: Gordon.E and Natarajan.K (1999), 'Banking Theory, Law and Practice', Himalaya Publishing House, Mumbai, p.178).

TABLE VIII

ADVANCES OF COMMERCIAL BANKS IN INDIA (1973-1996)

(Rupees in crores)

Year (1)	Public Sector Banks		Private Sector Banks	
	Nominal term (2)	Real term (3)	Nominal term (4)	Real term (5)
1973	6172.00	378.19	196.00	12.01
1974	7150.00	371.62	234.00	12.16
1975	9114.00	405.97	295.00	13.14
1976	11890.00	507.69	380.00	17.19
1977	13509.00	546.26	445.00	19.00
1978	16325.00	643.98	602.00	24.34
1979	19335.00	658.77	715.00	28.21
1980	23312.00	712.25	832.00	28.35
1981	29096.00	806.21	1111.00	33.94
1982	34260.00	881.17	1287.00	35.66
1983	39130.00	924.40	1526.00	39.25
1984	46654.00	1025.81	1848.00	43.66
1985	52310.00	1073.03	2035.00	44.45
1986	59773.00	1148.38	2570.00	52.72
1987	68176.00	1151.62	2879.00	55.31
1988-89*	88930.00	1333.28	3543.00	60.00
1989-90	107747.00	1615.40	4204.00	63.03
1990-91	123223.00	1671.27	4910.00	66.59
1991-92	135369.00	1613.07	6398.00	76.24
1992-93	145362.00	1591.44	7949.00	87.03
1993-94	137414.00	1374.14	9790.00	97.90
1994-95	164982.00	1506.00	13949.00	127.33
1995-96	192612.00	1729.94	17346.00	155.79
Average	66601.96	1029.13	3697.57	51.88
Coefficient of Variation (in percent)	86.90	44.40	124.34	71.82

* 1988-89 Data relating to January 1988 to March 1989.

Source :Columns 2 & 4: (a) Statistical tables relating to banks in India-Reserve Bank of India, for the period 1973-1995-96.

(b) Financial Analysis of Banks-Indian Banks Association for the period 1973-1995-96

Columns 3 & 5 were calculated by deflating the values given in columns 2 & 4.

In the reference period, the advances provided by public sector banks in nominal terms increased from Rs. 6,172 crores to Rs. 1,92,612 crores representing 31 times increase. In real terms, the advances of public sector banks increased from Rs.378.19 crores to Rs.1,729.94 crores representing 5 times increase.

Similarly, the advances of private sector banks in nominal terms, increased from Rs.196 crores to Rs. 17,346 crores and in real terms, it increased from Rs.12.01 crores to Rs.155.79 crores. In nominal terms, the advances of private sector banks increased by 89 times, while in real terms it increased by nearly 13 times.

The fluctuations in the volume of advances might be due to the changes in the lending rate. In 1973 the lending rate was 9 percent, but it was increased to 13.5 percent in 1974 and again reduced to 13 percent in 1978 and increased to 16.5 percent in 1979 which maintained a consistency upto 1990.

On an average, the advances of public sector banks (in nominal terms - Rs.66,601.96 crores and in real terms Rs.1,029.13 crores) was higher than that of private sector banks (in nominal terms Rs.3,697.57 crores and in real terms Rs.51.88 crores). Similarly, there had been less fluctuations in the advances of public sector banks as compared to private sector banks since the estimated coefficient of variation in advances of public sector banks (in nominal terms 86.90 percent and real terms 44.40 percent) was lower than that of private sector banks (in nominal terms 124.34 percent and in real terms 71.82 percent).

The difference in the quantum of advances of public sector and private sector banks after 1993 might be attributed to variations in prime lending rate charged by the public sector banks and private sector banks. While the prime lending rate for public sector banks ranged from 10 percent to 12 percent, for the private sector banks, the prime lending rate varied from 10 percent to 15.5 percent in 1996 (Facts For You Research Bureau, 2002).

(iii) Investments by commercial banks in India:

The commercial banks are investing their assets in securities. The investment by commercial banks comprise of Government securities, consisting of treasury bills, zero coupon bonds and other approved securities, shares, debentures and bonds, subsidiaries and joint venture and others (Shekar and Shekar, 2000). The Banking Regulation Act of 1949 requires both scheduled and non scheduled banks to employ not less than 25 percent of their assets in approved securities.

The relative proportion of various types of securities is determined by the bank's policy for maintaining a balance between liquidity, solvency and profitability. The banks have to invest in Government and other approved securities as they constituted a part of the statutory liquidity ratios stipulated by the Reserve Bank India. Though less profitable, banks invest in Government and other approved securities over and above the level of statutory requirement to keep a safety margin. Banks can also liquidate their investment in the case of shortage of funds to meet the customer needs.

While investing funds, the banks have to give importance to the criteria of safety of the principal amount, liquidity and profitability. The nature and volume of investment by the commercial banks depends upon the requirement of the Central Bank (Reserve Bank of India) in the form of liquid cash and the credit needs of the economy. In recent years, banks are advised to follow a more prudent policy for utilising the gains realised on sale of investment in securities. They are required to transfer the maximum amount of returns from investment in securities to the interest fluctuation reserve account (IFRA)[11].

Table IX shows details on investments by commercial banks in India.

[11] Interest fluctuation reserve account (IFRA) refers to a pool of reserves created by retaining a proportion of returns when proceeds are high which can be utilised to supplement payments when proceeds are low,
(Source: Report on Trend and Progress of Banking in India, 2001-02, p.19).

TABLE IX

INVESTMENTS BY COMMERCIAL BANKS IN INDIA (1973-1996)

(Rupees in crores)

Year (1)	Public Sector Banks		Private Sector Banks	
	Nominal term (2)	Real term (3)	Nominal term (4)	Real term (5)
1973	2884.00	176.72	81.05	4.97
1974	3337.00	173.44	99.00	5.15
1975	3913.00	174.30	126.00	5.61
1976	4904.00	209.39	157.00	7.10
1977	5570.00	225.23	215.00	9.18
1978	6968.00	274.87	288.00	11.65
1979	8358.00	284.77	345.00	13.61
1980	10011.00	305.87	466.00	15.88
1981	12003.00	332.59	481.00	14.70
1982	13700.00	352.37	601.00	16.65
1983	17568.00	415.02	763.00	19.62
1984	19822.00	435.84	875.00	20.67
1985	24346.00	499.41	1220.00	26.65
1986	31174.00	598.92	1506.00	30.89
1987	37789.00	638.33	1860.00	35.73
1988-89*	45429.00	681.09	2216.00	37.53
1989-90	54175.00	812.22	2558.00	38.35
1990-91	61952.00	840.25	3090.00	41.91
1991-92	75785.00	903.06	4038.00	48.12
1992-93	88967.00	974.02	5074.00	55.55
1993-94	118371.00	1183.71	6823.00	68.23
1994-95	133180.00	1215.70	9479.00	86.53
1995-96	143121.00	1285.44	9782.00	87.86
Average	40144.65	564.89	2267.09	30.53
Coefficient of Variation (in percent)	108.83	63.55	128.47	81.15

* 1988-89 Data relating to January 1988 to March 1989.

Source :Columns 2 & 4: (a) Statistical tables relating to banks in India-Reserve Bank of India, for the period 1973-1995-96.

(b) Financial Analysis of Banks-Indian Banks Association for the period 1973-1995-96

Columns 3 & 5 were calculated by deflating the values given in columns 2 & 4.

In the reference period, the investments by public sector banks in nominal terms increased from Rs. 2,884 crores to Rs. 1,43,121 crores representing 50 times increase. In real term, the investments by public sector banks increased from Rs.176.72 crores to Rs.1,285.44 crores representing 7 times increase.

The investments by private sector banks increased in nominal term from Rs. 81.05 crores in 1973 to Rs. 9,782 crores in 1996. In real term, the investments by private sector banks in India increased from Rs.4.97 crores to Rs.87.86 crores.

On an average, the investments by public sector banks in nominal terms (Rs.40,144.65 crores) and in real terms (Rs.564.89 crores) was higher than that of private sector banks (Rs.2,267.09 crores and Rs.30.53 crores). This in turn might be due to large quantum of assets of public sector banks as compared to private sector banks.

There had been less variation in investments by public sector banks since the estimated coefficient of variation in investments by public sector banks (in nominal terms 108.83 percent and in real terms 63.55 percent) was less than that of private sector banks (in nominal terms 128.47 percent and in real terms 81.15 percent).

(iv) Deposits of commercial banks in India:

Commercial banks in India have contributed significantly to the growth of the economy by mobilising deposits. Deposits are the main resources for the banks to carry on their lending operation. The position of a bank and it's ability to

finance priority sectors and other development activities depend upon the amount of deposits, it is able to tap from all possible sources.

Commercial banks mobilise two types of deposits – demand deposits and fixed deposits. The demand deposit holder can withdraw any amount standing in his credit without notice. The rate of return offered by the commercial banks on demand deposits is very low. Fixed deposits are made by the customer for a specified period ranging from 15 days to 5 years or more. At the end of the term, customer may either withdraw the amount along with interest or renew the deposits for a further period at his convenience. The banks pay higher rate of interest on such deposits and the rate of interest increases with the length of time period of fixed deposits. According to Narasimham Committee (1991) bank deposits constituted two fifth of the household sector's savings and there were 300 million deposit accounts.

Deposit mobilisation effort of the banking system are conditioned by a package of factors including the economic condition, alignment of interest rates within the subsectors of the economy, the spread of the banking habit , the evidence of competition and the dedication of staff at the grass root level of bank branches (Rangarajan, 1993).

The higher ratio of demand deposits to aggregate deposits is expensive even though only minimum interest is to be paid. This is because number of transactions per account is large and maintenance of the accounts includes higher amount of operating expenditure. On the other hand, though fixed deposits are kept for long period, because of high interest offered on fixed

account, they are also expensive. Kamaih et al (1988) suggests that it is essential to maintain a good deposit-mix to control average interest cost of deposits. Hence, a proper mix of these two types of deposits is desirable.

Table X gives information on aggregate deposits (which includes both demand and fixed deposits) of commercial banks in India during 1973-1996.

TABLE X

AGGREGATE DEPOSITS OF COMMERCIAL BANKS IN INDIA (1973-1996)

(Rupees in crores)

Year (1)	Public Sector Banks		Private Sector Banks	
	Nominal term (2)	Real term (3)	Nominal term (4)	Real term (5)
1973	9494.00	581.74	250.30	15.34
1974	11159.00	579.99	295.69	15.37
1975	13288.00	591.89	391.31	17.43
1976	16506.00	704.78	608.00	27.51
1977	20512.00	829.44	796.00	33.99
1978	25492.00	1005.60	1056.00	42.70
1979	30927.00	1053.73	1274.00	50.26
1980	37365.00	1141.61	1596.00	54.38
1981	45437.00	1258.99	1905.00	58.20
1982	52669.00	1354.66	2253.00	62.43
1983	62679.00	1480.72	2696.00	69.34
1984	73639.00	1619.15	3251.00	76.80
1985	87240.00	1789.54	4032.00	88.07
1986	103052.00	1979.87	4823.00	98.93
1987	118625.00	2003.80	5583.00	107.26
1988-89*	145189.00	2176.75	6549.00	110.91
1989-90	171758.00	2575.08	7785.00	116.72
1990-91	195053.00	2645.50	9348.00	126.79
1991-92	218357.00	2601.97	12197.00	145.34
1992-93	245235.00	2684.86	15341.00	167.95
1993-94	280777.00	2807.77	20050.00	200.50
1994-95	319670.00	2918.03	26369.00	240.70
1995-96	358942.00	3223.84	29469.00	264.68
Average	114915.87	1722.14	6866.01	95.29
Coefficient of Variation (in percent)	93.35	49.41	122.66	73.44

* 1988-89 Data relating to January 1988 to March 1989.

Source :Columns 2 & 4: (a) Statistical tables relating to banks in India-Reserve Bank of India, for the period 1973-1995-96.

(b) Financial Analysis of Banks-Indian Banks Association for the period 1973-1995-96

Columns 3 & 5 were calculated by deflating the values given in columns 2 & 4.

In the reference period, total deposits of public sector banks had increased from Rs.9,494 crores to Rs. 3,58,942 crores in nominal terms representing 37 times increase and from Rs.581.74 crores to Rs.3,223.84 crores in real terms indicating 6 times increase. The private sector banks increased their volume of deposits from Rs.250.3 crores to Rs.29,469 crores in nominal terms and from Rs.15.34 crores to Rs.264.68 crores in real terms. In nominal terms the deposits of the private sector banks increased by 118 times and in real terms by 17 times.

The average deposits of the public sector banks in nominal terms (Rs.1,14,915.87 crores) and in real terms (Rs.1,722.14 crores) was higher than that of private sector banks (Rs.6866.01 crores and Rs.95.29 crores respectively). But the coefficient of variation was higher both in nominal term and real term (122.66 percent and 73.44 percent) for private sector banks than that of public sector banks (93.35 percent and 49.41 percent respectively). The variation in deposits is attributed to the variations in average deposit rate. The average deposit rate during 1975-76 was 8 percent, while it was 6.5 percent in 1977-79, 7.5 percent in 1980-81, 8 percent in 1982-85, 9 percent in 1986-87, 10.5 percent in 1989-90 and 11 percent during 1991-92 (Report on trend and progress of banking, 2002).

Further there had been fluctuations in interest rates on fixed deposits. The interest rates on fixed deposits maturing after one year had increased from 6 percent in 1973-1974 to 7.5-8.5 percent in 1980-81 and to 12 percent in 1991-1992 and reduced to 11 percent in 1994-95 (Structure of interest rates :

http:/www.rbi.org.In/search/Reserve Bank of India search results). However, there had been increase in the deposits of commercial banks in India and this confirms the classical belief that interest elasticity of demand for deposits is insignificant.

The new economic reforms have introduced deregulation of interest rates and given flexibility to the commercial banks in setting their deposit stratum. From 1991, except for savings deposits on which interest rate was fixed as 4 percent, banks were free to introduce flexible interest rate systems for all new deposits while a fixed rate option is also available to depositors. (Reserve Bank of India – Annual Report, 2001-02).

(v) Borrowings of commercial banks in India:

Commercial banks in India resort to borrowings to meet unexpected demand for funds to meet the expenses of business and to meet cash emergencies. The commercial banks borrow funds from both within and outside India in the form of secured and unsecured loans.

Within India, borrowings of a commercial bank comprises of borrowings from Central bank (Reserve Bank of India) and borrowings from other banks. The commercial banks borrow from the Reserve Bank of India by rediscounting bills of exchange at the appropriate bank rate. The amount of borrowings by commercial banks from outside India depend upon the interest rate prevailing in foreign countries.

The magnitude of funds from borrowings will depend upon the cost of getting funds from it. If the cost of borrowing is more, the commercial banks prefer to liquidate a part of their investment rather than resorting to borrowings.

Table XI shows the details on borrowings of commercial banks in India, during 1973-1996.

TABLE XI

BORROWINGS OF COMMERCIAL BANKS IN INDIA (1973-1996)

(Rupees in crores)

Year (1)	Public Sector Banks		Private Sector Banks	
	Nominal term (2)	Real term (3)	Nominal term (4)	Real term (5)
1973	439.26	26.92	9.65	12.01
1974	461.00	23.96	8.94	12.16
1975	891.00	39.69	11.86	13.14
1976	1422.00	60.72	22.35	17.19
1977	1351.00	54.63	19.31	19.00
1978	1365.00	53.85	28.69	24.34
1979	1970.00	67.12	43.42	28.21
1980	2118.00	64.71	39.80	28.35
1981	2846.00	78.86	54.93	33.94
1982	4137.00	106.40	66.06	35.66
1983	4723.00	111.58	104.68	39.25
1984	6160.00	135.44	119.63	43.66
1985	6647.00	136.35	166.16	44.45
1986	6940.00	133.33	219.25	52.72
1987	10524.00	177.77	247.00	55.31
1988-89*	15350.00	230.13	344.00	60.00
1989-90	20945.00	314.02	366.00	63.03
1990-91	22446.00	304.44	438.00	66.59
1991-92	17122.00	204.03	528.00	76.24
1992-93	21917.00	239.95	777.00	87.03
1993-94	11190.00	111.90	575.00	97.90
1994-95	18687.00	170.58	1786.00	127.33
1995-96	28256.00	253.78	2266.00	155.79
Average	9039.45	134.79	358.37	51.88
Coefficient of Variation (in percent)	95.77	65.03	159.69	71.82

* 1988-89 Data relating to January 1988 to March 1989.

Source :Columns 2 & 4: (a) Statistical tables relating to banks in India-Reserve Bank of India, for the period 1973-1995-96.

(b) Financial Analysis of Banks-Indian Banks Association for the period 1973-1995-96

Columns 3 & 5 were calculated by deflating the values given in columns 2 & 4.

In the reference period, the borrowings of public sector banks in India, in nominal terms, increased from Rs. 439.26 crores to Rs. 28,256 crores representing 64 times increase. In real term also there was increase in borrowings of public sector banks from Rs.26.92 crores to Rs.253.78 crores representing 9 times increase.

Between 1973-1996, the borrowings of the private sector banks in nominal terms increased from Rs. 9.65 crores to Rs. 2,266 crores depicting 234 times increase and in real term it increased from Rs.12.01 crores to Rs.155.79 crores representing 13 times increase. On an average, the borrowings by public sector banks in nominal terms and in real terms (Rs.9,039.45 crores and Rs.134.79 crores respectively) was higher than that of private sector banks (Rs.358.37 crores and Rs.51.88 crores respectively).

There had been less variation in borrowings by public sector banks since the estimated coefficient of variation of borrowings by public sector banks (95.77 percent in nominal terms and 65.03 percent in real terms) was less than that of private sector banks (159.69 percent in nominal terms and 71.82 percent in real terms). Table XI implies that in the period 1973 – 1980 and 1991 –1996 there had been fluctuations in the borrowings of commercial banks. This might be due to frequent changes in bank rate.[12]

---

[12] Between 1970-80, bank rate had changed 5 times and the range of change was from 4 to 9 percent and from 1980-90, it had changed 2 times and the range of change was from 10 to 12 percent and from 1992-2000 it had changed 8 times and the range of change was from 7 to 8 percent.
(Source: Vasudevan.A (2002), Evolving monetary policy in India – some perspectives, Economic and Political Weekly, 37(1), p.1055).

(vi)Employees in commercial banks in India:

Labour is an important input in banking and it describes the number of employees in the commercial banks. Table XII represents the information on number of employees in commercial banks in India during 1973-1996.

TABLE XII

NUMBER OF EMPLOYEES IN COMMERCIAL BANKS IN INDIA (1973-1996)

Year (1)	Public Sector Banks (2)	Employees per branch (3)	Private Sector Banks (4)	Employees per branch (5)
1973	298321	22	13104	10
1974	324558	22	14374	10
1975	340518	21	16091	10
1976	367513	20	18742	9
1977	369908	18	21390	9
1978	416649	19	24366	10
1979	445037	20	26991	10
1980	480038	20	29215	10
1981	520268	20	32022	11
1982	560160	20	34111	11
1983	600632	21	36706	12
1984	641957	21	40033	12
1985	681075	21	44529	12
1986	705997	21	47228	13
1987	717487	21	48638	13
1988-89*	731301	21	49988	14
1989-90	750051	20	51095	14
1990-91	753728	20	52058	14
1991-92	759716	20	52517	14
1992-93	766810	20	53482	14
1993-94	782250	20	53904	14
1994-95	787874	20	54602	13
1995-96	787608	19	55791	13
Average (Rupees in crores)	590846	20	37869	12
Coefficient of Variation (in percent)	29.60	4.56	38.98	15.22

* 1988-89 Data relating to January 1988 to March 1989.

Source :Columns 2 & 4: (a) Statistical tables relating to banks in India-Reserve Bank of India, for the period 1973-1995-96.

(b) Financial Analysis of Banks-Indian Banks Association for the period 1973-1995-96

Columns 3 & 5 were calculated based on column 2 and 4 of Table XII and columns 2 & 3 of Table XIV.

In the reference period, on an average, the number of employees in the public sector banks (5,90,846) was greater than that of private sector banks (37,869). While the number of employees in public sector banks increased by three times, the number of employees in private sector banks increased by four times. The number of employees in public sector banks had been more consistent since the estimated coefficient of variation in the number of employees in public sector banks (29.60 percent) was lower than that of private sector banks (38.98 percent).

Table XIII makes it evident, the number of labourers per branch in public sector banks was greater than that of private sector banks. While on an average 12 labourers were employed in a branch of private sector bank, 20 labourers were employed in a branch of public sector bank. To reduce the overstaffing in public sector banks, the Government of India introduced voluntary retirement scheme in these banks.

(vii) Fixed capital of commercial banks in India:

Fixed capital of the commercial banks comprises of premises, office building, furniture, office equipment and computer. Table XIII helps to explain fixed capital of commercial banks in India from 1973-1996.

TABLE XIII

FIXED CAPITAL OF COMMERCIAL BANKS IN INDIA (1973-1996)

(Rupees in crores)

Year (1)	Public Sector Banks		Private Sector Banks	
	Nominal term (2)	Real term (3)	Nominal term (4)	Real term (5)
1973	99.10	6.07	3.35	0.21
1974	108.31	5.63	4.07	0.21
1975	124.83	5.56	5.85	0.26
1976	143.09	6.11	7.37	0.31
1977	161.78	6.54	9.50	0.38
1978	178.33	7.03	10.70	0.42
1979	196.42	6.69	11.74	0.40
1980	223.44	6.83	14.04	0.43
1981	266.43	7.38	18.04	0.50
1982	328.42	8.45	21.38	0.55
1983	403.00	9.52	26.15	0.62
1984	484.00	10.64	29.81	0.66
1985	579.00	11.88	34.39	0.71
1986	687.00	13.20	35.80	0.69
1987	770.00	13.01	43.14	0.73
1988-89*	913.00	13.69	51.37	0.77
1989-90	1079.00	16.18	54.41	0.82
1990-91	1211.00	16.42	66.11	0.90
1991-92	1534.00	18.28	84.00	1.00
1992-93	2527.00	27.67	162.00	1.77
1993-94	3680.00	36.80	230.00	2.30
1994-95	4785.00	43.68	543.00	4.96
1995-96	6170.00	55.42	834.00	7.49
Average	1158.79	15.33	100.01	1.18
Coefficient of Variation (in percent)	140.13	86.59	198.14	144.97

* 1988-89 Data relating to January 1988 to March 1989.

Source :Columns 2 & 4: (a) Statistical tables relating to banks in India-Reserve Bank of India, for the period 1973-1995-96.

(b) Financial Analysis of Banks-Indian Banks Association for the period 1973-1995-96

Columns 3 & 5 were calculated by deflating the values given in columns 2 & 4.

In the reference period, the fixed capital of public sector banks, in nominal terms increased from Rs.99.10 crores to Rs.6,170 crores representing 62 times increase and in real terms the fixed capital increased from Rs.6.07 crores to Rs.55.42 crores indicating 9 times increase.

The fixed capital of the private sector banks in nominal terms increased from Rs.3.35 crores to Rs.834.00 crores representing 249 times increase. In real terms also there was an increase in fixed capital from Rs.0.21 crores to Rs.7.49 crores indicating 36 times increase.

On an average, the fixed capital of public sector banks in nominal terms (Rs.1,158.79 crores) and in real terms (Rs.15.33 crores) was higher than that of private sector banks (in nominal terms Rs.100.01 crores and in real terms Rs.1.18 crores). The fixed capital of public sector banks had been more consistent since the estimated coefficient of variation in the fixed capital of public sector banks in nominal term (140.13 percent) and in real term (86.59 percent) was less than that of private sector banks (in nominal term - 198.14 percent and in real terms - 144.97 percent).

(viii) Branches of commercial banks in India:

In India, there had been steady branch expansion and as a result, more and more people are being brought to the field of organised banks (Khusera, 1983). Table XIV presents the details on number of branches of commercial banks in India from 1973-1996.

TABLE XIV

NUMBER OF BRANCHES OF COMMERCIAL BANKS IN INDIA (1973-1996)

Year (1)	Public Sector Banks (2)	Private Sector Banks (3)
1973	13434	1276
1974	14719	1419
1975	16319	1671
1976	18354	2006
1977	20196	2318
1978	21582	2510
1979	22651	2655
1980	24503	2826
1981	26309	2970
1982	27459	3048
1983	28784	3175
1984	30288	3265
1985	32623	3568
1986	32907	3575
1987	33601	3606
1988-89*	35337	3701
1989-90	37745	3768
1990-91	38163	3786
1991-92	38390	3777
1992-93	38833	3840
1993-94	39377	3965
1994-95	40174	4057
1995-96	40618	4169
Average	28885	3084
Coefficient of Variation (in percent)	29.75	28.04

* 1988-89 Data relating to January 1988 to March 1989.

Source : (a) Statistical tables relating to banks in India-Reserve Bank of India, for the period 1973-1995-96.

(b) Financial Analysis of Banks-Indian Banks Association for the period 1973-1995-96

In the reference period, the number of branches of public sector banks increased from 13,434 to 40,618 and the number of branches of private sector banks increased from 1,276 to 4,169. In both the groups of banks the number of branches had increased three times.

On an average, the number of branches was higher in public sector banks (28,885) than that of private sector banks (3,084). A higher variation of branch expansion was noticed in public sector banks since the estimated coefficient of variation for public sector banks (29.75 percent) was higher than that of private sector banks (28.04 percent).

ix) Total cost in commercial banks in India:

The scale economy of commercial banks is influenced by total cost (operating expenses and interest cost) incurred by commercial banks.

The operating expenses include payments and provision for employees, rent; taxes; printing and stationery; advertisement and publicity; depreciation on bank's property; director's fees allowances and expenses; auditor's fees and expenses; law charges; postage; telegrams; telephones; etc, repairs and maintenance; insurance and other expenditure. The interest cost includes the interest paid on deposits, interest on borrowings from the Reserve Bank of India and interest on inter bank borrowings and others. The cost reduction in banks depends upon asset management. The study of cost reflects the effective

allocation of assets and successful handling of resources mobilised (Malhotra, 1995).

Table XV A helps to explain total cost incurred by public scetor banks in India from 1973-1996.

TABLE XV A

TOTAL COST INCURRED BY PUBLIC SECTOR BANKS IN INDIA (1973-1996)

(Rupees in crores)

Year (1)	Establishment Expenses		Interest Paid		Other Cost		Total Cost	
	Nominal term (2)	Real term (3)	Nominal term (4)	Real term (5)	Nominal term (6)	Real term (7)	Nominal term (8)	Real term (9)
1973	284.00	17.40	366.00	22.43	26.48	1.62	676.48	41.45
1974	362.00	18.81	548.00	28.48	33.76	1.62	943.76	48.92
1975	421.00	18.75	712.00	31.71	38.03	1.69	1171.03	52.16
1976	391.00	16.70	982.00	41.93	48.50	2.07	1421.50	60.70
1977	485.00	19.61	1240.00	50.14	60.93	2.46	1785.93	72.22
1978	565.00	22.29	1430.00	56.41	77.80	3.07	2072.80	81.77
1979	703.00	23.95	1799.00	61.29	88.47	3.01	2590.47	88.26
1980	854.00	26.09	2355.00	71.95	107.00	3.27	3316.00	101.31
1981	998.00	27.65	3058.00	84.73	129.00	3.57	4185.00	115.96
1982	1129.00	29.04	3663.00	94.21	154.00	3.96	4946.00	127.21
1983	1318.00	31.14	4110.00	97.09	181.00	4.28	5609.00	132.51
1984	1733.00	38.10	5063.00	111.32	220.00	4.84	7016.00	154.27
1985	2057.00	42.19	5964.00	122.34	271.00	5.56	8292.00	170.09
1986	2288.00	43.96	7004.00	134.56	331.00	6.36	9623.00	184.88
1987	2538.00	42.87	8384.00	141.62	389.00	6.57	11311.00	191.06
1988-89*	3913.00	58.67	13049.00	195.64	580.00	8.70	17542.00	263.00
1989-90	3806.00	57.06	13334.00	199.91	645.00	9.67	17785.00	266.64
1990-91	4322.00	58.62	15752.00	213.64	748.00	10.15	20822.00	282.41
1991-92	5049.00	60.16	19600.00	233.56	884.00	10.53	25533.00	304.25
1992-93	5782.00	63.30	22405.00	245.29	929.00	10.17	29116.00	318.77
1993-94	6335.00	63.35	21887.00	218.87	1212.00	12.12	29434.00	294.34
1994-95	8213.00	74.97	23117.00	211.02	1437.00	13.12	32767.00	299.11
1995-96	10395.00	93.36	28491.00	255.89	1496.00	13.44	40382.00	362.69
Average	159.99	2.39	488.31	6.52	20.46	0.30	668.76	9.21
Coefficient of Variation (in percent)	1740.18	895.43	133.08	85.00	817.61	461.94	3.11	1.82

* 1988-89 Data relating to January 1988 to March 1989.

Source :Columns 2, 4& 6: (a) Statistical tables relating to banks in India-Reserve Bank of India, for the period 1973-1995-96.

(b) Financial Analysis of Banks-Indian Banks Association for the period 1973-1995-96

Columns 3, 5 & 7 were calculated by deflating the values given in columns 2 & 4 and 6.

In the reference period, the total cost in public sector banks increased in nominal terms from Rs. 676.48 crores to Rs.40,382 crores and in real term from Rs.41.45 crores to Rs.362.69 crores. There was an increase in establishment cost in nominal and real terms (from Rs.284 crores to Rs.10,395 crores and from Rs.17.40 crores to Rs.93.36 crores respectively), and this might be due to increase in staff salary. The interest cost also depicted an increase both in nominal terms (from Rs.366 crores to Rs.28,491 crores) and in real terms (from Rs.22.43 crores to Rs.255.89 crores) and this might be due to higher interest expenses on bank deposits and bank borrowings.

Table XV B depicts the information on total cost incurred by private sector banks in India from 1973-1996.

TABLE XV B

TOTAL COST INCURRED BY PRIVATE SECTOR BANKS IN INDIA (1973-1996)

(Rupees in crores)

Year (1)	Establishment Expenses		Interest Paid		Other Cost		Total Cost	
	Nominal term (2)	Real term (3)	Nominal term (4)	Real term (5)	Nominal term (6)	Real term (7)	Nominal term (8)	Real term (9)
1973	13.15	0.81	14.82	0.91	0.65	0.04	28.62	1.75
1974	14.15	0.74	19.26	1.00	1.28	0.07	34.69	1.80
1975	15.74	0.70	28.38	1.26	1.93	0.09	46.05	2.05
1976	19.00	0.86	35.34	1.60	2.60	0.11	56.94	2.57
1977	20.68	0.88	45.79	1.96	3.94	0.16	70.41	3.00
1978	25.44	1.03	58.70	2.37	5.15	0.20	89.29	3.61
1979	34.83	1.37	67.87	2.68	4.51	0.15	107.21	4.20
1980	42.52	1.45	85.00	2.90	6.62	0.20	134.14	4.55
1981	51.74	1.58	108.00	3.30	7.63	0.21	167.37	5.09
1982	61.46	1.70	130.00	3.60	12.22	0.31	203.68	5.62
1983	69.00	1.77	158.00	4.06	12.60	0.30	239.60	6.14
1984	91.00	2.15	199.00	4.70	13.54	0.30	303.54	7.15
1985	113.00	2.47	255.00	5.57	12.99	0.27	380.99	8.30
1986	132.00	2.71	303.00	6.22	13.72	0.26	448.72	9.19
1987	150.00	2.88	367.00	7.05	16.77	0.28	533.77	10.22
1988-89*	228.00	3.86	557.00	9.43	27.00	0.40	812.00	13.70
1989-90	231.00	3.46	531.00	7.96	26.49	0.40	788.49	11.82
1990-91	258.00	3.50	628.00	8.52	29.03	0.39	915.03	12.41
1991-92	297.00	3.54	805.00	9.59	40.00	0.48	1142.00	13.61
1993-94	377.00	3.77	1374.00	13.74	51.00	0.51	1802.00	18.02
1994-95	481.00	4.39	1810.00	16.52	64.00	0.58	2355.00	21.50
1995-96	616.00	5.53	2499.00	22.44	73.00	0.66	3188.00	28.63
Average	159.99	15.85	488.31	35.66	20.46	2.08	668.76	9.21
Coefficient of Variation (in percent)	104.58	91.48	133.08	85.96	101.60	95.64	124.89	76.39

* 1988-89 Data relating to January 1988 to March 1989.

Source :Columns 2, 4 & 6: (a) Statistical tables relating to banks in India-Reserve Bank of India, for the period 1973-1995-96.
(b) Financial Analysis of Banks-Indian Banks Association for the period 1973-1995-96

Columns 3,5 & 7 were calculated by deflating the values given in columns 2, 4 and 6.

Between 1973-1996, the total cost in private sector banks, increased from Rs.28.62 crores to Rs. 3,188 crores in nominal terms and from Rs.1.75 crores to Rs.28.63 crores in real terms. The establishment expenditure increased from Rs. 13.15 crores to Rs. 616 crores in nominal terms and from Rs.0.81 crores to Rs.5.53 crores in real terms. Interest expenditure also had increased from Rs.14.82 crores to Rs.2,499 crores in nominal terms and from Rs.0.91 crores to Rs.22.44 crores in real terms during the reference period.

Table XVI represents the percentage components of total cost in public sector and private sector banks in India.

TABLE XVI

PERCENTAGE COMPONENTS OF TOTAL COST IN PUBLIC SECTOR AND PRIVATE SECTOR BANKS (1973-1996)

Year	Public sector banks			Private sector banks		
	Establishment Expenses	Interest Paid	Other Cost	Establishment Expenses	Interest Paid	Other Cost
1973	41.98	54.10	3.91	45.95	51.78	2.27
1974	38.36	58.07	3.58	40.79	55.52	3.69
1975	35.95	60.80	3.25	34.18	61.63	4.19
1976	27.51	69.08	3.41	33.37	62.07	4.57
1977	27.16	69.43	3.41	29.37	65.03	5.60
1978	27.26	68.99	3.75	28.49	65.74	5.77
1979	27.14	69.45	3.42	32.49	63.31	4.21
1980	25.75	71.02	3.23	31.70	63.37	4.93
1981	23.85	73.07	3.08	30.91	64.53	4.56
1982	22.83	74.06	3.11	30.17	63.83	6.00
1983	23.50	73.28	3.23	28.80	65.94	5.26
1984	24.70	72.16	3.14	29.98	65.56	4.46
1985	24.81	71.92	3.27	29.66	66.93	3.41
1986	23.78	72.78	3.44	29.42	67.53	3.06
1987	22.44	74.12	3.44	28.10	68.76	3.14
1988-89*	22.31	74.39	3.31	28.08	68.60	3.33
1989-90	21.40	74.97	3.63	29.30	67.34	3.36
1990-91	20.76	75.65	3.59	28.20	68.63	3.17
1991-92	19.77	76.76	3.46	26.01	70.49	3.50
1992-93	19.86	76.95	3.19	22.03	75.10	2.87
1993-94	21.52	74.36	4.12	20.92	76.25	2.83
1994-95	25.06	70.55	4.39	20.42	76.86	2.72
1995-96	25.74	70.55	3.70	19.32	78.39	2.29
Average	25.80	70.72	3.48	29.46	66.66	3.88

* 1988-89 data relating to January 1988 to March 1989

From Table XVI it can be observed that interest cost was a major component of total cost in commercial banks in India. On an average, interest cost accounted for 70.72 percent, establishment cost accounted for 25.80 percent and other cost accounted for 3.48 percent of the total cost in public sector banks. In private sector banks, of the total cost, the proportion of interest cost was 66.66 percent, establishment cost was 29.46 percent and other cost was 3.88 percent. It is evident that during the reference period, interest cost had increased at an alarming rate from 54.10 percent to 70.55 percent in public sector banks and from 51.78 percent to 78.39 percent in private sector banks. But there was a decline in establishment expenses from 41.98 percent to 25.74 percent in public sector banks and from 45.95 percent to 19.32 percent in private sector banks. In this regard, Jain (1988) opined that interest cost and establishment expenses were the significant factors determining the economies of scale at the plant level and the firm level.

The finding of the current study that the interest cost was a dominant item of expenditure in Indian public sector and private sector banks coincides with the views of Amandeep (1993) that interest payments accounted for two third of total expenditure in Indian commercial banks. Similarly Narasimham committee (1991) found out that the interest cost of operation was higher and the increase in interest cost was due to a shift in the maturity pattern of deposits towards longer term deposits.

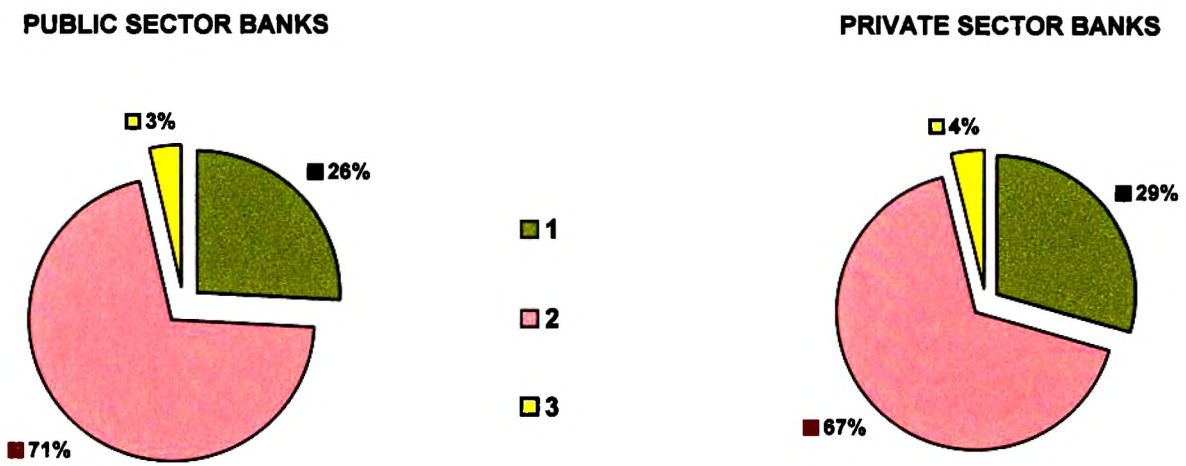
In this context Verma Committee (1999) proposed a restructuring strategy for commercial banks in which the crucial issue was cost reduction. It

recommended that to reduce the operating costs there is a need for decrease in the number of uneconomic branches and better housekeeping by banks.

Figure I represents the percentage components of total cost in public sector and private sector banks in India.

FIGURE - 1

PERCENTAGE COMPONENTS OF TOTAL COST IN PUBLIC SECTOR AND PRIVATE SECTOR BANKS IN INDIA (1973-1996)



1- ESTABLISHMENT EXPENSES 2 - INTEREST EXPENSES 3 - OTHER COSTS

B. SCALE ECONOMY OF INDIAN COMMERCIAL BANKS:

The current study tried to analyse scale economy with the help of translog cost function. The analysis of scale economy helps to find out whether Indian commercial banks enjoy operational efficiencies through scale expansion and whether the expansion of services via new branching is cost efficient to the service expansion at existing branches.

The translog cost function was estimated by considering advances and investments as output and labour, fixed capital and purchased funds (deposits and borrowings) as inputs.

The current study tried to estimate the translog cost function for public sector and private sector banks without branches (Firm level) and with branches (Plant level), with the help of the following formula.

Translog cost function at the firm level: Model I

$$\begin{aligned} \ln C = a_o &+ \beta_{Q1} \ln Q_1 + \beta_{Q2} \ln Q_2 + \beta_L \ln P_L + \beta_K \ln P_K + \beta_F \ln P_F + \tfrac{1}{2} \beta_{Q1Q1} \ln (Q_1)^2 \\ &+ \beta_{Q1Q2} \ln (Q_1 Q_2) + \tfrac{1}{2} \beta_{Q2Q2} \ln (Q_2)^2 + \tfrac{1}{2} \beta_{LL} \ln (P_L)^2 + \beta_{LK} \ln (P_L P_K) \\ &+ \beta_{LF} \ln (P_L P_F) + \tfrac{1}{2} \beta_{KK} \ln (P_K)^2 + \beta_{KF} \ln (P_K P_F) + \tfrac{1}{2} \beta_{FF} \ln (P_F)^2 \\ &+ \beta_{Q1L} \ln (Q_1 P_L) + \beta_{Q1K} \ln (Q_1 P_K) + \beta_{Q1F} \ln (Q_1 P_F) + \beta_{Q2L} \ln (Q_2 P_L) \\ &+ \beta_{Q2K} \ln (Q_2 P_K) + \beta_{Q2F} \ln (Q_2 P_F) + u \qquad \ldots.(52) \end{aligned}$$

Translog cost function at the plant level: Model II

$$\ln C = a_o + \beta_{Q1} \ln Q_1 + \beta_{Q2} \ln Q_2 + \beta_L \ln P_L + \beta_K \ln P_K + \beta_F \ln P_F + \tfrac{1}{2} \beta_{Q1Q1} \ln (Q_1)^2$$
$$+ \beta_{Q1Q2} \ln (Q_1 Q_2) + \tfrac{1}{2} \beta_{Q2Q2} \ln (Q_2)^2 + \tfrac{1}{2} \beta_{LL} \ln (P_L)^2 + \beta_{LK} \ln (P_L P_K)$$
$$+ \beta_{LF} \ln (P_L P_F) + \tfrac{1}{2} \beta_{KK} \ln (P_K)^2 + \beta_{KF} \ln (P_K P_F) + \tfrac{1}{2} \beta_{FF} \ln (P_F)^2$$
$$+ \beta_{Q1L} \ln (Q_1 P_L) + \beta_{Q1K} \ln (Q_1 P_K) + \beta_{Q1F} \ln (Q_1 P_F) + \beta_{Q2L} \ln (Q_2 P_L)$$
$$+ \beta_{Q2K} \ln (Q_2 P_K) + \beta_{Q2F} \ln (Q_2 P_F) + \beta_B \ln \beta_{Q1B} \ln (Q_1 B) + \beta_{Q2B} \ln (Q_2 B)$$
$$+ \beta_{LB} \ln (P_L B) + \beta_{KB} \ln (P_K B) + \beta_{FB} \ln (P_F B) + \tfrac{1}{2} k \ln (B)^2 + u \quad \ldots.(53)$$

where

C = Total cost which includes operating expenses and interest expenses (Deflated value measured in crores of rupees);

Q_1 = Total advances (Deflated value measured in crores of rupees);

Q_2 = Total Investments (Deflated value measured in crores of rupees);

L = Number of labourers (measured in number);

K = Fixed capital (Deflated value measured in crores of rupees);

F = Purchased funds (Deposits and borrowings) (Deflated value measured in crores of rupees);

P_L = Price of labour which was obtained as the ratio of establishment expenses by the number of labourers employed (Deflated value measured in crores of rupees);

P_K = Price of capital which was determined as the ratio of the sum of expenditure on rent, premises, furniture and equipment by the value of premises, furniture and equipment, (Deflated value measured in crores of rupees);

P_F = Price of purchased funds which was determined by the ratio of total interest expenses by total deposits and borrowings (measured in crores of rupees).

u = Error term.

(i) Summary statistics of the variables used in estimating the translog cost function:

Table XVII provides summary statistics of the variables used in estimating the translog cost function for public sector banks.

TABLE XVII

SUMMARY STATISTICS OF THE VARIABLES USED IN ESTIMATING THE TRANSLOG COST FUNCTION FOR PUBLIC SECTOR BANKS

Items	Asset size of the banks (Rupees in Crores)						
	Below 20	20-60	60-100	100-140	140-200	Above 200	Whole sample
1) Output:							
i) Advances (in crores of rupees)							
Mean	8.59	20.42	38.87	55.62	77.38	206.80	48.81
Standard deviation	14.80	10.87	12.32	9.46	13.75	149.46	75.22
Minimum	2.04	9.84	14.34	37.22	44.75	6.24	2.04
Maximum	147.46	106.04	113.89	73.82	111.40	548.46	548.46
ii) Investment (in crores of rupees)							
Mean	5.65	26.35	26.77	30.60	45.65	47.13	26.63
Standard deviation	14.65	62.43	42.47	10.11	16.63	36.37	44.98
Minimum	0.88	1.54	6.75	8.09	9.80	2.69	0.88
Maximum	101.81	380.41	393.56	53.89	92.77	145.39	393.56
2) Cost (in crores of rupees)							
Mean	1.74	3.32	6.24	9.70	13.67	34.47	8.24
Standard deviation	4.19	2.24	2.73	1.37	2.41	27.50	13.22
Minimum	0.31	1.41	0.49	84.35	10.30	1.30	0.31
Maximum	29.97	22.35	26.35	12.60	21.57	108.72	108.72
3) Input							
i) Labour (in number)							
Mean	842.00	13690.00	24157.00	31230.00	42375.00	90803.00	26857.00
Standard deviation	21278.00	7774.00	8236.00	8354.00	19077.00	80608.00	37149.00
Minimum	2481.00	2936.00	9152.00	11979.00	14755.00	7110.00	2481.00
Maximum	139101.00	72723.00	71263.00	45556.00	105212.00	233000.00	233000.00
ii) Fixed capital (in crores of rupees)							
Mean	0.13	0.27	0.56	0.78	1.67	2.52	0.70
Standard deviation	0.27	0.40	0.59	0.49	1.38	1.75	1.09
Minimum	0.02	0.06	0.21	0.40	0.60	0.07	0.02
Maximum	1.70	5.16	5.15	2.42	6.66	7.85	7.85
iii) Funds (in crores of rupees)							
Mean	24.72	37.00	71.65	112.49	146.69	340.87	88.70
Standard deviation	63.22	23.50	24.88	51.39	21.63	251.60	128.31
Minimum	3.30	16.47	11.40	84.35	103.47	21.63	3.30
Maximum	386.73	234.22	55.46	457.43	191.17	979.48	979.48
4) Input price							
5)							
i) Labour price (in crores of rupees)							
Mean	0.000053	0.000069	0.000069	0.000075	0.000079	0.0001	0.000072
Standard deviation	0.0000099	0.000032	0.000027	0.000024	0.000029	0.000076	0.000038
Minimum	0.000036	0.00003	0.000004	0.000046	0.000053	0.00005	0.000004
Maximum	0.0001	0.0002	0.0002	0.0001	0.0002	0.0004	0.0004
ii) Capital price (in crores of rupees)							
Mean	0.52	0.52	0.44	0.47	0.34	0.83	0.52
Standard deviation	0.96	0.27	0.18	0.19	0.19	1.68	0.72
Minimum	0.02	0.04	0.12	0.15	0.07	0.02	0.02
Maximum	9.75	1.36	1.04	0.93	0.93	10.00	10.00
iii) Funds price(in crores of rupees)							
Mean	0.07	0.06	0.06	0.07	0.07	0.10	0.07
Standard deviation	0.08	0.02	0.02	0.01	0.01	0.11	0.05
Minimum	0.002	0.003	0.002	0.01	0.03	0.002	0.002
Maximum	0.60	0.16	0.10	0.09	0.10	0.54	0.60
5) Number of branches							
Mean	346.00	1182.00	1406.00	1640.00	2005.00	2552.00	1313.00
Standard deviation	124.00	1625.00	962.00	432.00	645.00	1791.00	1362.00
Minimum	128.00	320.00	639.00	355.00	625.00	471.00	128.00
Maximum	660.00	8736.00	8885.00	3062.00	3813.00	8839.00	8885.00

In public sector banks, the advances of banks having the asset size of less than Rs.20 crores ranged from Rs.2.04 crores to Rs.147.46 crores and investments for these banks ranged from Rs.0.88 crores to Rs.101.81 crores. For the banks having the asset size of more than Rs.200 crores, advances ranged from Rs.6.24 crores to Rs.548.46 crores and investment ranged from Rs.2.69 crores to Rs.145.39 crores. Hence it is evident that as asset size increases, average output (advances and investments) also increases.

With regard to inputs, on an average, labour employed in the banks having the asset size of more than Rs.200 crores was higher (90803) than that of other groups. Similarly, the average fixed capital employed in the banks having the asset size of more than Rs.200 crores was Rs.2.52 crores and this was exceeding that of other groups. Further, on an average, the funds employed in large banks were higher as compared to small banks. This indicates that among public sector banks, large banks were having favourable input endowment as compared to small banks.

Table XVII also makes it clear that as the asset size increases, the total cost also increases. This might be due to the fact that the large banks, due to the employment of more labour were incurring more establishment expenditure. Since the quantum of funds (deposits and borrowings) was high, for the large banks, the interest cost in these banks also was high.

With regard to input price - price of labour, price of capital and price of funds was high among large banks as compared to other groups. The summary statistics for the whole public sector banks indicated that on an average, the

public sector banks were having the advances of Rs.48.81 crores and investments of Rs. 26.63 crores. The average labour requirement was 26857, and they had average fixed capital as Rs. 0.70 crores and funds as Rs.88.70 crores and on an average they were operating with 1313 branches.

Table XVIII presents the summary statistics of the variables used in estimating the translog cost function for private sector banks.

SUMMARY STATISTICS OF THE VARIABLES USED IN ESTIMATING THE TRANSLOG COST FUNCTION FOR PRIVATE SECTOR BANKS

Items	Asset size of the banks (Rupees in crores)					
	Below 4	4-8	8-12	12-16	Above 16	Whole sample
1) Output						
i) Advances (in crores of rupees)						
Mean	0.82	2.63	4.11	6.11	11.50	2.38
Standard deviation	0.49	0.60	0.66	0.70	4.77	2.96
Minimum	0.08	1.11	2.08	4.77	6.26	0.09
Maximum	2.42	4.17	5.65	7.49	24.73	24.73
ii) Investment (in crores of rupees)						
Mean	0.41	1.45	2.56	3.85	7.28	1.39
Standard deviation	0.28	0.45	0.59	0.53	2.91	1.89
Minimum	0.003	0.70	0.39	2.67	4.22	0.003
Maximum	1.43	2.49	3.81	4.89	14.87	14.88
2) **Cost** (in crores of rupees)						
Mean	0.15	0.46	0.78	1.10	1.94	0.42
Standarad deviation	0.09	0.14	0.19	0.20	0.84	0.52
Minimum	0.002	0.22	0.38	0.75	1.03	0.002
Maximum	0.40	1.03	1.25	1.45	4.68	4.68
3) Input						
i) Labour (in number)						
Mean	864.00	2247.00	3241.00	3605.00	4837.00	1740.00
Standard deviation	465.00	796.00	1009.00	969.00	668.00	1361.00
Minimum	15.00	558.00	1067.00	1921.00	3378.00	15.00
Maximum	2299.00	4065.00	5063.00	5099.00	5770.00	5770.00
ii) Fixed capital (in crores of rupees)						
Mean	0.01	0.05	0.08	0.12	0.41	0.06
Standard deviation	0.01	0.03	0.05	0.10	0.57	0.17
Minimum	0.00052	0.01	0.02	0.04	0.05	0.00052
Maximum	0.05	0.26	0.24	0.47	2.27	2.27
iii) Funds : (in crores of rupees)						
Mean	1.52	4.98	8.31	12.09	22.33	4.59
Standard deviation	0.98	1.10	1.17	1.07	9.26	5.79
Minimum	0.01	3.19	6.32	10.21	13.28	0.006
Maximum	4.79	7.72	10.79	13.99	51.60	51.60
4) Input price						
i) Labour price (in crores of rupees)						
Mean	0.000054	0.000060	0.000066	0.000073	0.000077	0.000584
Standard deviation	0.000017	0.000015	0.000015	0.000013	0.000015	0.000017
Minimum	0.000014	0.000031	0.000042	0.000054	0.000055	0.000014
Maximum	0.0001	0.0001	0.0001	0.000099	0.0001	0.0001
ii) Capital price (in crores of rupees)						
Mean	0.47	0.48	0.40	0.33	0.30	0.45
Standard deviation	0.38	0.26	0.20	0.16	0.21	0.33
Minimum	0.00003	0.08	0.1	0.04	0.04	0.00003
Maximum	2.44	1.33	1.00	0.75	0.75	2.44
iii) funds price (in crores of rupees)						
Mean	0.10	0.06	0.07	0.07	0.07	0.09
Standard deviation	0.16	0.01	0.01	0.01	0.01	0.12
Minimum	0.00007	0.04	0.04	0.05	0.05	0.00007
Maximum	1.31	0.11	0.09	0.09	0.10	1.31
5) **Number of branches**						
Mean	104.00	141.00	213.00	259.00	307.00	141.00
Standard deviation	69.00	77.00	75.00	55.00	38.00	91.00
Minimum	1.00	22.00	52.00	139.00	197.00	1.00
Maximum	321.00	300.00	333.00	336.00	360.00	360.00

In private sector banks, the advances of banks having the asset size of less than Rs.4 crores ranged from Rs.0.08 crores to Rs.2.42 crores, while the range of advances was from Rs.6.26 crores to Rs.24.73 crores for the banks having the asset size of more than Rs.16 crores. Similarly, the investments in the banks having the asset size of less than Rs.4 crores ranged from Rs.0.003 crores to Rs.1.43 crores, while the range was from Rs.4.22 crores to Rs.14.87 crores for the banks having the asset size of more than Rs.16 crores. It is evident that as asset size increases average output (advances and investments) also increases.

It can be inferred that, the average number of labourers employed in large banks (having assets of more than Rs.16 crores) was higher (4837) as compared to other groups of banks. Similarly, the average fixed capital employed in large banks (0.41 crores) was exceeding that of other banks. The average amount of funds was also higher (Rs.22.33 crores) for the banks having assets of more than Rs.16 crores. But as asset size increases, there had been no corresponding variation in input price of capital and funds. For the whole private sector banks, the average advances and investments were estimated to be Rs.2.38 crores and Rs.1.39 crores respectively. The required labour, capital and funds for the private sector banks on an average were estimated as 1740, Rs.0.06 crores and Rs. 4.59 crores respectively. On an average, the private sector banks were carrying out their business with 141 branches.

The study tested the multicollinearity of the chosen variables by calculating zero order correlation coefficient. The matrix of zero order correlation

coefficient is given in Appendix II. For different size groups of public sector banks, with and without branches, there was no multicollinearity of the variables. Similarly, among the private sector banks, for all the size groups with and without branches, there was no multicollinearity of the variables.

(ii) Parameter estimates of the translog cost function:

Table XIX represents the parameter estimates of the translog cost function for different size groups of public sector banks at the firm level.

TABLE XIX

ARAMETER ESTIMATES OF THE TRANSLOG COST FUNCTION FOR DIFFERENT SIZE GROUPS OF PUBLIC SECTOR BANKS AT THE FIRM LEVEL

S.No	Variable	Asset size (Rupees in crores)													
		Below 20		20-60		60-100		100-140		140-200		Above 200		Whole sample	
		coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value
1	a_0	16.6135	757.326**	17.5033	1067.132**	18.0817	918.886**	18.4553	833.394**	18.7735	1283.482**	19.9290	294.627**	17.7470	328.435**
2	Q_1	0.2841	4.258**	0.9363	26.460**	0.5639	12.307**	0.5863	4.413**	0.7423	12.682**	1.0980	13.184**	0.5801	5.071**
3	Q_2	0.6492	14.043**	0.119	9.384**	0.3169	10.374**	0.4322	6.323**	0.3958	12.295**	0.2820	2.681**	0.2086	4.051**
4	P_L	0.2496	1.807	0.2462	5.489**	0.2650	4.840**	0.5100	4.721**	0.1360	2.602**	0.4784	3.511**	- 0.1558	- 0.497
5	P_K	0.0057	0.258	- 0.0083	- 0.279	- 0.0651	- 2.325*	0.0879	1.901	0.0072	0.506	0.1050	1.510	0.0352	0.451
6	P_F	0.4545	8.376**	0.4366	9.366**	0.2509	3.360**	- 0.2829	- 2.888*	0.4066	6.671**	0.2804	2.822**	0.5357	4.820**
7	Q_1Q_1	0.2726	2.836**	- 0.1161	- 2.504*	0.0784	0.832	0.1935	0.680	0.6812	4.044**	0.1830	4.095**	0.8097	9.005**
8	Q_1Q_2	- 0.5781	- 3.665**	0.1695	4.897**	- 0.0948	- 1.502	0.1136	0.400	- 0.4297	- 2.009*	0.0702	0.869	- 1.0235	- 12.18**
9	Q_2Q_2	0.3378	5.132**	- 0.0562	- 8.388**	- 0.0941	- 4.952**	0.2048	2.203*	0.0423	0.783	0.0546	1.686	- 0.0285	- 1.057
10	LL	0.1294	0.714	0.0324	0.718	- 0.0977	- 1.240	- 0.4811	- 2.342*	- 0.1611	- 1.664	0.1217	1.592	0.1815	1.609
11	LK	0.0373	0.427	- 0.0541	- 1.673	- 0.3012	- 5.432**	0.0656	0.403	- 0.1912	- 2.985**	0.1582	2.141*	- 0.0130	- 0.100
12	LF	0.0530	0.275	0.0624	0.594	- 0.4512	- 2.311*	0.7228	1.755	0.4625	2.736**	0.2922	1.931	- 0.3033	- 1.409
13	KK	- 0.0304	- 1.459	- 0.0268	- 2.444*	- 0.0084	- 0.379	0.0337	1.408	- 0.0322	- 2.428*	0.0119	0.509	- 0.0147	0.289
14	KF	- 0.0143	- 1.111	- 0.1337	- 2.896**	0.1950	2.975**	- 0.1588	- 0.877	- 0.0806	- 1.101	- 0.1152	- 2.242*	0.1848	2.666**
15	FF	0.2316	26.057**	0.0349	1.630	- 0.0351	- 2.039*	- 0.1434	- 1.767	- 0.2213	- 1.780	- 0.3049	- 6.373**	0.1008	2.344*
16	LQ_1	- 0.1169	- 0.597	0.2495	3.223**	0.5954	5.878**	- 0.5479	- 1.435	0.3440	1.938	0.3107	3.101**	- 1.2509	- 5.441**
17	KQ_1	0.1001	2.679**	0.0214	0.515	0.0467	0.707	0.1425	1.254	- 0.0674	- 1.244	0.2238	2.739**	0.0255	0.203
18	FQ_1	0.4366	3.889**	0.0822	0.975	- 0.1646	- 0.767	- 0.9107	- 1.975*	0.0636	0.235	- 0.0094	- 0.168	1.0745	9.353**
19	LQ_2	0.0581	0.250	- 0.0523	- 1.574	0.0991	- 1.421	- 0.0588	- 0.268	- 0.1603	- 1.422	0.3592	3.242**	- 0.2107	- 1.829
20	KQ_2	- 0.0283	- 1.232	- 0.0225	- 0.697	- 0.1094	- 2.160*	- 0.0562	- 0.833	0.0330	0.733	0.1789	2.443*	- 0.1626	- 2.872**
21	FQ_2	- 0.6809	- 5.604**	0.0379	0.104	- 0.0873	- 0.592	- 0.8788	- 2.296*	0.4230	3.342**	0.1180	1.626	0.0599	0.763
R^2		0.98		0.96		0.96		0.46		0.93		0.99		0.50	
Number of cases		100		177		82		49		46		52		506	

* Statistically significant at five percent level
** Statistically si`gnificant at one percent level

(Appendix III)

Table XIX makes it obvious that in all the size groups of public sector banks, the output coefficients (Q_1 and Q_2) were positive and statistically significant at one percent level. This implies that there was positive cost elasticity.

The estimated coefficient of cost in relation to price of labour (P_L) was positive among all the size groups. The estimated coefficient of price of capital (P_K) was positive in all the size groups except the second and third groups (the banks having assets of Rs.20-Rs.60 crores and the banks having assets of Rs.60-Rs.100 crores). The estimated coefficient of price of purchased funds was positive in all the size groups of banks except the banks having assets in the range of Rs.100-Rs.140 crores. By and large, the input price coefficients were positive indicating positive input shares. The goodness of fit of the estimated model is indicated by the R^2 value.

For public sector banks as a whole the output coefficients were positive and statistically significant implying positive cost elasticities. The coefficient of cost function in relation to input price of capital and purchased funds were positive indicating corresponding positive input share in the total cost.

The current study also estimated the parameters of translog cost function for the public sector banks with branch variable. Table XX presents information on parameter estimates of the translog cost function for different size groups of public sector banks at the plant level.

TABLE XX

PARAMETER ESTIMATES OF THE TRANSLOG COST FUNCTION FOR DIFFERENT SIZE GROUPS OF PUBLIC SECTOR BANKS AT THE PLANT LEVEL

S.No	Variable	Asset size (Rupees in Crores)													
		BELOW 20		20-60		60-100		100-140		140-200		ABOVE 200		WHOLE SAMPLE	
		coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value
1	a_0	16.5995	621.591**	17.5896	972.255**	18.0821	1156.105**	18.4472	881.188**	18.7562	1484.323**	19.9410	345.712**	17.7939	331.611**
2	Q_1	0.3634	3.801**	0.7673	19.408**	0.5545	14.220**	0.5898	5.062**	0.6065	10.417**	0.9647	13.785**	0.6176	5.377**
3	Q_2	0.6033	10.821**	0.2112	11.933**	0.3923	9.031**	0.3954	5.054**	0.3049	8.888**	0.2084	2.610**	0.4833	6.892**
4	P_L	0.3364	2.204*	0.2268	5585**	0.2949	6.241**	0.4006	4.306**	0.1856	4.288**	0.1302	1.319	- 0.1681	- 1.084
5	P_K	- 0.0016	- 0.062	0.017	0.495	- 0.0552	- 2.452*	0.1663	3.880**	0.0192	1.744	0.0693	1.182	0.0114	0.146
6	P_F	0.5099	8.372**	0.3625	8.527**	0.2983	5.139**	- 0.0425	- 0.484	0.4542	8.114**	0.5009	7.372**	0.4545	3.970**
7	Q_1Q_1	0.3546	3.044**	- 0.0308	- 0.741	- 0.1322	- 1.360	0.1414	0.400	0.3908	2.681**	0.1232	4.186**	0.7419	7.730**
8	Q_1Q_2	- 0.3799	- 1.937	0.0994	3.116**	0.0339	0.424	- 1.1972	- 2.883**	0.2438	1.036	- 0.0596	- 0.946	- 0.7870	- 5.666
9	Q_2Q_2	0.2851	4.263**	- 0.0593	- 9.403**	0.1901	3.151**	- 0.1719	- 1.648	- 0.0333	- 0.690	0.1329	2.947**	- 0.8221	- 1.917
10	LL	0.1052	0.451	0.0465	1.219	- 0.2342	- 3.195**	- 0.5482	- 3.101**	0.1607	1.969**	0.2941	4.828**	0.1384	1.186
11	LK	0.0511	0.586	- 0.0320	- 1.178	- 0.1839	- 4.022**	0.3076	2.012*	- 0.1801	- 3.176	0.2262	4.636**	- 0.0720	- 0.535
12	LF	0.1702	0.904	0.0330	0.376	0.2181	0.876	1.238	3.181**	0.1892	1.124	0.0238	0.246	- 0.1602	- 0.649
13	KK	- 0.0187	- 1.268	- 0.0120	- 1.268	- 0.0086	- 0.479	0.0087	0.399	- 0.0079	- 0.720	- 0.0134	- 0.785	- 0.1032	- 0.242
14	KF	0.0006	- 0.037	- 0.0739	- 1.868	0.1917	3.655**	- 0.2948	- 1.641	- 0.0344	- 0.516	- 0.1146	- 3.248**	0.1194	1.437
15	FF	0.2080	20.956**	0.0334	1.872	- 0.0317	- 2.342*	- 0.0009	- 0.012	- 0.1924	- 1.399	- 0.4115	- 13.044**	0.1171	2.672**
16	LQ_1	- 0.3050	- 1.105	0.0939	1.161	0.0740	0.479	- 0.4133	- 1.140	- 0.2908	- 1.790	0.0491	0.702	- 1.0973	- 4.482
17	KQ_1	0.0275	0.334	0.0063	0.135	0.0532	0.996	0.2589	1.768	0.0209	0.330	0.1615	2.361*	- 0.0812	- 0.593
18	FQ_1	0.4702	3.566**	0.1294	1.814	0.2502	1.170	0.0107	0.026	0.6542	2.598**	- 0.1160	- 3.333	0.9834	7.997**
19	LQ_2	0.0973	0.354	- 0.1146	- 3.578**	0.0283	0.370	- 0.3529	- 1.639	- 0.2491	- 2.419*	0.3390	3.709**	- 0.4804	- 3.265
20	KQ_2	- 0.0559	- 2.226*	- 0.0193	- 0.666	- 0.0853	- 1.628	- 0.4712	- 3.983**	- 0.0281	- 0.659	0.1631	2.949**	- 0.1204	- 1.752
21	FQ_2	- 0.5627	- 4.857**	- 0.1206	- 2.444*	- 0.2226	- 1.534	1.1061	2.040*	0.3825	3.080**	0.2151	3.452**	0.1396	1519
22	BA	0.0458	0.397	- 0.0142	- 0.792	0.0129	0.261	- 0.0739	- 1.056	0.2107	6.246**	- 0.2012	- 3.651**	- 0.5683	- 5.723
23	Q_1BA	- 0.3338	- 1.248	0.1035	3.416**	0.0939	0.904	1.5021	4.953**	- 0.1239	- 0.405	0.0881	2.249*	- 0.3034	- 1.868
24	Q_2BA	0.0081	0.041	0.0346	1.428	- 0.5071	- 3.326**	0.7227	4.147**	- 0.1782	- 2.159*	- 0.1286	- 2.287*	0.0206	0.212
25	LBA	0.1931	0.491	0.0904	1.729	0.0899	0.527	- 0.1963	- 0.772	0.4017	2.078*	- 0.1791	- 2.992**	0.3082	1.182
26	KBA	0.1094	1.195	0.0273	1.000	- 0.0665	- 1.224	0.4345	4.137**	0.0336	0.608	- 0.0231	- 0.539	0.0086	0.067
27	FBA	- 0.2448	- 1.947	0.1100	1.752	0.0511	0.630	- 0.5408	- 2.312*	- 0.4315	- 2.151*	- 0.4456	- 6.825**	0.1091	0.653
28	BABA	0.0635	0.405	- 01232	- 3.768**	0.0625	0.617	- 0.5677	- 4.647**	0.1217	1.260	- 0.1051	- 4.597**	0.0535	0.533
R^2		0.99		0.96		0.97		0.63		0.97		0.97		0.53	
Number of cases		100		177		82		49		46		52		506	

* Statistically significant at five percent level ** Statistically significant at one percent level

From Table XX it can be observed that among the public sector banks with branches, the branch coefficient was positive among three asset size groups viz., asset size of below Rs.20 crores, asset size of Rs.60-100 crores and asset size of Rs.140-200 crores. For the other groups and public sector as a whole, the branch coefficient was negative. However, with the inclusion of branch variable, the R^2 value increases.

The current study also tried to estimate the parameters of the translog cost function for private sector banks at the firm level and the plant level. Table XXI provides details on parameter estimates of the translog cost function for different size groups of private sector banks at the firm level.

TABLE XXI

METER ESTIMATES OF THE TRANSLOG COST FUNCTION FOR DIFFERENT SIZE GROUPS OF PRIVATE SECTOR BANKS AT THE FIRM LEVEL

S.No	Variable	Asset size (Rupees in crores)											
		Below 4		4-8		8-12		12-16		Above 16		Whole sample	
		coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value
1	a_0	14.3547	734.260**	15.3580	1262.273**	15.8788	1070.633**	16.2262	1298.927**	16.7826	1910.165**	15.3694	364.082**
2	Q_1	0.5718	10.961**	0.5787	12.080**	0.4869	4.959**	1.2410	8.204**	0.5586	15.943**	0.6387	4.405**
3	Q_2	0.3668	8.278**	0.4171	11.585**	0.5834	8.584**	- 0.2681	- 2.600*	0.3819	8.191**	0.3609	2.965**
4	P_L	0.2450	5.142**	0.1243	2.858**	0.0165	0.209	- 0.4988	- 4.795**	- 0.1001	- 1.733	- 0.0614	- 0.446
5	P_K	0.0252	1.507	- 0.0086	- 0.530	0.0620	2.658**	0.0109	0.642	0.0237	1.163	- 0.1859	- 4.098**
6	P_F	0.1887	6.742**	0.4561	8.135**	0.6848	7.252**	0.9262	9.537**	0.9079	16.837**	1.1191	14.620**
7	Q_1Q_1	0.1216	1.351	0.3247	3.272**	- 0.0275	- 0.111	16.6859	40.029**	- 0.0082	- 0.092	0.1789	0.831
8	Q_1Q_2	- 0.2918	- 1.857	- 0.2191	- 1.657	- 0.7579	- 1.731	- 8.1866	-14.524**	- 0.2085	- 0.704	- 0.5821	- 1.859
9	Q_2Q_2	0.1457	1.929	- 0.0241	- 0.314	0.3359	4.554**	- 0.0219	- 0.120	- 0.0124	- 0.080	0.1319	0.962
10	LL	0.0161	0.189	- 0.6837	- 5.116**	- 0.1159	- 1.087	0.1485	1.236	1.1014	2.984**	- 0.7828	- 3.037**
11	LK	- 0.0918	- 1.622	0.0822	1.302	- 0.2117	- 3.996**	- 0.4802	-19.443*	0.3955	4.398**	- 0.1469	- 0.978
12	LF	0.0451	0.933	0.9219	3.491**	0.2535	1.058	4.4190	24.506**	- 0.6934	- 2.414*	- 0.1544	- 0.965
13	KK	- 0.0499	- 3.322**	- 0.0204	- 1.313	0.0142	1.033	0.0062	1.493	0.0450	5.784**	- 0.0785	- 2.024*
14	KF	0.0327	1.734	- 0.1357	- 1.418	0.0549	0.861	- 0.6533	-25.884**	- 0.0188	- 0.213	- 0.0100	- 0.178
15	FF	- 0.0783	- 5.258**	0.2890	1.363	- 0.4710	- 3.218**	- 4.8751	-33.397**	0.3350	1.369	- 0.2609	- 5.164**
16	LQ_1	- 0.1488	- 1.189	- 0.4599	- 2.251*	0.6361	1.882	-14.1057	-31.360**	1.0651	5.213**	- 0.1986	- 0.619
17	KQ_1	- 0.0187	- 0.400	- 0.2155	- 3.807**	- 0.0068	- 0.080	1.3678	18.512**	- 0.0677	- 0.864	- 0.2818	- 2.299*
18	FQ_1	0.2244	3.119**	- 0.0771	- 0.246	0.3828	0.949	- 0.3219	- 2.673**	0.2755	1.013	0.3884	1.830
19	LQ_2	0.0808	0.063	0.2794	1.823	- 0.9818	- 5.077**	- 1.4121	- 5.752**	- 0.2776	- 1.353	0.2294	0.736
20	KQ_2	0.0959	2.332*	0.0342	0.850	- 0.0124	- 0.134	- 1.0599	-23.811**	0.1190	2.360*	0.2573	2.486*
21	FQ_2	- 0.1323	- 2.210*	0.1660	0.896	0.6892	1.490	4.6359	20.367**	- 0.7106	- 1.754	0.2454	1.394
R^2		.97		.94		.90		.92		.997		0.73	
Number of cases		283		107		42		23		28		483	

* Statistically significant at five percent level
** Statistically significant at one percent level

In all size groups of private sector banks without branch variable, the output coefficient (Q_1) was positive and statistically significant at one percent level. The other output coefficient (Q_2) was positive in all the size groups of banks except the group having the assets of Rs.12-16 crores. This implies that there was positive cost elasticity.

The estimated coefficient of cost in relation to price of labour was positive in all the size groups of banks, except in large sized banks (the asset size between Rs.12-Rs.16 crores and above Rs.16 crores). The estimated coefficient of price of capital was positive in all groups of banks except the second group (the banks having the assets of Rs.4-Rs.8 crores). The estimated coefficient of purchased funds was positive and statistically significant in all the asset size groups. By and large, the input price coefficients were positive indicating positive input shares. The estimated parameters were statistically valid as indicated by the R^2 value.

It is evident that for the private sector banks as a whole without branches the output coefficients were positive and statistically significant. However, the estimated coefficient of cost in relation to price of labour and capital were negative. The estimated equation is statistically valid as indicated by high R^2 value.

Table XXII represents the parameter estimates of the translog cost function for different size groups of private sector banks at the plant level.

TABLE XXII

PARAMETER ESTIMATES OF THE TRANSLOG COST FUNCTION FOR DIFFERENT SIZE GROUPS OF PRIVATE SECTOR BANKS AT THE PLANT LEVEL

S.No	Variable	Asset size (Rupees in Crores)											
		Below 4		4-8		8-12		12-16		Above 16		Whole sample	
		Coefficient	t- value	Coefficient	t- value	Coefficient	t- value	Coefficient	t- value	Coefficient	t- value	Coefficient	t- value
1	a_0	14.3632	773.621**	15.3383	1382.674**	15.8963	1087.563**	16.2417	9212.535**	16.9201	1472.849**	15.4286	363.931**
2	Q1	0.5233	10.342**	0.5080	11.797**	0.5654	5.766**	- 1.0179	- 3.1015**	0.1248	3.0815**	0.6459	4.524**
3	Q2	0.3376	8.086**	0.3846	10.982**	0.3983	4.738**	0.5940	6.7769**	0.7411	1.4858	0.2528	2.054*
4	P_L	0.2853	6.184**	0.1775	4.529**	- 0.0021	- 0.028	0.8371	3.6603**	- 0.0631	- 9.8563**	0.0831	0.601
5	P_K	0.0163	1.016	- 0.0178	- 1.293	0.0571	2.576*	0.1027	1.8203	0.2380	1.1521	- 0.1387	- 3.020**
6	P_F	0.1754	6.662**	0.3778	7.667**	0.8908	10.078**	0.0682	4.5316**	2.6722	1.9053	1.0809	14.086**
7	Q_1Q_1	0.3395	3.716**	0.3801	4.486**	1.1458	2.623**	0.1937	5.8258**	- 1.1653	- 1.1436	0.4393	1.947
8	Q_1Q_2	- 0.6209	- 4.072**	- 0.3384	- 2.771*	- 1.7864	- 2.845**	23.4546	- 8.3874**	- 3.1739	- 1.2501	- 0.8259	- 2.723**
9	Q_2Q_2	0.2762	3.688**	- 0.1642	- 1.744	0.3979	4.965**	- 6.2922	- 4.1928**	0.1882	2.0410*	0.1167	0.873
10	LL	0.0059	0.073	- 0.5553	- 4.609**	- 0.3073	- 2.430*	- 0.1145	1.3537	6.2078	1.5402	- 0.8442	- 3.344**
11	LK	- 0.0797	- 1.515	0.0135	0.237	- 0.2999	- 4.732**	0.2189	0.0003	2.7832	1.7303	- 0.0695	- 0.481
12	LF	0.0999	2.028*	0.5029	2.095*	0.2466	0.953	4.5326	6.6897**	6.2687	1.2651	0.0223	0.135
13	KK	- 0.0610	- 3.952**	- 0.0273	- 1.945	- 0.0055	- 0.368	- 0.5263	- 2.2310*	0.2964	1.3559	- 0.0840	- 2.085*
14	KF	0.0234	1.338	- 0.2404	- 2.839**	- 0.0268	- 0.338	0.6669	- 3.8751**	1.9899	1.2572	- 0.0085	- 0.155
15	FF	- 0.0766	- 5.423**	0.6371	3.418**	0.0707	0.262	- 0.1286	- 0.1235	2.4006	9.0214**	- 0.2333	- 4.798**
16	LQ_1	- 0.0446	- 0.372	- 0.2235	- 1.209	0.0473	0.124	- 2.1014	- 2.003*	2.4410	1.2935	- 0.6276	- 2.012*
17	KQ_1	- 0.0211	- 0.479	- 0.1754	- 3.513**	0.1469	1.412	- 6.7191	- 3.7391**	- 1.0058	- 1.1694	- 0.2633	- 2.220*
18	FQ_1	0.1795	2.758**	- 0.6212	- 2.228*	1.0920	1.733	-23.6176	- 5.4816**	- 1.7649	- 7.9393**	0.4201	2.080*
19	LQ_2	- 0.0389	- 0.310	0.2055	1.383	- 0.6486	- 1.771	-12.0759	5.0181**	- 2.9974	- 1.2384	0.4730	1.544
20	KQ_2	0.0549	1.401	0.0854	2.067*	- 0.1594	- 1.216	1.6921	4.5915**	0.3253	5.0924**	0.2070	1.947
21	FQ_2	- 0.1495	- 2.736**	0.3089	1.945	- 0.1048	- 0.130	26.1312	- 1.4002	3.6306	8.3810**	0.0172	0.097
22	BA	0.0813	3.231**	0.1241	6.806**	0.1389	3.479**	- 0.3376	4.0952**	- 0.1001	- 2.4487*	0.1007	1.432
23	Q_1BA	- 0.1190	- 2.331*	- 0.0983	- 1.622	- 1.1258	- 3.713**	18.2685	- 3.6837**	10.6639	1.1604	- 0.3788	- 2.239*
24	Q_2BA	0.1230	2.640**	0.1146	2.262*	1.0632	2.625**	- 8.0305	4.1815**	3.6430	5.4807**	0.5288	3.472**
25	LBA	- 0.0162	- 0.309	0.1294	2.240*	- 0.1318	- 1.79	- 4.2275	- 2.7889**	1.2168	2.8756**	0.3720	2.215*
26	KBA	0.0136	0.622	- 0.0550	- 3.196	- 0.1519	- 2.01*	- 0.1840	- 2.7896**	1.4608	1.4449	0.0066	0.101
27	FBA	0.0406	1.452	0.0186	0.294	- 0.2322	- 0.926	- 4.8216	- 4.2782**	0.1608	3.8672**	0.1673	1.810
28	BABA	- 0.0539	- 2.973**	0.0907	4.498**	- 0.2328	- 2.904**	- 3.2033	- 2.9867**	-16.8939	- 1.4405	- 0.2388	- 4.166**
R^2		.98		.96		.92		1.00		1.00		0.74	
Number of cases		283		106		43		23		28		483	

* Statistically significant at five percent level
** Statistically significant at one percent level

Among the private sector banks with branches, the branch coefficient was positive among the small and medium banks (having the assets of below Rs.4 crores, Rs.4-8 crores and Rs.8-12 crores). For the other groups of banks, the branch coefficient was negative. However, with the inclusion of branch variable, the R^2 value increases.

For the private sector banks, as a whole the estimated branch coefficient was positive and statistically significant. This implies that with the expansion of branches, the private sector banks have to incur more cost.

The current study tried to test the linear homogenity of the cost function by imposing two restrictions - the first restriction was related to linear homogenity of the cost function in input prices and the second restriction was related to linear homogenity of the cost function in outputs.

The validity of two restrictions were tested statistically through likelihood ratio tests. Table XXIII represents the calculated chi square values for likelihood ratio test of restrictions one and two for different size groups of public sector and private sector banks in India.

TABLE XXIII

CALCULATED CHI SQUARE VALUES FOR LIKELIHOOD RATIO TEST OF RESTRICTIONS ONE AND TWO FOR PUBLIC SECTOR AND PRIVATE SECTOR BANKS IN INDIA

S.No	Asset size (Rupees in crores)	Restriction One		Restriction Two	
		Plant level	Firm level	Plant level	Firm level
1.	Public Sector Banks				
a)	Below 20	92.85**	94.53**	31.52**	21.92**
b)	20-60	16.28**	30.09**	47.53**	39.68**
c)	60-100	42.35**	39.23**	0.42	41.66**
d)	100-140	-9.44**	36.85**	-37.79**	-61.48**
e)	140-200	50.00**	23.77**	65.79**	27.14**
f)	Above 200	36.93**	99.11**	28.95**	96.90**
	Whole sample	97.59**	107.46**	68.87**	19.60**
2.	Private Sector Banks				
a)	Below 4	126.92**	127.44**	81.85**	78.44**
b)	4-8	100.97**	72.74**	32.24**	77.73**
c)	8-12	8.21**	23.68**	21.76**	34.08**
d)	12-16	977.77**	27.29**	41.62**	980.45**
e)	Above 16	1160.53**	59.20**	52.00**	1162.26**
	Whole sample	166.62**	169.03**	68.87**	19.59**

** Statistically significant at one percent level

For the public sector banks at the plant level, for the first restriction, the likelihood ratios were statistically significant for all the asset size groups. Even in the case of firm level, the likelihood ratios were statistically significant for all the groups. For the second restriction also both at the plant level and firm level, for majority of the public sector banks, the likelihood ratios were statistically significant. For the public sector banks as a whole for first and second restriction, likelihood ratios were statistically significant at the plant level and firm level.

From Table XXIII it is clear that for restriction one, for all size groups of private sector banks at the plant level and firm level, the long run test statistic was significant at one percent level. For the private sector banks as a whole for first restriction, at the plant level and firm level, the calculated chi square value was exceeding table value at one percent level of significance. For restriction two, for all the size group of private sector banks at the plant level and firm level, the test was statistically significant. Hence the study rejects the hypothesis of linearity of the cost function in input prices and outputs.

(iii) Input share equation:

The current study estimated the share equations for labour, fixed capital and purchased funds for different size groups of public and private sector banks at the firm level and plant level.

Table XXIV A and XXIV B represents input share equation for different size groups of public sector banks under alternate models – firm level and plant level.

TABLE XXIV A

INPUT SHARE EQUATION FOR DIFFERENT SIZE GROUPS OF PUBLIC SECTOR BANKS UNDER ALTERNATE MODELS – FIRM LEVEL

Variable	Asset size (Rupees in crores)													
	Below 20		20-60		60-100		100-140		140-200		Above 200		Whole sample	
	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value
LABOUR SHARE EQUATION														
CONSTANT	- 1.1970	-63.778**	- 1.3266	-103.521**	- 1.3936	- 87.650**	- 1.4918	-61.249**	- 1.5125	-61.125**	- 1.6812	- 40.841**	- 1.4013	-107.813**
Q_1	- 0.1304	- 3.810**	- 0.1817	- 6.499**	- 0.0614	- 1.266	- 0.0230	- 0.146	- 0.1101	- 0.882	- 0.0289	- 0.823	- 0.1108	- 4.723**
Q_2	- 0.0513	- 1.939	0.0482	4.430**	0.0515	1.672	0.0603	0.754	0.1722	2.683**	- 0.1277	- 3.416**	- 0.0199	- 1.511
P_L	0.2747	3.121**	0.1830	6.678**	0.1484	4.330**	0.0611	0.542	0.2236	2.440*	- 0.1794	- 3.751**	0.0718	2.402*
P_K	- 0.0972	- 5.057**	- 0.0696	- 4.147**	- 0.0026	- 0.096	- 0.0222	- 0.556	0.0145	0.445	- 0.1060	- 3.296**	- 0.0742	- 4.755**
P_F	- 0.0830	- 3.487**	- 0.4894	- 16.183**	- 0.4147	- 16.093**	- 0.0522	- 0.599	- 0.1333	- 9.242**	0.0109	0.355	- 0.1766	- 9.246**
R^2	.48		.63		.77		.04		.67		.30		.21	
CAPITAL SHARE EQUATION														
CONSTANT	12.5776	78.193**	12.5570	111.898**	12.4869	79.481**	2.3892	50.508**	12.1411	47.463**	12.1753	30.007**	12.4339	170.035**
Q_1	0.3324	1.133	0.5116	2.090*	0.2340	0.488	0.8040	0.505	2.0297	1.574	0.1349	0.390	0.2911	2.205*
Q_2	0.0091	0.040	- 0.0332	- 0.348	0.2945	0.968	1.0202	1.267	0.4734	0.714	- 0.2725	- 0.739	- 0.0137	- 0.185
P_L	0.1739	0.230	- 0.2373	- 0.989	- 0.0515	- 0.152	2.1149	1.865	0.4020	0.424	- 0.2095	- 0.445	- 0.0427	- 0.254
P_K	0.4047	2.457*	0.7439	5.065**	0.2764	1.049	0.3518	0.873	0.1944	0.576	0.1290	0.407	0.3876	4.415**
P_F	- 0.2482	- 1.216	- 0.5396	- 2.038*	- 0.1435	- 0.564	- 0.7169	- 0.817	- 0.6256	- 0.541	- 0.2493	- 0.824	- 0.3009	- 2.801**
R^2	.17		.16		.03		.08		.07		.13		.08	
FUNDS SHARE EQUATION														
CONSTANT	15.7058	994.440**	15.7526	1580.913**	15.7807	1710.591**	- 10.9225	- 0.977	15.8328	1471.395**	15.8489	585.114**	15.7876	1599.774**
Q_1	0.1282	4.450**	0.0662	3.047**	0.0794	2.822**	- 50.7527	- 0.699	0.0592	0.109	0.0337	1.460	0.0845	4.739**
Q_2	- 0.0254	- 1.142	- 0.0315	- 3.725**	- 0.0779	- 4.362**	- 134.3132	- 3.659**	- 0.1234	- 4.423**	0.0235	0.955	- 0.0251	- 2.499*
P_L	- 0.1055	- 1.424	- 0.1251	- 5.869**	- 0.1684	- 8.468**	- 160.3598	- 3.101**	- 0.1280	- 3.214**	0.0741	2.354*	- 0.0490	- 2.158*
P_K	0.0274	1.696	- 0.0002	- 0.018	0.00193	0.125	- 12.1932	- 0.664	0.0585	0.412	- 0.0284	- 1.342	0.0349	2.946**
P_F	0.1278	6.379**	0.5468	23.254**	0.7015	46.920**	493.5152	12.333**	0.5417	11.142**	0.0779	3.864**	0.2783	19.193**
R^2	.39		.76		.97		.78		.77		.54		.43	

* Statistically significant at five percent level

** Statistically significant at one percent level

TABLE XXIV B

INPUT SHARE EQUATION FOR DIFFERENT SIZE GROUPS OF PUBLIC SECTOR BANKS UNDER ALTERNATE MODELS – PLANT LEVEL

Variable	Asset size (Rupees in crores)													
	Below 20		20-60		60-100		100-140		140-200		Above 200		Whole sample	
	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value
LABOUR SHARE EQUATION														
CONSTANT	-1.1962	- 57.640**	- 1.3253	-101.692**	- 1.3967	- 89.743**	- 1.4890	-64.319**	- 1.5104	- 68.148**	- 1.6690	- 42.283**	- 1.4048	-109.037**
Q_1	-0.1284	- 3.154**	- 0.1797	- 6.378**	- 0.0941	- 1.891	- 0.0994	- 0.647	- 0.2930	- 2.360*	- 0.0176	- 0.523	- 0.196	- 5.125**
Q_2	-0.0500	- 1.657	0.0544	3.433**	- 0.0165	- 0.374	0.0241	0.311	0.1132	1.886	- 0.1581	- 4.181**	- 0.0581	- 3.408**
P_L	0.2730	3.029**	0.1861	6.657**	0.1643	4.798**	0.0516	0.482	0.2156	2.628**	- 0.1791	- 3.939**	0.0626	2.107*
P_K	-0.0973	- 5.057**	- 0.0703	- 4.181**	0.0056	0.213	- 0.0272	- 0.716	- 0.0166	- 0.541	- 0.1147	- 3.723**	- 0.0768	- 4.973**
P_F	-0.0834	- 3.462**	- 0.4903	- 16.202**	- 0.4145	- 16.512**	- 0.0028	- 0.032	- 0.8814	- 8.030**	0.0301	0.994	- 0.1595	- 8.183**
BA	-0.0055	- 0.088	- 0.0121	- 0.541	0.165	2.094*	0.1568	2.321*	0.25	3.375**	0.0765	2.354*	0.0864	3.479**
R^2	.49		.64		.78		.13		.74		.36		.23	
CAPITAL SHARE EQUATION														
CONSTANT	12.4088	71.553**	12.5031	111.508**	12.4859	79.104**	12.3886	50.438**	12.1311	48.380**	12.1771	29.753**	12.4252	169.799**
Q_1	- 0.0882	- 0.259	0.4300	1.774	0.2236	0.443	0.8216	0.504	2.8778	2.049*	0.1366	0.391	0.2693	2.032*
Q_2	- 0.2679	- 1.062	- 0.2896	- 2.123*	0.2729	0.608	1.0285	1.251	0.7468	1.099	- 0.2770	- 0.706	- 0.1093	- 1.130
P_L	0.5433	0.721	- 0.3613	- 1.502	- 0.0464	- 0.134	2.1171	1.865	0.4388	0.473	- 0.2095	- 0.444	- 0.0659	- 0.391
P_K	0.4176	2.599**	0.7744	5.353**	0.2789	1.048	0.3530	0.874	0.3388	0.977	0.1277	0.400	0.3811	4.346**
P_F	- 0.1811	- 0.900	- 0.5025	- 1.930	- 0.1435	- 0.564	- 0.7283	- 0.804	- 1.3304	- 1.071	- 0.2464	- 0.785	- 0.2582	- 2.332*
BA	1.1886	2.281*	0.4964	2.581**	0.0369	0.066	- 0.0362	- 0.050	- 1.1594	- 1.383	0.0113	0.034	0.2168	1.536
R^2	.21		.20		.03		.08		.11		.13		.09	
FUNDS SHARE EQUATION														
CONSTANT	15.7158	908.075**	15.7486	1573.233**	15.7802	1705.129**	- 10.1	- 0.920	15.8327	1473.106**	15.8385	634.086**	15.7872	1595.385**
Q_1	0.1531	4.508**	0.0601	2.779**	0.0748	2.526*	- 73.0889	- 1.004	0.0159	0.265	0.0240	1.127	0.0834	4.655**
Q_2	- 0.0090	- 0.357	- 0.0507	- 4.161**	- 0.0876	- 3.333**	-144.9090	- 3.947**	- 0.1202	- 4.127**	0.0496	2.074*	- 0.0296	- 2.263*
P_L	- 0.1274	- 1.695	- 0.1344	- 6.259**	- 0.1661	- 8.159**	-163.1378	- 3.217**	- 0.1276	- 3.207**	0.0738	2.565*	- 0.5013	- 2.198*
P_K	0.0267	1.663	0.0021	0.159	0.0031	0.198	- 13.6486	- 0.757	0.0076	0.509	- 0.0209	- 1.076	0.0346	2.918**
P_F	0.1239	6.170**	0.5496	23.642**	0.7015	46.993**	507.9827	12.548**	0.5333	10.020**	0.0615	3.208**	0.2803	18.720**
BA	- 0.0705	- 1.355	0.0371	2.163*	0.0166	0.502	45.8852	1.433	- 0.0138	- 0.383	- 0.0657	- 3.196**	0.0104	0.543
R^2	.40		.76		.97		.79		.77		.62		.43	

* Statistically significant at five percent level ** Statistically significant at one percent level

In labour share equation for all size groups of public sector banks at the plant level and firm level, except very large sized banks, the coefficient of labour price was positive and significant. This implies that as the price of labour increases, the share of labour in total cost increases.

From capital share equation, it is evident that for all size groups of public sector banks at the firm level and plant level, the coefficient of price of capital was positive and also significant. Hence, as the price of capital increases the share of capital in total cost increases.

From purchased funds share equation, it is evident that for all size groups of public sector banks both at the firm level and plant level, the coefficient of price of purchased funds was positive and statistically significant. As such, as the price of purchased funds increases, the share of funds in total cost increases. For the public sector banks as a whole at the firm level and plant level, the input share in total cost increases as input price increases.

Table XXV A and XXV B presents input share equation for different size groups of private sector banks under alternate models – firm level and plant level.

TABLE XXV A

INPUT SHARE EQUATION FOR DIFFERENT SIZE GROUPS OF PRIVATE SECTOR BANKS UNDER ALTERNATE MODELS – FIRM LEVEL

Variable	Asset size (Rupees in crores)											
	Below 4		4-8		8-12		12-16		Above 16		Whole sample	
	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value
LABOUR SHARE EQUATION CONSTANT	- 1.1823	- 75.751**	1.2915	- 60.060**	- 1.3523	- 51.738**	- 1.4371	- 41.532**	- 1.6345	- 89.122**	- 1.2867	- 97.681**
Q_1	0.1376	3.008**	0.0741	0.748	0.0064	0.037	- 0.2173	- 0.518	- 0.3701	- 4.678**	0.0422	0.971
Q_2	- 0.2669	- 6.477**	0.0538	0.712	0.0379	0.439	0.0092	0.032	- 0.1299	- 1.510	- 0.2095	- 5.478**
P_L	0.4947	11.265**	- 0.2005	- 1.907	- 0.1460	- 1.148	- 0.0872	- 0.304	0.4894	3.500**	0.2908	6.657**
P_K	- 0.1276	- 7.395**	0.0030	0.089	- 0.0057	- 0.137	0.0964	2.092*	0.0339	1.490	- 0.0431	- 2.791*
P_F	- 0.0338	- 1.758	- 0.0336	- 0.248	0.3920	2.344*	0.2830	1.052	- 0.5130	- 3.788**	- 0.1410	- 7.053**
R^2	.50		.06		.15		.26		.85		.28	
CAPITAL SHARE EQUATION CONSTANT	12.7833	198.740**	12.7357	108.693**	12.1286	48.972**	11.7261	27.817**	11.8404	29.758**	12.5918	199.184**
Q_1	0.6295	3.335**	0.9008	1.669	3.0794	1.898	7.7864	1.524	0.1389	0.081	0.5737	2.750**
Q_2	- 0.2859	- 1.683	- 0.1178	- 0.286	- 0.0538	- 0.066	- 7.6237	- 2.204*	1.9913	1.067	- 0.2400	- 1.308
P_L	- 0.4836	- 2.672**	0.3453	0.603	- 0.3033	- 0.252	0.1838	0.053	- 3.6337	- 1.198	- 0.2852	- 1.360
P_K	0.7047	9.910**	0.3913	2.123*	0.3105	0.796	0.6765	1.206	0.2260	0.457	0.5499	7.427**
P_F	- 0.1209	- 1.527	- 0.5661	- 0.766	- 2.3877	- 1.507	1.4489	0.442	1.9375	0.659	- 0.1447	- 1.508
R^2	.32		.08		.12		.30		.15		.13	
FUNDS SHARE EQUATION CONSTANT	15.7668	986.864**	15.7443	1717.794**	15.7898	1014.155**	15.8053	1287.186**	15.8631	4161.705**	15.7891	1546..990**
Q_1	- 0.2638	- 5.626**	- 0.0808	- 1.914	- 0.0057	- 0.056	0.0889	0.598	0.0960	5.839**	- 0.1479	- 4.390**
Q_2	0.4112	9.747**	0.00004	0.001	- 0.0857	- 1.661	0.0184	0.183	0.0283	1.581	0.3044	10.273**
P_L	- 0.4096	- 9.112**	- 0.1300	- 2.901**	- 0.2714	- 3.585**	0.0187	0.184	- 0.0956	- 3.288**	- 0.2738	- 8.088**
P_K	0.1147	6.493**	- 0.0121	- 0.838	- 0.0470	- 1.917	- 0.0301	- 1.841	- 0.0050	- 1.064	0.0719	6.013**
P_F	0.1592	8.094**	0.4577	7.921**	0.3441	3.454**	- 0.0920	- 0.964	0.1280	4.546**	0.2118	13.668**
R^2	.63		.39		.32		.22		.88		.54	

* Statistically significant at five percent level ** Statistically significant at one percent level

TABLE XXV B

INPUT SHARE EQUATION FOR DIFFERENT SIZE GROUPS OF PRIVATE SECTOR BANKS UNDER ALTERNATE MODELS – PLANT LEVEL

Variable	Asset size (Rupees in crores)											
	Below 4		4-8		8-12		12-16		Above 16		Whole sample	
	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value	coefficient	t- value
LABOUR SHARE EQUATION												
CONSTANT	- 1.1761	- 76.400**	- 1 2743	- 62.559**	- 1.3433	- 56.939**	- 1.4608	- 62.960**	- 1.6396	-114.187**	- 1.2799	- 97.824**
Q_1	0.1106	2.428*	0.0962	1.046	- 0.1252	- 0.789	- 0.3114	- 1.125	- 0.4021	- 6.464**	0.0291	0.677
Q_2	- 0.2788	- 6.880**	- 0.0917	- 1.171	- 0.0400	- 0.492	- 0.5227	- 2.480*	- 0.2027	- 2.927**	- 0.2401	- 6.245**
P_L	0.5055	11.719**	- 0.1848	- 1.894	- 0.1915	- 1.668	0.3081	1.521	0.5753	5.186**	0.3022	7.011**
P_K	- 0.1373	- 8.012**	- 0.0065	- 0.207	- 0.0160	- 0.432	- 0.0093	- 0.259	0.0264	1.480	- 0.0492	- 3.222**
P_F	- 0.0319	- 1.693	- 0.0289	- 0.231	0.5281	3.392**	- 0.2032	- 1.025	- 0.5869	- 5.480**	- 0.1391	- 7.062**
BA	0.0684	3.453**	0.1343	4.152**	0.1793	3.241**	0.7162	5.478**	0.4295	4.239**	0.0775	3.933**
R^2	.52		.19		.32		.68		.91		.30	
CAPITAL SHARE EQUATION												
CONSTANT	12.8017	199.777**	12.7372	106.433**	12.1526	49.122**	11.6982	27.338**	11.8276	29.696**	12.6049	198.098**
Q_1	0.5488	2.895**	0.9028	1.670	2.7257	1.637	7.6759	1.503	0.0595	0.034	0.5487	2.629**
Q_2	- 0.3211	- 1.904	- 0.1306	- 0.284	- 0.2632	- 0.309	- 8.2504	- 2.122*	1.8094	0.942	- 0.2981	- 1.595
P_L	- 0.4517	- 2.516*	0.3467	0.605	- 0.4255	- 0.354	0.6496	0.174	- 3.4201	- 1.111	- 0.2636	- 1.258
P_K	0.6760	9.478**	0.3905	2.113*	0.2827	0.728	0.5521	0.833	0.2076	0.419	0.5383	7.249**
P_F	- 0.1153	- 1.471	- 0.5657	- 0.766	- 2.0221	- 1.239	0.8761	0.240	1.7536	0.590	- 0.1410	- 1.472
BA	0.2031	2.463*	0.0118	0.062	0.4819	0.830	0.8439	0.350	1.0705	0.381	0.1475	1.539
R^2	.34		08		.14		.28		.15		.13	
FUNDS SHARE EQUATION												
CONSTANT	15.7726	997.407**	15.7390	1744.367**	15.7819	1330.109**	15.8136	1886.930**	15.8639	4658.281**	15.7910	1536.5530**
Q_1	- 0.2891	- 6.180**	- 0.0875	- 2.147*	0.1099	1.377	0.1219	1.219	0.1008	6.837**	- 0.1516	- 4.4960**
Q_2	0.4001	9.614**	0.0442	1.275	- 0.0172	- 0.420	0.2045	2.687*	00393	2.391*	0.2958	9.7970**
P_L	- 0.3996	- 9.019**	- 0.1347	- 3.118**	- 0.2315	- 4.009**	- 0.1196	- 1.635	- 0.1085	- 4.123**	- 0.2706	- 7.9920**
P_K	0.1056	6.002**	- 0.0092	- 0.659	- 0.0379	- 2.036*	0.0069	0.529	- 0.0039	- 0.921	0.0701	5.8490**
P_F	0.1610	8.321**	0.4563	8.193**	0.2245	2.868**	0.0781	1.091	0.1391	5.477**	0.2123	13.7280**
BA	0.0639	3.138**	- 0.0408	- 2.847**	- 0.1576	- 5.662**	- 0.2506	- 5.307**	- 0.0649	- 2.704*	0.0218	1.4120
R^2	.64		.43		.61		.65		.91		.54	

* Statistically significant at five percent level ** Statistically significant at one percent level

In labour share equation, the coefficient of price of labour was positive and statistically significant for very small banks (having the assets below Rs.4 crores), very large banks (having the assets above Rs.16 crores) and for the whole sample at the firm level and plant level. The positive coefficient of input share with respect to labour price indicates that as price of labour increases, the share of labour in total cost increases.

It is also clear that in capital share equation, the coefficient of price of capital was positive and statistically significant for all size groups of banks and for the whole sample in alternate models – firm level and plant level. In funds share equation, at the firm level, the coefficient of price of purchased funds was positive and statistically significant for the whole sample and for all size groups of private sector banks except the third group (having the assets of Rs.8-12 crores). But at the plant level, the coefficient of price of purchased funds was positive and significant for majority of the size groups of public sector banks and for the whole sample.

(iv) Elasticity of substitution between inputs:

The banks face binding constraints to the amount of inputs that can be used in any given time period and hence they need to substitute between factors. The elasticity of substitution are derived from the cost function and they provide information on relative input responsiveness to changes in relative input prices.

The Allen elasticity of substitution is a derived demand elasticity divided by input share. Inputs i and j are Allen substitutes if increase to the price of one input leads to increase in the price of other input and Allen complements if an

increase in the price of one leads to decreased utilisation of the other (Chambers, 1988).

The current study estimated elasticity of substitution between different inputs-labour, capital and purchased funds for different size groups of public sector and private sector banks. These elasticities were calculated at the mean input cost shares. Table XXVI presents the estimated Allen's elasticity of substitution between inputs in different size groups of public sector banks.

TABLE XXVI

ESTIMATED ALLEN'S ELASTICITY OF SUBSTITUTION (σ) BETWEEN INPUTS IN PUBLIC SECTOR BANKS

S.No	Particulars	Asset size (Rupees in crores)													
		Below 20		20-60		60-100		100-140		140-200		Above 200		Whole sample	
		Firm level	Plant level	Firm level	Plant level	Firm level	Plant level	Firm level	Plant level	Firm level	Plant level	Firm level	Plant level	Firm level	Plant level
1	Labour-capital	1.05	1.03	0.98	0.98	0.95	0.96	1.01	1.07	0.97	0.97	1.02	1.14	0.98	0.98
2	Labour-funds	1.06	1.25	0.94	1.01	0.95	1.08	0.84	0.88	1.22	1.56	1.04	1.01	0.86	0.97
3	Capital-funds	0.98	1.00	1.10	0.98	1.02	1.12	1.07	1.03	0.97	0.91	0.98	0.98	1.06	1.02

In all size groups of public sector banks and public sector banks as a whole, the estimated Allen elasticity of substitution between labour-capital, labour-funds and capital-funds were positive. This implies that increase in the price of one input leads to increase in the use of other input and hence labour, capital and funds were substitutes. At the firm level, for the banks in the size group of Rs.20-60 crores, Rs.100-140 crores and above Rs.200 crores and for the whole sample, greater degree of substitution was noticed between labour-capital as compared to labour-funds. At the plant level, labour was found to be a substitute more for funds than for capital for the banks in the size group of below Rs.20 crores, Rs.20-60 crores, Rs.60-100 crores, Rs.140-200 crores and for the whole sample since the estimated elasticity of substitution between labour-funds in these groups were higher than that of labour-capital.

The estimated elasticity of substitution between capital-funds indicates that at the firm level, there was greater degree of substitution of capital-funds for the banks in the size group of Rs.20-60 crores, Rs.60-100 crores, Rs.100-140 crores and for the whole sample. Hence in these groups, the banks were substituting funds rather than labour in the place of capital. However, at the plant level, only for the banks in the size group of Rs.60-100 crores and for the whole sample of public sector banks, the estimated elasticity of substitution of capital-funds was exceeding that of labour-capital.

Table XXVII presents the estimated Allen's elasticity of substitution between inputs in different size groups of private sector banks.

TABLE XXVII

ESTIMATED ALLEN'S ELASTICITY OF SUBSTITUTION (σ) BETWEEN INPUTS IN PRIVATE SECTOR BANKS

S.No	Particulars	Asset size (Rupees in crores)											
		Below 4		4-8		8-12		12-16		Above 16		Whole sample	
		Firm level	Plant level	Firm level	Plant level	Firm level	Plant level	Firm level	Plant level	Firm level	Plant level	Firm level	Plant level
1	Labour-capital	14.98	24.75	1.12	1.00	0.90	0.88	1.02	1.04	-0.39	1.01	0.95	0.97
2	Labour-funds	- 2.18	- 9.49	0.82	0.74	1.17	1.32	1.09	1.12	1.26	1.01	0.98	1.00
3	Capital-funds	1.30	1.29	1.18	1.20	1.01	0.98	1.01	1.01	0.76	1.01	0.99	0.99

For the private sector banks as a whole and for majority of the size groups, at the plant level and firm level, labour-capital were substitutes, since the estimated elasticity of substitution between labour-capital were positive. Similarly, labour-funds were proved to be Allen substitutes for the whole sample and for all the size groups except the case of very small banks. The estimated elasticity of substitution between capital-funds were positive for the whole private sector banks and for different size groups indicating that capital and funds were substitutes for each other.

For the whole sample of private sector banks, at the firm level, greater degree of substitution was noticed between capital-funds, since the estimated Allen elasticity of capital-funds was higher than that of labour-capital and labour-funds. However, at the plant level, labour seemed to be a better substitute for funds as the estimated Allen's elasticity of labour-funds was higher than that of labour-capital and capital-funds.

Since Allen's partial elasticity of substitution are symmetric ($\sigma_{ij} = \sigma_{ji}$) with respect to the order of input, their knowledge is insufficient for revealing the main channels through which the inter input substitution possibilities are realised. In order to detect this channel, own and cross price elasticities have been estimated. Table XXVIII represents the estimated own and cross price elasticities in public sector banks.

TABLE XXVIII

ESTIMATED OWN AND CROSS PRICE ELASTICITIES (η)

IN PUBLIC SECTOR BANKS

Inputs	Asset size (Rupees in crores)	Labour		Capital		Funds	
		Firm level	Plantlevel	Firm level	Plant evel	Firm level	Plant evel
Labour	< 20 crores	0.10	0.50	0.83	1.11	1.01	0.60
	20-60 crores	0.47	0.61	1.74	1.61	- 0.73	1.87
	60-100 crores	1.63	1.72	2.19	1.65	3.28	1.04
	100-140 crores	2.15	0.75	1.68	2.30	- 1.18	- 4.61
	140-200 crores	1.35	1.44	3.01	2.49	1.05	0.22
	> 200 crores	1.75	0.22	2.67	2.05	2.56	3.36
	Whole sample	- 0.03	1.22	1.13	1.90	2.48	2.63
Capital	< 20 crores	1.01	1.48	- 0.23	0.09	0.94	0.48
	20-60 crores	1.42	1.57	0.76	0.62	- 0.85	1.80
	60-100 crores	2.54	2.69	1.30	0.71	3.54	1.08
	100-140 crores	3.33	2.16	0.68	1.15	- 1.50	- 5.35
	140-200 crores	2.35	2.30	1.99	1.56	0.86	0.13
	> 200 crores	2.77	1.02	1.61	0.79	2.41	3.27
	Whole sample	0.71	2.12	0.16	0.93	3.06	2.77
Funds	< 20 crores	1.02	1.79	0.78	1.08	0.20	- 0.09
	20-60 crores	1.37	1.60	1.95	1.59	-1.82	0.87
	60-100 crores	2.54	3.03	2.36	1.92	2.44	- 0.07
	100-140 crores	2.78	1.78	1.77	2.20	- 2.30	- 6.22
	140-200 crores	2.95	3.71	3.00	2.32	- 0.40	- 2.21
	> 200 crores	2.83	0.90	2.56	1.76	1.33	2.21
	Whole sample	0.62	2.10	1.21	1.98	1.94	1.75

At the firm level, own price elasticity of labour was negative for the whole public sector banks in accordance with the theory. But at the plant level for different size groups of public sector banks and whole public sector banks, the own price elasticity of labour was positive. The estimated elasticity of input demand for labour with respect to price of capital were positive for all the size groups and the public sector banks as a whole both at the firm level and plant level. For the whole sample of public sector banks, the response of labour to a change in the price of funds was more as compared to change in price of capital since the estimated cross elasticity of demand for labour with respect to the price of funds was greater than that of capital both at the firm level and plant level.

From Table XXVIII it can be observed that at the plant level, own price elasticity of capital was negative among very small banks. For other groups of banks and for the public sector banks as a whole, the estimated own price elasticity of capital were positive implying that an increase in the price of capital tended to increase the demand for capital. The estimated elasticity of input demand for capital with respect to price of labour were positive for all the size groups and public sector banks as a whole both at the firm level and plant level. Hence, an increase in the price of labour tended to increase the demand for capital. Similarly, in majority of the size groups and public sector banks as a whole, the cross elasticity of demand for capital in relation to the price of funds were observed to be positive.

An analysis of own and cross price elasticity for funds revealed that own price elasticity of funds was negative among small and medium banks at the

plant level and the firm level. However, the estimated cross elasticity of demand for funds in relation to the price of labour and in relation to the price of capital were positive for all the size groups and public sector banks as a whole at the plant level and firm level. Hence as the price of labour and capital increases, the demand for funds tended to increase.

The current study's estimates of own and cross price elasticities were different from the earlier estimates. Humphrey (1985) estimated own price elasticity of input demand for capital as .35. But in none of the size groups of public sector and private sector banks and for the whole sample, either at the plant level or firm level, the estimated own elasticity of demand for capital was closer to the previous estimates. Similarly, Noulas et al (1990) estimated cross elasticity of substitution between labour-funds as .08, labour-capital as .11 and funds-capital as .02 for U.S banks. But the current study estimates of cross elasticity of substitution between labour-funds, labour-capital and funds-capital were not in tune with Noulas et al (1990) estimates.

Table XXIX depicts the estimated own and cross price elasticities in private sector banks.

TABLE XXIX

ESTIMATED OWN AND CROSS PRICE ELASTICITIES (η)

IN PRIVATE SECTOR BANKS

Inputs	Asset size (Rupees in crores)	Labour		Capital		Funds	
		Firm level	Plant evel	Firm level	Plant evel	Firm level	Plant evel
Labour	< 4 crores	-1.58	- 1.31	3.36	4.16	- 1.05	- 4.51
	4-8 crores	0.88	1.24	0.36	1.51	- 1.92	- 0.59
	8-12 crores	-0.31	- 0.19	2.22	1.99	2.09	0.94
	12-16 crores	-6.27	- 1.36	4.61	-2.99	-10.48	-21.24
	> 16 crores	-4.46	-31.80	-0.06	-8.58	1.08	-25.05
	Whole sample	2.55	3.56	0.73	0.47	2.30	1.88
Capital	< 4 crores	-0.44	- 0.50	-1.00	-1.20	0.63	0.61
	4-8 crores	2.45	2.48	-0.75	0.49	- 2.76	- 0.95
	8-12 crores	0.74	0.96	1.49	1.27	1.80	0.70
	12-16 crores	-5.35	- 2.05	3.52	-3.84	- 9.78	-19.18
	> 16 crores	1.20	-30.93	-0.42	-9.52	0.66	-25.08
	Whole sample	3.57	4.59	-0.34	-0.68	2.33	1.86
Funds	< 4 crores	0.06	0.19	0.29	0.21	- 0.68	- 0.69
	4-8 crores	1.80	1.84	0.38	1.81	- 3.46	- 2.60
	8-12 crores	0.97	1.44	2.51	2.23	0.51	- 0.19
	12-16 crores	-5.70	- 2.22	4.59	-2.91	-10.13	-19.92
	> 16 crores	-3.91	-30.85	0.07	-8.57	- 0.40	-25.94
	Whole sample	3.69	4.75	0.76	0.48	1.23	0.75

From Table XXIX it is evident that own price elasticity of labour was positive for the private sector banks as a whole both at the firm level and plant level. However, at the firm level and at the plant level, own price elasticity of labour was negative for the banks of all the asset size group except size group of Rs.4-8 crores. Hence in these size groups, as the price of labour increases, the use of labour tended to decrease. The estimated elasticity of input demand for labour with respect to price of capital was positive in majority of the size groups and for the private sector banks as a whole at the firm level and plant level. Hence, when the price of capital increases, banks were motivated to use more of labour. Similarly, for the whole private sector banks and for medium and large banks, the estimated cross elasticities of demand for labour with respect to price of funds were positive at the firm level and at the plant level. For the whole private sector banks, the response of labour to change in the price of funds was more than the response of labour to the change in price of capital since the estimated cross elasticity of demand for labour with respect to price of funds was greater than that of capital.

At the firm level and plant level, the own price elasticity of capital was negative for the whole sample of private sector banks. However, the cross elasticity of demand for capital with respect to price of labour was positive for small and medium banks and for the whole sample. The estimated cross elasticity of demand for capital with respect to price of funds was observed to be positive for whole private sector banks at the firm level and plant level.

An analysis of input demand for funds with respect to own price indicated that for the private sector banks as a whole and for medium banks, the demand for funds increased inspite of increase in the price of funds, since the estimated elasticities were positive. The elasticity of input demand for funds with respect to price of labour was positive for the small and medium private sector banks and whole private sector banks at the firm level and plant level. Hence, the demand for funds increases when the price of labour increases. The estimated elasticity of input demand for funds with respect to price of capital was positive in all cases, except medium and very large banks at the plant level.

As a whole, the analysis of substitution between inputs revealed that Indian public and private sector banks did not face restrictions in the use of liability management. The liability management by the banks was more likely to involve funds since they were more price responsive than capital. But the degree of substitution among the inputs was not varying with the size of the banks.

(v) Ray scale economy:

Based on the parameter estimates of the translog cost function the Ray scale economies were calculated at the plant level and at the firm level for different size groups of public sector banks and private sector banks and for the whole sample.

Table XXX presents Ray scale economy estimates at the plant level and the firm level for different size groups of public sector banks.

TABLE XXX

RAY SCALE ECONOMY ESTIMATES FOR DIFFERENT SIZE GROUPS OF PUBLIC SECTOR BANKS

Asset Size (Rupees In crores)	RSCE (Plant Level)	RSCE (Firm Level)
Below 20	0.8938	0.8806
20-60	0.9616	1.0657
60-100	0.9609	0.8935
100-140	0.9315	1.0684
140-200	0.9322	1.1196
Above 200	0.8725	0.9882
Whole Sample	1.1009	0.7887

For the public sector banks, ray scale economy for the whole sample at plant level was estimated as 1.1009 and it was found to be greater than one. This means that public sector banks as a whole do not find it cost efficient to increase the scale of operation if the number of branches also increase along with output. The estimated ray scale economy was closer to the estimate of Noulas et al (1990) as 1.01 for US banks at the plant level for the year 1980.

For the public sector banks, ray scale economy for the whole sample at firm level was estimated as 0.7887. This means that an average sized bank will have cost benefit from equiproportionate increase in it's output at the existing branches.

The current study also evaluated scale economies for different asset size groups of public sector banks. Data points chosen in the study were the averages (geometric mean) of output and other variables of banks in six size groups.

At the plant level, scale economies exist among public sector banks in all size groups of banks, since in all size groups of banks, the estimated ray scale economy was less than one. As a whole, the scale economy at plant level seem to cluster within the range of .87 to .96 signifying that a proportionate increase in output causes reduction in cost from 4 to 13 percent. This is in tune with the findings of Mester (1987) that scale economy for Indian commercial banks ranged from .89 to .99, and Chatterjee (1997) that, scale economy for Indian commercial banks was in the range of .86 to .97.

Table XXX implies that at the plant level very large public sector banks have greater degree of scale economy as compared to other groups. Hence the findings of the current study are in confirmity with the findings of Hunter and Timme (1986), Vipin Shah (1986), Sheffer (1988), Jain (1988) and Berger et al (1993) that there was significant economies of scale among the large banks.

But at the firm level, greater degree of scale economy exists for very small banks (i.e) having the assets of less than Rs.20 crores. At higher asset size classes (Rs.20-60 crores, Rs.100-140 crores and Rs.140-200 crores) the scale economy measures were not less than one. This was in tune with the view of Jain (1988) that economies of scale operate at the firm level for Indian public sector banks and very small banks have more scale economy as compared to other banks and the view of Ray and Sanyal (1995), that substantial scale economies exist among Indian public sector banks and very small banks enjoy more scale economy as compared to other banks.

Table XXXI presents estimated ray scale economy estimates at the plant level and the firm level for different size groups of private sector banks.

TABLE XXXI

RAY SCALE ECONOMY ESTIMATES FOR DIFFERENT SIZE GROUPS OF PRIVATE SECTOR BANKS

Asset Size (Rupees In crores)	RSCE (Plant level)	RSCE (Firm level)
Below 4	0.7849	0.8569
4-8	0.9121	1.0313
8-12	0.9546	1.0591
12-16	1.2901	0.9948
Above 16	0.9686	0.9181
Whole Sample	0.8987	0.9996

For the private sector banks ray scale economy for the whole sample at the plant level was estimated as 0.8987. Hence with branch expansion, the private sector banks as a whole find it cost efficient to increase the scale of operation. Even at the firm level, ray scale economy for whole sample of private sector banks was less than one. Hence the private sector banks have the cost benefit from increase in output at the existing branches. Since the degree of scale economy was higher at the plant level than the firm level, the private sector banks as a whole can gain more cost efficiency by increasing the number of branches.

An analysis of ray scale economy for different asset size groups of private sector banks indicated that at the plant level significant scale economies exist among the banks upto the third size class (i.e) having assets upto Rs.12 crores. For large sized banks (i.e) having the assets of Rs. 12-16 crores, ray scale economy was greater than one. Hence the banks in this group do not experience reduction in cost when output expands along with branch expansion.

The scale economy of private sector banks at plant level ranges between 0.78 to 0.97. From Table XXXI, it can be observed that very small private sector banks have greater degree of scale economy as compared to other groups both at the plant level and firm level. In this context, the findings of the current study are in confirmity with the scale economy results reported by Benston et al (1982), Humphrey (1984), Ray and Sanyal (1995) and Gropper (1991) that small sized banks have more scale economy.

At the firm level, for very small banks, those having the asset size of below Rs.4 crores, ray scale economy was estimated as .8569. Similarly for large banks (i.e) having the assets exceeding Rs.12 crores, the estimated ray scale economy was less than one. Hence very small and large banks have the cost benefit of increase in output at the existing number of branches. At the firm level the scale economy ranges between 0.85 to 0.99 and there was higher degree of scale economy for very small banks.

As a whole, the analysis of ray scale economy indicated that private sector banks in India demonstrated scale economy and hence the hypothesis that economies of scale do not exist in Indian private sector banks was rejected. As such the finding of the current study is in accordance with the view of Das (1997), Bishnoi (1992) and Chatterjee (1997) that substantial scale economies exist in Indian private sector banks.

However, the current study noted that, both for public sector and private sector banks, at the plant level and firm level there was no relation between the estimated ray scale economy and the asset size of banks.

(vi) Expansion path scale economies:

The study defined expansion path scale economy as elasticity of cost with respect to output when the output mix changes along the expansion path. The current study estimated expansion path scale economy for different size groups of public sector and private sector banks. Table XXXII shows the expansion path scale economy estimates at plant level and firm level for different size groups of public sector banks.

TABLE XXXII

EXPANSION PATH SCALE ECONOMY ESTIMATES FOR DIFFERENT SIZE GROUPS OF PUBLIC SECTOR BANKS

Asset size (Rupees in crores)	EXPSE (Plant level)	EXPSE (Firm level)
Below 20	0.0130	0.0140
20-60	2.6274	2.4444
60-100	1.0457	1.0813
100-140	0.5172	0.6458
140-200	1.0791	1.2694
Above 200	-	-

Under the condition that in the process of output expansion, if new branches are opened, EPSCE for the first size class (i.e) banks with assets upto Rs.20 crores were lower than one. But for the large size group (i.e) banks with assets of Rs.140-200 crores, EPSCE was not less than one. Thus if public sector banks alter their output mix in the process of branch expansion only very small banks will gain in terms of cost efficiency.

Table XXXII makes it clear that in the process of output expansion, at the existing branches, only banks in the size group of below Rs.20 crores assets, and Rs.100-140 crores assets will gain in terms of cost efficiency, since only for these group of banks, the estimated expansion path scale economy at the firm level was less than one.

Table XXXIII depicts expansion path scale economy estimates at plant level and firm level for different size groups of private sector bnsks.

TABLE XXXIII

EXPANSION PATH SCALE ECONOMY ESTIMATES FOR DIFFERENT SIZE GROUPS OF PRIVATE SECTOR BANKS

Asset size (Rupees in crores)	EXPSE (Plant level)	EXPSE (Firm level)
Below 4	0.7258	0.8096
4-8	0.3775	0.4193
8-12	0.8778	2.0149
12-16	0.8418	0.9142
Above 16	-	-

Among the private sector banks expansion path scale economy at the plant level were less than one for banks having assets up to Rs.16 crores. The banks having the assets of Rs.4-8 crores have greater degree of expansion path scale economy and hence only small banks will gain more cost advantage by altering their output mix along with the branch expansion. In the process of output expansion at the existing branches to handle the increased output, banks in all size groups, except the third group (having the assets of Rs.8-12 crores) will gain in terms of cost efficiency as EPSCE measures for these size groups at firm level was found to be less than one.

III. SCALE EFFICIENCY OF COMMERCIAL BANKS IN INDIA:

The current study tried to estimate scale efficiency of commercial banks in India by using Data Envelopment Analysis (DEA). In the current study DEA was applied by following the computer software Ideas 1.01 version.

(i) Scale efficiency of public sector banks in India:

Data envelopment analysis compares the actual operating results of each decision making unit (bank) with those of all other decision making units and identifies the relatively inefficient units. A decision making unit (bank) is said to be relatively efficient if it cannot be shown that some other decision making unit in the reference set can produce the same outputs by utilising less inputs or can produce more outputs by using the same inputs (Charnes et al, 1985).

Data envelopment analysis efficiency results of public sector banks in India are depicted in Table XXXIV.

TABLE XXXIV

DATA ENVELOPMENT ANALYSIS EFFICIENCY RESULTS OF PUBLIC SECTOR BANKS IN INDIA

Asset size (Rupees in crores)	Number of decision making units	Number of efficient units	Percentage of efficient units	Number of inefficient units	Percentage of inefficient units
Below 20	100	1	1.00	99	99.00
20-60	177	5	2.82	172	97.18
60-100	82	3	3.66	79	96.34
100-140	49	4	8.16	45	91.84
140-200	46	8	17.39	38	82.61
Above 200	52	3	5.77	49	94.23
Whole sample	506	24	4.72	482	95.28

(Appendix IV)

It is evident that of the public sector banks in the size group of below Rs.20 crores, only one percent of the banks were scale efficient. Among the banks in the size group of Rs.20 - Rs.60 crores, the number of banks achieving 100 percent efficiency was 5 and it accounted for 2.82 percent of the banks in the concerned size and among the banks in the size group of Rs.60-Rs.100 crores only three banks were scale efficient and as such 3.66 percent of the banks were scale efficient. Of the total banks having the asset size of Rs.100-Rs.140 crores only 8.16 percent were scale efficient. However, among the large sized banks having the assets of Rs.140-Rs.200 crores, 17.39 percent were scale efficient and of the banks having the assets exceeding Rs.200 crores, only 5.77 percent were scale efficient. As a whole, of the total public sector banks, 4.72 percent were scale efficient and 95.28 percent were scale inefficient.

The current study calculated the average scale efficiency by including the best productive banks and excluding best productive banks for different size groups of public sector banks. Average scale efficiency of different size groups of public sector banks in India are given in Table XXXV.

TABLE XXXV

AVERAGE SCALE EFFICIENCY OF DIFFERENT SIZE GROUPS OF PUBLIC SECTOR BANKS IN INDIA

Assets size (Rupees in crores)	Average scale efficiency including best productive banks	Average scale efficiency excluding best productive banks	Minimum scale efficiency
Below 20	78.05	77.82	75.96
20-60	78.96	78.35	76.48
60-100	79.88	79.12	77.84
100-140	92.03	91.33	86.77
140-200	96.38	95.49	91.71
Above 200	78.65	77.34	75.61
Whole sample	81.91	81.01	75.61

It can be observed that the average scale efficiency including best productive banks was high for large banks as compared to small banks. While the average scale efficiency for the banks having the asset size of Rs.140-200 crores was 96.38, it was only 78.05 for the banks having the asset size of below Rs.20 crores. This implies that among the banks having the asset size of Rs.140-200 crores, only 3.62 percent of the resources remained unutilised. But among the banks having the asset size of below Rs. 20 crores, 21.95 percent of the resources were unutilised. Even by excluding best productive banks, the average scale efficiency for the banks having the asset size of Rs.140-200 crores was high (95.49) as compared to banks having the asset size of below Rs. 20 crores (77.82).

Similarly, the minimum scale efficiency was higher for large banks as compared to small banks. The finding of the current study that large banks were more scale efficient as compared to small banks supports the earlier finding of Clark (1996) that large banks appeared to be more efficient or closer to the efficiency frontier than the smaller. It also supports the view of Sawhney and Dipietro (1979) and Federal Reserve Bank of Atlanta (1999) that inefficiencies were smaller for large banking firms than for small banking firms.

Table XXXV highlights the fact that the average scale efficiency increased as the asset size increased upto Rs.200 crores. But beyond this limit, the scale effiicency declined even though asset size increased. The average scale efficiency of public sector banks as a whole including best productive banks was estimated to be 81.91. By excluding best productive banks, the average scale

efficiency was 81.01. This estimated efficiency is in tune with the estimated average efficiency of financial services for eleven OECD countries for the period 1971 to 1986 as 82 percent by Fecher and Pestinau (1993). It was also closer to the estimated average efficiency of 427 banks in eight developed countries as 80 percent by Pastor et al (1997).

(ii) Comparative analysis of inputs and outputs of the efficient and inefficient decision making units of public sector banks:

After identifying the efficient and inefficient units, the current study tried to investigate the level of output produced and inputs used by efficient and inefficient units. The efficient decision making units would consume less amount of resources for achieving their level of output. Table XXXVI presents the comparative analysis of inputs and outputs of the efficient and inefficient decision making units of public sector banks in India.

TABLE XXXVI

COMPARTIVE ANALYSIS OF INPUTS AND OUTPUTS OF THE EFFICIENT AND INEFFICIENT DECISION MAKING UNITS OF PUBLIC SECTOR BANKS IN INDIA

Asset size (Rupees in crores)	Average inputs of the efficient units			Average inputs of the inefficient units			Average outputs of the efficient units		Average outputs of the inefficient units	
	Labour (in number)	Capital (Rupees in crores)	Funds (Rupees in crores)	Labour (in number)	Capital (Rupees in crores)	Funds (Rupees in crores)	Advances (Rupees in crores)	Investment (Rupees in crores)	Advances (Rupees in crores)	Investment (Rupees in crores)
Below 20	7081	0.06	20.95	9870	0.13	22.85	147.47	5.68	7.19	2.44
20-60	13585	0.24	36.98	17309	0.27	37.86	21.09	28.23	20.40	20.48
60-100	24124	0.40	39.16	25025	0.56	72.89	39.39	144.80	24.85	22.29
100-140	31077	0.77	104.80	32960	0.77	199.05	56.38	33.91	55.55	30.30
140-200	41524	1.52	142.21	46420	1.78	153.72	82.92	45.78	76.21	44.99
Above 200	59784	0.63	24.80	92702	2.64	342.98	232.13	47.44	205.25	42.07
Whole sample	26428	0.69	86.44	35468	0.84	134.05	79.70	91.66	47.27	23.39

(Appendix V)

In all size groups of public sector banks, the inefficient decision making units consumed more resources of labour, capital and funds to produce the output. For example, in the asset group of below Rs.20 crores, the inefficient units used 139.39 percent of labour to produce their outputs as compared to the efficient units in the same asset size group. The decision making units in the size group of Rs.20-60 crores, were using 127.41 percent of labour required for efficient decision making units. In the size group of Rs. 60-100 crores the inefficient units were using 103.73 percent of labour required for efficient decision making units. Similarly, the decision making units of Rs.100-140, Rs.140-200 and above Rs.200 crores were respectively using 106.06 percent, 111.79 percent and 155.06 percent of labour required for efficient units.

Table XXXVI also makes it clear that there was excess use of capital by inefficient units. For example, very small public sector inefficient banks (having the asset size of below Rs.20 crores) were using 216.67 percent of capital required for efficient units. Similarly, the inefficient banks in the asset group of Rs.100-140 crores were using 101.30 percent of capital required for efficient units.

The inefficient public sector banks were also excessively using funds. The decision making units in the size group of below Rs.20 crores, Rs.20-60 crores, Rs.60-100 crores, Rs.100-140 crores, Rs.140-200 crores and above Rs.200 crores were using respectively 109.07 percent, 102.38 percent, 186.13 percent, 189.93 percent, 108.09 percent and 194.69 percent of funds required for efficient units.

For the inefficient units in the public sector banks as a whole, there was excess use of labour, capital and funds. They were utilising 134.21 percent of labour, 121.83 percent of capital and 155.07 percent of funds required for efficient units.

The basic cause for inefficiency in decision making units is deficient output. In all size groups of public sector banks and whole public sector banks, the inefficient units were producing less output as compared to efficient units. For instance, the decision making units in the size groups of below Rs.20 crores, produced 4.88 percent of advances and 42.96 percent of investments produced by efficient units in the same size group. Similarly, the units in the size group of Rs.100-140 crores, were producing only 98.53 percent of advances and 89.35 percent of investments produced by efficient units in the corresponding size group.

As far as the whole sample of public sector banks were concerned, the inefficient units produced only 59 percent of advances and 26 percent of investments produced by to the efficient decision making units.

(iii) Scale efficiency of private sector banks in India:

Data envelopment analysis efficiency results of private sector banks in India are given in Table XXXVII.

TABLE XXXVII

DATA ENVELOPMENT ANALYSIS EFFICIENCY RESULTS OF PRIVATE SECTOR BANKS IN INDIA

Asset size (Rupees in crores)	Number of decision making units	Number of efficient units	Percentage of efficient units	Number of inefficient units	Percentage of inefficient units
Below 4	283	40	14.13	243	85.87
4-8	107	2	1.87	105	98.13
8-12	42	3	7.14	39	92.86
12-16	23	2	8.69	21	91.30
Above 16	28	1	3.57	27	96.43
Whole sample	483	48	9.94	435	90.06

(Appendix VI)

Among the private sector banks having the asset size of below Rs. 4 crores, 40 banks have achieved 100 percent scale efficiency and it accounted for 14.13 percent. However of the banks in the size group of Rs.4-8 crores, only 2 banks were scale efficient and hence 1.87 percentage of the banks were scale efficient. With regard to banks in the size group of Rs.8 - Rs.12 crores, 3 banks were scale efficient and hence only 7.14 percent of the banks were scale efficient. Among the banks in the size group of Rs.12-16 crores, only 2 banks were scale efficient and it accounted for 8.69 percent. Of the large sized private sector banks having the assets exceeding Rs.16 crores, only one bank was scale efficient and it accounted for 3.57 percent. Of the whole private sector banks, 9.94 percent were scale efficient and 90.06 percent were scale inefficient.

The current study calculated the average scale efficiency by including the best productive banks and excluding best productive banks for different size groups of private sector banks. Table XXXVIII helps to explain the average scale efficiency of different size groups of private sector banks in India.

TABLE XXXVIII

AVERAGE SCALE EFFICIENCY OF DIFFERENT SIZE GROUPS OF PRIVATE SECTOR BANKS

Assets Size (Rupees in crores)	Average scale efficiency including best productive banks	Average scale efficiency excluding best productive banks	Minimum scale efficiency
Below 4	95.20	94.41	89.04
4-8	93.45	93.33	85.73
8-12	91.91	91.30	83.93
12-16	95.33	91.86	85.16
Above 16	92.57	77.31	76.21
Whole sample	93.41	92.68	76.21

The average scale efficiency of private sector banks in the size group of below Rs. 4 crores excluding the best productive banks was 94.41 percent. Hence these banks were under utilising 5.59 percent of their resources. However for the banks in the size group of above Rs.16 crores excluding the best productive banks, the average scale efficiency was 77.31 percent and hence the unutilised resources were to the extent of 22.69 percent. Even by including best productivity banks, the average scale efficiency was higher for small banks having the asset size of below Rs.4 crores.

The finding that small banks were scale efficient supports the finding of Ferrier and Lovell (1990) that of 575 institutions which participated in Federal Reserve system financial cost analysis (FCA) programme in 1984 most efficient banks belong to the smallest size classes. However, the finding of the current study contradicts the earlier findings of Humphrey (1990), McAllister and McManus (1993) that smaller banking firms were less efficient than large banks.

The average scale efficiency of private sector banks as a whole including best productive banks was estimated to be 93.41 and by excluding best productive banks, the average scale efficiency was estimated as 92.68. As such, the current study supports the finding of Das (1997) that average scale efficiency of Indian private sector banks was 92 percent.

(iv) Comparative analysis of inputs and outputs of the efficient and inefficient decision making units of private sector banks in India:

Table XXXIX presents the comparative analysis of inputs and outputs of the efficient and inefficient decision making units of private sector banks in India.

TABLE XXXIX

COMPARTIVE ANALYSIS OF INPUTS AND OUTPUTS OF THE EFFICIENT AND INEFFICIENT DECISION MAKING UNITS OF PRIVATE SECTOR BANKS IN INDIA

Asset size (Rupees in crores)	Average inputs of the efficient units			Average inputs of the inefficient units			Average outputs of the efficient units		Average outputs of the inefficient units	
	Labour (in number)	Capital (Rupees in crores)	Funds (Rupees in crores)	Labour (in number)	Capital (Rupees in crores)	Funds (Rupees in crores)	Advances (Rupees in crores)	Investment (Rupees in crores)	Advances (Rupees in crores)	Investment (Rupees in crores)
Below 4	532	0.01	1.18	919	0.02	1.57	0.83	0.43	0.74	0.34
4-8	1790	0.03	4.97	2255	0.05	5.44	2.64	2.15	1.99	1.44
8-12	2931	0.06	8.28	3264	0.08	8.31	4.57	2.57	4.08	242
12-16	2947	0.05	12.07	3668	0.13	12.31	6.16	4.24	5.57	3.81
Above 16	4699	0.08	21.51	4848	0.16	33.07	15.76	10.49	11.18	7.03
Whole sample	999	0.06	3.55	1824	0.06	4.47	2.44	1.43	1.84	1.11

It is evident that, among the private sector banks, inefficient decision making units used more resources than the efficient units in all the asset size groups. For instance, in the asset size of below Rs.4 crores, the inefficient units used 172.74 percent of labour, 138.53 percent of capital and 132.76 of funds required for efficient units. The large banks having the asset size of above Rs.16 crores were using 103.17 percent of labour, 197.92 percent of capital and 153.74 percent of resource used by efficient units. In the whole sample of private sector banks, the inefficient units were using 182.58 percent of labour, 108.09 percent of capital and 126.03 percent of funds needed for efficient units.

In all the size groups of private sector banks and private sector banks as a whole, the inefficient units were producing less amount of output as compared to efficient units. For instance, the decision making units in the asset size of Rs.8-12 crores had produced only 90.56 percent of advances and 94.05 of investments produced by efficient units. For the whole sample of private sector banks the inefficient units produced 75.17 percent of advances and 78.29 of investments produced by efficient units.

SUMMARY AND CONCLUSION

CHAPTER V

SUMMARY AND CONCLUSION

The financial sector of the economy is the stimulating force for economic development. Commercial banks are the predominant financial intermediaries since they act as the main conduit for transfer of surplus funds from the savers to the borrowers for the purpose of productive investment. The banking sector is an important segment of the financial sector as significant part of the funds flow through the banking system. Indian commercial banking witnessed significant development during the last two decades in terms of assets, branches, deposits, advances and investments. In the era of competition, the survival of banks depends upon scale economies enjoyed by them.

In India, there have been limited studies focusing on scale economy of commercial banks. Rangarajan and Mampilly (1972), Jain (1988), Bishnoi (1992), Ray and Sanyal (1995), Chatterjee (1997) etc have analysed the scale economy of Indian commercial banks. But they have concentrated on individual banks for a limited period of one or two years. There had been little attempt to analyze the scale economy over a long period of time for all private sector and public sector banks in India. Hence the current study, on 'Economies of scale in Indian commercial banks (1973-1996)' tried to fill this gap by analyzing scale economy for a long period of time.

The basic objectives of the study were to study

a) The profile of Indian commercial banks;

b) To estimate the scale economy of Indian commercial banks at the plant level and the firm level; and

c) To estimate the scale efficiency of Indian commercial banks.

The study was related to scheduled public sector banks and private sector banks in India for the period 1973-1996. The data relating to assets, advances, investments, deposits, borrowings, employees, fixed capital, operating expenses, interest paid and number of branches were compiled from various issues of Report of Currency and Finance, Report on Trend and progress of Banking in India, Reserve Bank of India Monthly Bulletin, Reserve Bank of India – Annual report published by Reserve Bank of India and Financial Analysis, the performance highlights published by Indian Banks Association. The monetary values of the variables were converted into real values by using Gross national product deflator. The current study adopted intermediation approach and considered advances and investments as output and labour, fixed capital and purchased funds (deposits and borrowings) as inputs. In the current study total cost is considered as operating costs plus interest cost.

The study considered assets as an indicator of the size of commercial banks. In each of the reference years, the banks were placed in different size groups. The size groups of the public sector banks were below Rs.20 crores, Rs.20-60 crores, Rs.60-100 crores, Rs.100-140 crores, Rs.140-200 crores and above Rs.200 crores. The public sector banks having the asset size of below

Rs.20 crores (100 cases) and Rs.20-60 crores (177 cases) were considered as small banks. The public sector banks having the asset size of Rs.60-100 crores (82 cases) and Rs.100-140 crores (46 cases) were considered as medium banks. Those banks having the asset size of Rs.140-200 crores (45 cases) and above Rs.200 crores (52 cases) were considered as large banks.

Since there was a greater variation in the assets of public sector banks and private sector banks, the current study attempted a separate size wise classification of private sector banks based on their assets. The size groups of the private sector banks were below Rs.4 crores, Rs.4-8 crores, Rs.8-12 crores, Rs.12-16 crores and above Rs. 16 crores. The private sector banks having the asset size of below Rs.4 crores (283 cases) and Rs.4-8 crores (107 cases) were considered as small banks. The private sector banks having the assets size of Rs.8-12 crores (42 cases) were considered as medium banks. The private sector banks having the asset size of Rs.12-16 crores (23 cases) and above Rs. 16 crores (28 cases) were considered as large banks.

The study estimated the parameters of translog cost function for different size groups of public sector banks and private sector banks and for the whole sample of public sector and private sector banks at the firm level and plant level by applying computer software SAS 4.1 version. The multicollinearity of the variables chosen for estimating translog cost function were tested by calculating zero order correlation coefficients. The current study imposed restrictions related to linear homogenity of the cost function in input prices and linear homogenity of the cost function in outputs. The validity of the restrictions were tested through

likelihood ratios. Input share equations, Allen's elasticities of substitution between inputs, own and cross price elasticities of different inputs were also estimated. Based on the parameters of the translog cost function, the study estimated ray scale economy and expansion path scale economy at the firm level and plant level.

The current study estimated the scale efficiency of each decision making unit in the concerned size group of public sector and private sector banks by using non parametric method – data envelopment analysis. The study also tried to find out excess inputs and deficient outputs of inefficient decision making units as compared to efficient decision making units in different size groups of banks. Data envelopment analysis efficiency results were obtained by applying computer software Ideas 1.01 version.

The major findings that emerged out of the study were as follows:

A. Profile of commercial banks in India:

a) In the reference period the assets of public sector banks increased from Rs.11,532 crores to Rs.4,66,471 crores in nominal term and from Rs.706.62 crores to Rs.4189.61 crores in real term. The assets of private sector banks increased from Rs. 370 crores to Rs.36,077 crores in nominal term and from Rs.22.67 crores to Rs.324.03 crores in real term. Between 1973-1996, the number of small public sector banks had declined while the number of large public sector banks had increased. Similarly in the reference period, the number of small private sector banks had declined.

b) Between 1973-1996, the advances of public sector banks in nominal term increased from Rs. 6,172 crores to Rs. 1,92,612 crores and in real term it increased from Rs.378.19 crores to Rs.1729.94 crores. The advances of private sector banks in nominal term increased from Rs.196 crores to Rs.17,346 crores and in real term, it increased from Rs.12.01 crores to Rs.155.79 crores.

c) The investments by public sector banks in nominal term increased from Rs.2,884 crores to Rs.1,43,121 crores and in real term it increased from Rs.176.72 crores to Rs.1285.44 crores. The investments by private sector banks increased in nominal term from Rs.81.05 crores to Rs.9,782 crores and in real term it increased from Rs.4.97 crores to Rs.87.86 crores.

d) In the reference period, in nominal term, the aggregate deposits of public sector banks increased from Rs.9,494 crores to Rs.3,58,942 crores and in real terms it increased from Rs.581.74 crores to Rs.3223.83 crores. However, aggregate deposits of the private sector banks increased from Rs.250.3 crores to Rs.29,469 crores in nominal term and from Rs.15.34 crores to Rs.264.68 crores in real term.

e) Between 1973-1996, in nominal term, the borrowings of public sector banks increased from Rs.439.26 crores to Rs.28,256 crores and in real term it increased from Rs.26.92 crores to Rs.253.78 crores. The borrowings of private sector banks in nominal term increased from Rs.9.65 crores to Rs.2,266 crores and in real term it increased from Rs.12.01 crores to Rs.155.79 crores.

f) In the reference period, the number of employees in public sector banks increased from 2,98,321 to 7,87,608 and in private sector banks it increased from 13,104 to 55,791. The average number of employees per branch for the public sector banks was estimated as 20 and for the private sector banks it was estimated as 12 .

g) Between 1973-1996, the fixed capital in public sector banks in nominal term increased from Rs.99.10 crores to Rs.6,170 crores and in real terms it increased from Rs.6.07 crores to Rs.55.42 crores. The fixed capital of private sector banks in nominal term increased from Rs.3.35 crores to Rs.834 crores and in real term it increased from Rs.0.21 crores to Rs.7.49 crores.

h) In the reference period, the number of branches in public sector banks increased from 13,434 to 40,618 while in private sector banks it increased from 1,276 to 4,169.

i) In the reference period, the total cost in public sector banks increased in nominal term from Rs.676.48 crores to Rs.40,382 crores and in real term it increased from Rs.41.45 crores to Rs.362.69 crores. However, the total cost in private sector banks increased from Rs.28.62 crores to Rs.3,188 crores in nominal term and from Rs.1.75 crores to Rs.28.63 crores in real term. In public sector banks, on an average, of the total cost, establishment cost accounted for 25.80 percent, interest cost accounted for 70.72 percent and other cost accounted for 3.48 percent. In the private sector banks, on an average, of total cost, establishment cost accounted for 29.46 percent,

interest cost accounted for 66.66 percent and other cost accounted for 3.88 percent.

B. Scale economy of commercial banks in India:

a) An analysis of summary statistics of the variables used in estimating the translog cost function indicated that among public sector and private sector banks, on an average, the value of output (advances and investment) and value of inputs (labour, fixed capital and purchased funds) was higher for large banks as compared to small banks.

b) The estimated parameters of the translog cost function for different size groups of public sector banks and private sector banks revealed that, the output coefficients and input price coefficients were positive and statistically significant implying positive cost elasticities. This was true both at the plant level and firm level.

c) For two restrictions - one related to linear homogeneity of the cost function in input prices and the other related to linear homogeneity of the cost function in outputs both at the plant level and firm level, for majority of the size groups of public sector banks and private sector banks and for whole public sector and private sector banks, the likelihood ratios were statistically significant and hence the hypothesis of linear homogenity of the cost function was rejected.

d) The estimated input share equation for labour, capital and funds indicated that for different groups of public sector banks and private sector banks at the plant level and firm level, the share of labour, capital and funds in total cost increases as the price of labour, price of capital and price of funds increases.

e) The estimated Allen elasticity of substitution between labour-capital, labour-funds and capital-funds were positive at the plant level and firm level for different size groups of public sector banks and for the whole sample.

For the private sector as a whole and for majority of the size groups, both at the plant level and firm level, labour, capital and funds were proved to be substitutes since the estimated elasticity of substitution between labour-funds, labour-capital and capital-funds were positive.

f) An analysis of own and cross price elasticities in public sector banks indicated that in majority of the cases, own price elasticities were positive. For the whole sample of public sector banks, the response of labour to a change in the price of funds was more than the response of labour to the change in price of capital since the estimated cross elasticity of demand for labour with respect to the price of funds was greater than that of capital both at the firm level and plant level.

In private sector banks for the whole sample, own price elasticity of labour and funds were positive. For the whole private sector banks at the plant level and firm level, the cross elasticity of demand for labour in relation to the price of funds was higher than the cross elasticity of demand for labour in relation to the price of capital.

g) For the public sector banks as a whole, Ray scale economy at the plant level was estimated as 1.1009 and at the firm level it was estimated as 0.7887. For the public sector banks, at the plant level, the scale economies seem to cluster within the range of .87 to .96 signifying that a proportionate increase in

output causes reduction in cost from 4 to 13 percent. At the plant level, very large banks have greater scale economy as compared to other groups. This finding is in confirmity with the findings of Hunter and Timmo (1986), Shaffer (1988) and Berger et al (1993) that there exists economies of scale among the large banks. But at the firm level, very small banks have greater degree of scale economy as compared to other groups.

For the private sector banks as a whole, Ray scale economy was estimated as .8987 at the plant level and 0.9996 at the firm level. For the private sector banks at the plant level, high degree of scale economies exist among very small banks (having the assets below Rs.4 crores). But for large banks (having the assets upto Rs.12-16 crores), ray scale economy was greater than one. At the firm level, very small banks have greater scale economy as compared to other groups.

h) Among the public sector banks, expansion path scale economy at the plant level and firm level were lower than one for very small banks (having the assets of below Rs.20 crores) and medium banks (having the assets of Rs.100-140 crores). Small banks have greater degree of expansion path scale economy as compared to other groups of banks.

Among the private sector banks, the degree of expansion path scale economy at the plant level and firm level, was higher for small banks as compared to other groups.

C. Scale efficiency of commercial banks in India:

a) Among the public sector banks large banks were more scale efficient. While 17.39 percent of large banks (having the assets of Rs.140-200 crores) have achieved scale efficiency, only one percent of small banks (having the assets of below Rs.20 crores) were scale efficient.

b) The average scale efficiency including the best productive banks was higher (96.38) for large public sector banks (having the assets of Rs.140-200 crores) as compared to other groups of banks. Even with the exclusion of best productive banks, the average scale efficiency of large public sector banks (95.49 percent) was higher than that of other groups of banks.

For the public sector banks as a whole, including best productive banks, the average scale efficiency was estimated to be 81.91 and excluding the best productive banks, the average scale efficiency was estimated as 81.01.

c) In all size groups of public sector banks the efficient decision making units consumed less resource of labour, capital and funds to produce their level of output. As a whole, the inefficient units of public sector banks were using 134.21 percent of labour,121.74 percent of capital and 155.08 percent of funds required by the efficient units. However the inefficient units of the public sector banks were producing only 59 percent of advances and 26 percent of investments produced by the efficient units.

d) Among the private sector banks, small banks were more scale efficient. While 14.13 percent of small banks (having assets below Rs.4 crores) were scale

efficient only 3.57 percent of large banks (having the assets exceeding Rs.16 crores) were scale efficient.

e) The average scale efficiency including the best productive banks was higher (95.20) for small private sector banks (having the assets of below Rs.4 crores) as compared to other groups of banks. Even with the exclusion of best productive banks the average scale efficiency of small banks (94.41 percent) was exceeding that of other groups of banks. The average scale efficiency for the private sector banks as a whole with the inclusion of best productive banks was estimated to be 93.41 and with the exclusion of best productive banks it was estimated as 92.68.

f) The inefficient units in the public sector banks as a whole were using 134.21 percent of labour, 121.74 percent of capital and 155.08 percent of funds required by the efficient units, but they were producing only 59 percent of advances and 26 percent of investments produced by the efficient units

g) The inefficient units of the private sector banks were using 182.38 percent of labour,108.09 percent of capital and 126.03 percent of funds required by the efficient units, but they were producing only 75.17 percent of advances and 78.29 percent of investments produced by the efficient units.

Conclusion:

a) During 1973-1996, there hed been remarkable development in Indian public sector and private sector banks. The banking sector reforms introduced in 1991, had given an encouragement for the increase in advances, investments, deposits, borrowings and expansion of branches.

b) Among the public sector banks, large banks have greater degree of scale economy, but among the private sector banks, small banks enjoy more scale economy as compared to other groups.

c) Among the public sector banks, large banks were more scale efficient and among the private sector banks, small banks were scale efficient. By minimizing the use of resources, the less productive banks can improve the efficiency level.

Unlike most of the studies in banking which were based on data for limited period of time, the current study tried to estimate the cost function with input prices using multiple years of data and large number of cases of banks. The study had used econometric technique – translog cost function and non parametric technique – data envelopment analysis. Hence the current study makes a significant contribution to the methodology of analysing scale economy and efficiency of banks.

Measures recommended:

To improve the scale economy and efficiency of Indian commercial banks, the current study recommends the following set of measures.

a) Banks have to define proper strategies in terms of their size, their products and their policies regarding customers enabling them to achieve a more productive position within the market and to ensure successful performance on a long term basis.

b) Mergers, amalgamations and acquisition can be undertaken on a large scale inorder to gain size and to focus more sharply on competitive strategies. The

consolidation of banks will help to maximise economies of scale by bundling the production of financial resources.

c) Further, formation of local area banks statewise by merging commercial banks in the concerned area will help to improve scale economy.

d) It is essential to give more importance to universal banks which involves themselves in the provision of range of services-commercial, market, investment and even insurance.

e) Virtual banking can be developed where in the banks can provide new products such as any branch banking, call banking and Internet banking. When these are provided the banks can become a virtual financial services provider under one roof.

f) A supervisory strategy compromising of on site inspection, offsite monitoring and control systems based on CAMELS (capital daequacy, asset quality, management, earnings, liquidity and systems and controls) methodlogy for banks should be installed.

g) The commercial banks can also shift their attention from traditional banking to merchant banking. Merchant banking services offered by the banks include acting as bankers to the issue of coins, involving in capital market issues by helping the companies to raise money.

h) To improve the efficiency of private sector banks the Bank's Board will be expanded by inclusion of Directors selected from among the shareholders. They will be able to lead the banks to perform in a better and efficient manner and

l) The scope of transparency can be extended to bank's housekeeping aspects such as clearing of old outstanding entries.

Scope for future research:

a) A study on determinants of efficiency in banks can be formulated and

b) A research study on the relation between risk, scale and efficiency can also be designed.

BIBLIOGRAPHY

BIBLIOGRAPHY

Books:

Amandeep, '***Profits and profitablity in commercial banks***', Deep and Deep Publications, NewDelhi,1993, pp.10-15.

Bishnoi, 'Economies of scale in Indian banking: A statistical cost analysis', ***Monetary and Banking Development in India***, Ed. M.L.Chhipa, Printwell Publishers, Jaipur, 1992, pp. 65-83.

Chambers .G. Robert, (1988), '***Applied production analysis – A dual approach***', Cambrigde University Press, Cambridge, Newyork, p.96.

Doti, L.J. and Aditi, E.S.M., '***Econometric analysis, an applications approach***', Prentice Hall, New Jersey, 1988, p 41.

Fecher, F. and Pestieau, P., 'Efficiency and competition in OECD financial services' in the ***The measurement of productive efficiency:Technique and application***', ed by Fried C.A, Lovell K, and Schmidt .S.S., Oxford University Press, Newyork, 1993, pp.374-385.

Ghosh, K. Suresh., '***Econometrics: Theory and Applications***', Prentice Hall of India Private Limited, 1994, pp.331-337.

Gramely, E.L., 'A Study of Scale Economies in Banking', Federal Reserve Bank of Kansas City, cited in Guttentag,J.M. and Edward,S.H., ***Banking structure and performance***, Institute of Finance, Newyork University, Newyork, 1962, p.43.

Gujarati, N. Damodar, '***Basic Econometrics***', McGraw Hill, Inc, New York, 1995, p.338.

Heathfield .F. David and Wibesoren, '***An introduction to cost and production functions***', Macmillan Education Limited, London, 1987, pp.110-112.

Humphrey .D.B., 'Costs and scale economies in bank intermediation' in ***Handbook of banking strategy*** ed by Aspinwell .D.E. and Eisheis Wiley, New Delhi, 1985, pp.745-783.

James .L. Cochrane and Samuel Gubions, Kiker B.F., '***Macro Economics: Analysis and Policy***', Scott Foresman and Company, Glenview, Illinois, 1974, pp.16-18.

Kamerschen .R. David, '***Money and Banking***', South Western Publishing Corporation, 1980, p.170.

Khubchandani, B.S, '***Practice and law of banking***', Macmillan India limited, 2000, p.284.

Klein, M.A., '***A text book of econometrics***', Illinois, 1953, p.258.

Kumbaker .C. Subal, 'Efficiency measurement using stochastic frontier and non frontier models:A survey of methods and application to Indian agriculture', ***Quantitative Economics, Theory and Practice***, ed by Chakravarty R.Satija et al, Allied Publishers Limited, New Delhi, 1998, pp.139-176.

Moschandraes Maria, '***Business Economics***', Routledge, London, 1994, p.149.

Marshall, Alfred, '***Principles of Economics***', (8^{th} Edition), Macmillan, London, 1920, p.285-288.

Mithani, D.M. '***Money, banking, international trade and public finance***', Himalaya Publications, 11^{th} Edition, Mumbai, 1998, pp.210-215.

Narula .R.K, '***Legal and practical bank advances***', UDH Publishers, New Delhi, 1984, pp.140-145.

Ramachandra, Rao .B., '***Current trends in Indian banking***', Deep and Deep Publications, New Delhi, 1984, pp.38-41.

Robinson, E.E.G., '***Monopoly***', Games Nidet & Co., C.U.P, 1958, p.28.

Rose .P, '***Commercial bank management***', McGraw-Hill Companies, Inc., NewYork, 1995, pp.112.

Ruud.A.Paul, '***An introduction to classical econometric theory***', Oxford University Press, 2000, pp.699-700.

Ryan, W.J.L, '***Price Theory***', Macmillan India Ltd., 1989, p. 88.

Shekar, K.C. and Shekar Lakshmi, '***Banking theory and practice***', Vikas Publishing House, New Delhi, 2000, p.60

Schumpeter, '***The theory of economic development***', Harvard University Press, Cambridge, 1911, pp.74-81.

Seshadri, G.B., '***Economic doctrines***', B.R. Publishing Corporation, New Delhi, 1999, p.149.

Talwar, S.P., ***'March to the new millenium by Indian banks in on going developments in banking and financial sector'***, ed by Raj Kepila and Uma Kapila, Academic foundation, Newdelhi, 2000, pp.13-19.

Vasudevan, S.V., '***Theory of banking***', Sultan Chand and Company, New Delhi, 1994, pp.54-63.

Walters, A.A., '***An Introduction to Econometrics***', Macmillan Education Limited, London, 1968, p.181.

Wooldridge .M. Jeffrey, '***Introductory Econometrics – A Modern Approach***', South Western College Publishers, United States of America, p.409.

Journals:

Adar, Z., et al, (1971), 'Output mix and jointness in production in the banking firm', ***Journal of Money, Credit and Banking***, May, 11 (2) : 235-243.

Abdulla, Jasim Yusuf Ali, (1994), 'An empirical analysis of commercial banks performance in Baharin', ***Savings And Development***, 18 (3) : 307-321.

Ahuja Kanta, (1997), 'The banking sector after the reforms', ***The Indian Economic Journal***, April-June, 44 (4) : 10

Alfaraj, T.A.S. and Bu Bshek.K.A., (1993) , 'Evaluation of bank branches by means of data envelopment analysis', ***International Journal of Operations and Production Management***, p. 45-52.

Allister, M.C., et al, (1993) 'Resolving the scale efficiency puzzle in banking', ***Journal of Banking and Finance***, April, 17 : 389-405.

Altunbas, Evans, (2001), 'Bank ownership and efficiency', ***Journal of Money, Credit and Banking***, 30 (6) : 926-954.

Aly, Y. H., et al, (1990), 'Technical, scale and allocative efficiencies in U.S. banking: An empirical investigation', ***The Review of Economics and Statistics***, May, 72 (2) : 211-218.

Ammannya .K.K., (1996), 'Monetary and credit policy for the second half of 1996-97', ***Banker***, October, 25 (11) : 28.

Amel, D.F. and Jacowski, M.J., (1989), 'Trends in banking structure since the mid – 1970s', ***Federal Reserve Bulletin***, March, 75 : 120-133.

Amita Batra, (1996), 'Bank profitability with a hybrid profit function – The Indian case', ***Indian Economic Review***, 31 (2) : 223-234.

Andrea Resti, (1997), 'Evaluating the cost-efficiency of the Italian banking system: what can be learned from the joint application of parametric and non-parametric techniques', ***Journal of Banking and Finance***, 21 : 221-250.

Angadi, V.B., (1987), 'Integrated approach to study banks' profitability', ***Prajnan***, 16 (4) : 523-538.

Anindya Bhukte, (2002) 'Banking sector reform in India', ***Yojana***, July, 46 : 5-9.

Athanassopoulos, D.A., (1998), 'Formulated non parametric frontier models for assessing the market and cost efficiency of large scale bank branch networks', ***Journal of Money, Credit and Banking***, 30 (2) : 172-192.

Aul Morrison .J. and Siegeli .S. Donald, (1999), 'Scale economies and industry agglomeration externalities', ***American Economic Review***, March, 89 (1) : 272-281.

Benston, G.J., (1965), 'Branch banking and economies of scale', ***Journal of Finance***, 20 : 312-331.

Benston, G.J., (1972) 'Economies of scale and financial institutions', ***Journal of Money, Credit and Banking***, 4 (6) : 312-341.

Benston, G.J. et al, (1982), 'Operating costs in commercial banking', ***Economic Review***, Federal Reserve Bank of Atlanta, November, pp.6-21.

Benston, G.J., et al, (1982), 'Scale economies in banking: A restructuring and reassessment', ***Journal of Money, Credit and Banking***, 14 : 435-456.

Benston, G.J. and Humphrey, (1985), 'Scale economies in banking : a restructuring and reassessment', ***Journal of Money, Credit and Banking***, 14 (4) : 435-456.

Berger, A.N., et al, (1987), 'Competitive viability in banking: Scale, scope, and product mix economies', ***Journal of Monetary Economics***, 20 : 501-520.

Berger, A.N., et al, (1993), 'The efficiency of financial institutions: A review and preview of research past, present and future', ***Journal of Banking and Finance***, 17 (2-3) : 221-249.

Berger, A.N., et al, (1993), 'Bank efficiency derived from the profit function', ***Journal of Banking and Finance***, 17 : 317-347.

Berger, Allen .N. and Humphrey, D.B., (1991), 'The dominance of inefficiencies over scale and product mix economies in banking', ***Journal of Banking and Finance***, 28 : 117-148.

Berger, Allen .N. and Deyoung, R., (1997), 'Problem loans and cost efficiency in commercial banks', ***Journal of Banking and Finance***, 21 : 849-870.

Berger, N. Allen, et al, (1997), 'The efficiency of bank branches', ***Journal of Monetary Economics***, September, 40 : 141-162.

Berger, G.A. and Mester, (1997), 'Inside the black box: what explains differences in the efficiencies of financial institutions', ***Journal of Banking and Finance***, 21 : 895-947.

Chakraborty, T., (1986), 'Profitability of banks: An empirical attempt for identification of variables of income and expenditure of scheduled

commercial banks for profit planning', ***Reserve Bank of India Occasional Papers***, June, 7 (1) : 63-77.

Chopra, S.P., (2002) 'Monetary policy, key to economic growth', ***Facts For You***, November, p.5.

Charnes, A., et al, (1962), 'Measuring the efficiency of decision making units', ***European Journal of Operational Research***, 2 (6) : 429-444.

Charnes, A., et al, (1985), 'A developmental study of data envelopment analysis in measuring the efficiency of maintenance units in the U.S. Air forces', ***Annuals of Operations Research***, 2 (2) : 95-112.

Charnes, A. and Cooper, W.W., (1962), 'Programming with linear fractional functionals', ***Naval Research Logistics Quarterly***, 9 : 181-185.

Charnes, A. et al, (1978), 'Measuring the efficiency of decision making units', ***European Journal of Operations Research***, 2 : 429-444.

Charnes, A. et al, (1986), 'Classifying and characterising efficiencies and inefficiencies in data envelopment analysis', ***Operations Research Letters***, 5 : 105-110.

Charnes, A. and Cooper.W., (1984), 'Some models for estimating technical and scale inefficiencies in data envelopment analysis', ***Management Science***, 30 : 1078-1092.

Chatterjee, Goutam, (1997), 'Scale economies in banking – Indian experience in deregulated era', ***Reserve Bank of India Occasional Papers***, March, 18 (1) : 37-59.

Clark, J.A. and Speaker, J.P., (1994), 'Economies of scale and scope in banking: evidence from a generalised translog cost function', ***Quarterly Journal of Business and Economics***, Spring, 33 (2) : 3-25.

Clark, J.A., (1996), 'Economic cost, scale efficiency and competitive viability in banking', ***Journal of Money, Credit and Banking***, August, Part I, 28 (3) : 342-362.

Clark, J.A. and Thomas, S.F., (1997), 'Competitive viability in banking: looking beyond the balance sheet', Federal Reserve Bank of Dellas, ***Financial Industry Studies***, December, 5 : 30-46.

Christensen, L.R., Jorgenson .D.W. and Lau .L.J., (1975), 'Transcendental logarithmic utility functions', ***Asian Economic Review***, June, 63 : 367-383.

Christensen, L. and Greece .W., (1976), 'Economies of scale in US, electrical power generation', ***Journal of Political Economy***, 84 (4) : 653-676.

Cobenoyan, (1993), 'Multiproduct cost functions and scale economies in banking', ***The Financial Review***, 23: 499-512.

Cooper, W.W., Charnes, A., et al, (1990), 'Polyhedral cone ratio DEA models with an illustrative application to large commercial banks', ***Journal of Econometrics***, 46 : 73-91.

Das, M.R., (1997), 'An investigation into the existence of scale economies and determination of optimal size in Indian public sector banks', ***Vinimaya***, October-November, 18 (4) : 5-11.

Das, Abhiman, (1997), 'Technical, allocative and scale efficiency of public sector banks in India', ***Reserve Bank of India Occasional Papers***, June - September, 18 (2,3) : 10-15.

Das, Abhiman, (1997), 'Measurement of productive efficiency and its decomposition in Indian banking firms', ***Asian Economic Review***, December, 39 (3) : 422-439.

Das, Kumar Pranap and Meiti Pradip, (1991), 'Bank credit, output and bank deposits in West Bengal and selected states', **Economic and Political Weekly**, November, 33 (47, 48) : 3081-3082.

Deller, C.S. and Nelson, H.C., (1991), 'Measuring the economic efficiency of producing rural road services', ***American Journal of Agricultural Economics***, 73(1) : 195.

Desai, V.V., (1983), 'Commercial banks performance appraisal', ***Indian Banking Today and Tomorrow***, May, 8 (5) : 6-7.

Driswell, P.J. and Boisvert, R., (1991), 'Dual, second and third order translog models of production', ***American Journal of Agricultural Economics***, November, 73 (1) : 1146-1160.

Elavia, B.H. and Bansal, N.S., (1993), 'Economies of scale in the Indian banking industry: A profit function approach', ***The Journal of the Indian Institute of Bankers***, January-March, 64(1) : 22-27.

Fare, R. and Grosskopf, S., (1994), 'Estimation of returns to scale using DEA – A comment', ***European Journal of Operational Research***, 79 : 379-382.

Fare, R. and Lovell, A.K., (1978), 'Modelling scale economies with ray homothetic production function', ***Review of Economics and Statistics***,47 : 624-629.

Fare, R., et al , (1995) , 'Non parametric tests of regulation, Farrell efficiency and goodness of fit', ***Journal of Econometrics***, 69 : 415-425.

Farrell, M.J., (1957), 'The measurement of production efficiency', ***Journal of Royal Statistical Society Series***, 120A : 257-281.

Ferrier, Gary .D. and Lovell.C.A., (1990), 'Measuring cost efficiency in banking : econometrics and linear programming evidence', ***Journal of Econometrics***, 46 : 229-245.

Ferrier, Gary .D., et al, (1993), 'Economies of diversification in the banking industry: A frontier approach', ***Journal of Monetary Economics***, 31: 229-249.

Fisher, D.M.J., (1991), 'Technical progress, inefficiency and productivity change in US banking-1984-1993', ***Journal of Money, Credit and Banking***, 31 (2) : 212-218.

Ganguly, A.K., (1983), 'Growth of commercial banks in India', ***Banker***, May, 30 (3) : 3.

Gertler, M., (1988), 'Financial structure and aggregate economic activity: An overview', ***Journal of Money, Credit and Banking***, 20 : 559-588

Goldberg, I.G., et al, (1991), 'Economies of scale and scope in the securities market', ***Journal of Banking and Finance***, 15 : 91-107.

Ghafar, A.R. and Habibullah, S.M., (1990), 'Scale economies in Malaysian commercial banking: Preliminary results', ***The Indian Journal of Economics***, October, 71 (281) : 159-180.

Ghosh .A., (1991), 'Commercial banks and industrial schemes-The Indian experience', ***The Journal of the Indian Institute of bankers***, January-March, 62 (1) : 26-32.

Ghosh .D.N., (1989), 'Commercial banking – Lessons for Indian experience', ***The Journal of the Indian Institute of bankers***, January-March, 60 (1) : 45.

Gilligan, T. and Smirlock, M., (1984), 'An empirical study of the joint production and scale economies in commercial banking', ***Journal of Banking and Finance***, 8 : 67-76.

Gilligan, T., et al, (1984), 'Scale and scope economies in multi product banking firm', ***Journal of Monetary Economics***, 13 : 393-405.

Glass, J.C. and Mckillop, D.G., (1992), 'An empirical analysis of scale and scope economies and technical change in an Irish multi product banking firm', ***Journal of Banking and Finance***, 16 : 423-437.

Griffin, M., James and Gregory .R. Paul, (1976), 'An inter country translog model of energy substitution responses', December, 66 (5) : 845-857.

Gropper, D.M., (1991), 'An empirical investigation of changes in scale economies for the commercial banking firm, 1979-1986', ***Journal of Money, Credit and Banking***, November, 23 (4) : 718-727.

Haslem, A.J., (1968), 'A statistical analysis of the relative profitability of commercial banks', ***Journal of Finance***, March, 23 (1) : 167-176.

Hassan, M.K. and Hossain Tariq, (1992), 'Performance evaluation of private sector commercial banks in Bangladesh', ***The Indian Journal of Economics***, October, 73 (289) : 159-180.

Hayes, J.K. and Yaisawarng, S., (1993), 'Economies of diversification in the banking industry: A frontier approach', ***Journal of Monetary Economics***, 31 : 229-249.

Hester, Donald .D. and John .F. Zoellner, (1966), 'The relation between bank portfolios and earnings: An econometric analysis', ***The Review of Economics and Statistics***, 48 : 372-386.

Hughes, J.P. and Mester, L.J., (1993), 'A quality and risk-adjusted cost function for banks: Evidence on the 'Too-Big-To-Fail' Doctrine', ***Journal of Productivity Analysis***, 4 : 293-315.

Hughes, J.P. and Mester, L.J., (1998), 'Bank capitalization and cost : Evidence of scale economies in risk management and signaling', ***Review of Economics and Statistics***, May, 80 (20) : 314-325.

Hunter .W.C. and Timme, S.T., (1986), 'Technical change, organizational form, and the structure of bank production', ***Journal of Money, Credit and Banking***, May, 18 : 152-166.

Humphrey, D.B., (1987), 'Cost dispersion and the measurement of economies in banking', ***Economic Review***, May / June, 73 : 24-38

Humphrey, D.B., (1990), 'Why do estimates of bank scale economies differ', ***Economic Review***, September/October, 76 : 38-50.

Humphrey, D.B. and Pulley, L.B., (1997), 'Banks's responses to deregulation: profits, technology and efficiency', ***Journal of Money, Credit and Banking***, February, 29 (1) : 73-93.

Ismail, Ghafar Abdul, (1993), 'Deregulation and bank behaviour in the financial market', ***Asian Economic Review***, August, 35 (2) : 195-202.

Jadhav, N. and Ajith, D., (1997), 'The role of banks in economic development of India', ***Prajnan***, 25 (3-4) : 320

Jain, Jayanti Lal, (1988), 'Economies of scale in banking: Empirical evidence', ***Prajnan***, 17 (3) : 301-317.

Kamaiah, B.D., et al, (1988), 'Ratio analysis of bank branches: Case study of a nationalized bank in the Tamil Nadu region', ***Decision***, April-June, 15 (2) : 131-140.

Kaparakis, I., et al, (1994), 'Short-run cost inefficiency of commercial banks: A flexible stochastic frontier approach', ***Journal of Money, Credit and Banking***, November, 26 (4) : 875-893.

Kim .M., (1986), 'Banking technology and the existence of a consistent output aggregate', ***Journal of Monetary Economics***, 18 (2) : 187-195.

Kim, H.Y., (1986), 'Economies of scale and economies of scope in multi product financial institutions: Further evidence from credit unions', ***Journal of Money, Credit and Banking***, 18 (2) : 220-226.

Kim, H.Y., (1992), 'The translog production function and variable returns to scale', ***The Review of Economics and Statistics***, August, 74 (3) : 546-552.

Kishan, R.P. and Opiela, P.T., (2000), 'Bank size, bank capital and the bank lending channel', ***Journal of Money, Credit and Banking***, February, 32 (1) : 121-129.

Khusera.B.L, (1983), 'Branch expansion of commercial banks', ***The Banker***, May, 30 (3) : 5.

Klein, M.A., (1971) ' A theory of banking firm', ***Journal of Money, Credit and Banking***, 31 (3) : 205-218.

Krishnamurthy, C.M.D., (2002), 'Reforms of Indian banking sector', ***Industrial Economist***, January, p.31

Kwast, L.M. and Rose, T.J., (1982), 'Pricing, operating efficiency and profitability among large commercial banks', ***Journal of Banking and Finance***, 6 : 237-253.

Lavin and Zenson .S., (1998), 'Role of financial institutions in economic development', ***American Economic Review***, June, 88 (3) : 25.

Lawrence,C., (1989), 'Banking costs, generalised functional forms and estimation of economies of scale and scope', ***Journal of Money, Credit and Banking***, August, 21 : 368-379.

Leibenstein, H. and Shilo, M., (1992), 'Empirical estimation and partitioning of X inefficiency – Data Envelopment Approach', ***American Economic Review papers and proceedings***, May, 42 (2) : 450-452.

Lindley, (1977), 'Inputs, outputs and a theory of production and cost at depository financial institutions', ***Journal of Finance***, 32 : 1251-1266.

Longbrake, A.W. and Haslem, A.J., (1975), 'Productive efficiency in commercial banking : The effects of size and legal form of organisation on the cost of producing demand deposit services', ***Journal of Money, Credit and Banking***, November, 7 (4) : 317-330.

Mahmood Adam .M. et al, (1996), 'Measuring productivity of software projects: Data envelopment analysis approach', ***Decision Sciences***, 77 (1) : 57-74.

Manickavasagan, V. and Vethirajan, (2002), 'Performance of commercial banks in India', ***Facts For You***, August, pp.29-31.

Malhotra .R.N., (1995), 'Banking in 1990s', ***Southern Economist***, November, 29 (6) : 5-8.

Mathew Joseph, (2002), 'WTO and Indian banking sector – The road ahead', ***Economic and Political Weekly***, June, p.2317.

Mathur, K.B.L., (2002), 'Public sector banks in India-should they be privatised', ***Economic and Political Weekly***, June, 37 (23) : 2245-2253.

McAllister,P.H. and McManus,D.A., (1993), 'Resolving the scale efficiency puzzle in banking', ***Journal of Banking and Finance***, 17 : 389-405.

Mester, L.J., (1987), 'A multiproduct cost study of savings and loans', ***Journal of Finance***, 42 : 423-445.

Mitchell, K. and Onvural, M.N., (1996), 'Economies of scale and scope at large commercial banks: Evidence from the fourier flexible functional form', ***Journal of Money, Credit and Banking***, May, 28 (2) : 178-199.

Mohana Kumar, P.S., (1997), 'The measurement of productive efficiency-frontier production function: A brief survey', ***Indian Journal of Applied Economics***, 6 (4) : 105-113.

Morrison .J. C., et al, (1999),'Scale economies and industry agglomeration externalities-A dynamic cost function approach, ***American Economic Review***, March, 89 (1) : 272.

Mittal, R.K., (2000), 'Improving financial performance of regional rural banks', ***Yojana***, March, 43 (3) : 10-12.

Murray, J.D. and White R.A., (1983), 'Economies of scale and economies of scope in multi product financial institutions: A study of British Columbia credit unions', ***Journal of Finance***, June, 38 : 887-901.

Nag, A.K. and Shivaswamy, K., (1990), 'Foreign banks in India-Recent performance', ***Reserve Bank of India Occasional Papers***, December, 11 (4) : 297-328.

Narayanasamy, N. and Babu, V., (1993), 'Size, cost and profitability: An empirical study of Pandyan Grama Bank in Tamil Nadu', ***Finance India***, March, 7 (1) : 97-110.

Nelson, W.R., (1985), 'Branching, scale economies and banking costs', ***Journal of Banking and Finance***, 9 : 177-191.

Noulas, G.A. and Ketker, W.K., (1996), 'Technical and scale efficiency in the Indian banking sector', ***International Journal of Development***, June, 14 (1) : 19-27.

Noulas,G.A., et al, (1990), 'Returns to scale and input substitution for large US banks', ***Journal of Money, Credit and Banking***, February, 22 (1) : 94-108.

Noulas, G.A., et al, (2001), 'Non parametric production frontier approach to the study of efficiency of non life insurance companies in Greece', ***Journal of Financial Management and Analysis***, 14 (1) : 19-26.

Nyong, O.M., (1990), 'Market structure, risk and profitability in banking: The quite life hypothesis and relative economic efficiency', ***Development Policy Review***, 8 : 179-201.

Panzer, J.C. and Willig, D.R., (1977), 'Economies of scale in a multiproduct production', ***Quarterly Journal of Economics***, 91 : 481-494.

Pastor .J.F., et al, (1997), 'Efficiency analysis in banking firm :An international comparison', ***European Journal of Operational Research***, 98 : 396-408.

Peristiani, S., (1997), 'Do mergers improve the X efficiency and scale efficiency of US banks-Evidence from 1980s', ***Journal of Money, Credit and Banking***, August, 29 (3) : 327-345.

Pindyck, R.S., (1979), 'Interfuel substitution and the industrial demand for energy : An international comparison', ***Review of Economics and Statistics***, 51 : 169-179.

Pingle, J., (1973), "A theory of the banking firm", ***Journal of Money, Credit and Banking***, 5 : 990-996.

Pollak, A.R. and Wales, J.T., (1992), 'Price-augmenting returns to scale: An application to non separable two-stage technologies', ***The Review of Economics and Statistics***, May, 74 (2) : 213-220.

Pulley, B.L. and Braunstein, M.Y., (1992), 'A composite cost function for multiproduct firms with an application to economies of scope in banking', ***The Review of Economics and Statistics***, May, 74 (2) : 221-230.

Rajwade, A.V., (2002), 'Monetary Policy of India', ***Economic and Political Weekly***, 37 (11) : 1017.

Ramachandra, Rao (1996), 'Assets of commercial banks', ***The Banker***, January, 25 : 18-21.

Ramanathan, R., (2001), 'A data envelopment analysis of comparative performance of financial institutions', ***Operations Research***, 38 (2) : 160-170.

Rangarajan, C., (1993), 'Banking and finance: monetary and fiscal policies, financial sector reforms and banking industry', ***Reserve Bank of India Bulletin***, July, pp. 991-995.

Rao, C.S. and Madhavi, K.L., (1990), 'Productivity and operating efficiency in public enterprises: A study', ***Prajnan***, 19 (1) : 5-25.

Ray, I. and Sanyal, S., (1994-1995), 'Scale efficiency in Indian commercial banking: An econometric investigation', ***Prajnan***, 23 (4) : 459-486.

Reddy, Y.V., (2002), 'Developing bond markets in emerging economies: Issues and Indian experience', ***Reserve Bank of India Bulletin***, April, 56 (4) : 239.

Ross Levine, Sara Zervos, (1998), 'Stock markets, banks and economic growth', The American Economic Review, June, 88 (3) : 537-558

Rossi, V.C., (1988), 'Mortgage banking cost structure: resolving an enigma', ***Journal of Economics and Business***, March- April, 50 (2) : 219-234.

Rouseau .L. Peter and Wachtel Paul, (1998), 'Financial intermediation and economic performance', ***Journal of Money, Credit and Banking***, 36 (4) : 657.

Sahoo .K. Biresh and Mohapatra .K.J. Pratap, (2001), 'Measuring technical efficiency in data envelopment analysis', ***Operations Research***, 38 (5) : 456-482.

Salian Indu, (1999), 'The changing banking scenario', ***Express Investment Week***, January 11-17, pp.8-11.

Sandesara, J.C., (1985), 'Economies of scale in Indian manufacturing industry: evidence and interpretation', ***International Journal of Development Banking***, July, 3 (2) : 13-22.

Sarkar .P.C., (1999), 'Role of banks and financial institutions in Indian economic development, ***Asian Economic Review***, 41 (3) : 403.

Sarkar, P.C. and Das, A., (1997), 'Development of composite index of banking efficiency: The Indian case', ***Reserve Bank of India Occasional Papers***, December, 18 (4) : 679-709.

Sarkar, P.C. and Das, A., (1999), 'An approach to evaluate the relative performance of public sector banks in India', ***Indian Journal of Applied Economics***, 8 (4) : 137-158.

Sarkar, P.C. and Nayak, T.G., (1993), 'Patterns of credit outstanding in priority sector – A regional analysis', ***Reserve Bank of India Occasional Papers***, June, 14 (2) : 133-149.

Sarkar, S., (1994), 'Capital structure and productivity of capital in Indian corporate sector', ***Finance India***, June, 8 (2) : 399-401.

Sawhney, B. and Dipietro, W., (1979), 'Economies of scale in the U.S. banking industry: An application of the survivor approach', ***The Asian Economic Review***, April-August, 21 (1-2) : 1-16.

Sealey, C.W. and Lindley, J.T., (1977), 'Inputs, outputs, and a theory of production and cost at depositary financial institutions', ***Journal of Finance***, September, pp.1251-1266.

Seiford .L.H. and Robert, A.T., (1990), 'Recent developments in DEA the mathematical programming approach to frontier analysis', ***Journal of Econometrics***, 46 : 7-8.

Sengupta, K., (1987), 'Efficiency measurement in non market systems through DEA, ***International Journal of Systems Science***, 18 : 2279-2304.

Sengupta .K., (1990), 'Transformations in stochastic DEA models, ***Journal of Econometrics***, 46 : 109-123.

Sen Joydeep (2002), 'Banking in universality', ***Economic and Political Weekly***, November - December, 37 (48) : 4770-4771.

Shah,D. Vipin, (1986), "Empirical relationship between size and cost at branch level", ***Prajnan***, January-March, 15 (1) : 29-48.

Sherman, H.D. and Gold, F., (1985), 'Bank branch operating efficiency – Evaluating with DEA', ***Journal of Banking and Finance***, 9: 297-315.

Sherman David, H. and Ladio George, (1995), 'Data envelopment analysis for managing bank productivity', ***Interface***, March-April, 25 (2) : 60-73.

Siberston, A., (1972), "Economies of scale in theory and practice", ***Economic Journal***, March, pp. 369-391.

Singh, S., (1989), 'Profitability of commercial banks in India', ***Punjab National Bank Monthly Review***, October, 11 (10) : 535-549.

Stigler, G.J., (1958), 'The economies of scale', ***The Journal of Law and Economics***, 1 : 55.

Subrahmanyam, G., (1984), 'An approach to interbank and inter-temporal productivity comparisons', ***Prajnan***, October-December, 13 (4) : 381-392.

Subrahmanyam, G., (1994), 'Measurement of output scale economies and productivity in banks: A methodological note', ***Indian Economic Review***, 29 (2) : 223-227.

Subrahmanyam, G. and Swami, B.S., (1995), 'A direct translog model of Indian household sector financial portfolios', ***Indian Economic Review***, 30 (2) : 265-274.

Subrahmanyam, G. and Swamy, B.S., (1994), 'Production efficiency differences between large and small banks', ***Artha Vijnana***, September, 36 (3) : 183-193.

Subrahmanyam, G. and Swami .B.S., (1993), 'Bilateral productivity comparisons of public sector banks in India', ***The Indian Economic Journal***, July-September, 41 (1) : 1-15.

Suchitra Srinivas, (2002), 'Future strategy for Indian banks', ***Industrial Economist***, 30 December 2002 – January 2003, p.25

Sueyoshi Toshiyunki, (1996), 'Divestitute of Nippon telegraph and telephone', ***Management science***, September, 42 (9) : 1326-1349.

Susheela,S., (2002), 'Indian banks: Vibrant or vulnerable', ***Southern Economist***, June, 41(3) : 2-3.

Tangri .S. Shanti, (1967), 'Economic system and economic efficiency', ***The American Economic Review***, 10 (1) : 18.

Tseng, K.C., (1999), "Bank scale and scope economies in California", ***American Business Review***, January, 17 (1) : 79-85.

Varde, S.D, (1973), "Efficiency of rural branches: An empirical pilot study", ***Prajnan***, April-June, 2 (2) : 187-203.

Vasudevan, A., (2002), 'Evolving monetary policy in India: Some perspectives', ***Economic and Political Weekly***, 37 (11) : 1055.

Vennet, R., (2002), 'Cost and profit efficiency of financial conglomerates and universal banks in Europe', ***Journal of Money, Credit and Banking***, February, 34 (1) : 254-282.

Vivas, A., (1997), 'Profit efficiency for spanish savings banks', ***European Journal of Operational Research***, April, 98 (2) : 381-394.

Wheelock, C. David and Wilson, W. Paul, (1999), 'Technical progress, inefficiency and productivity change in U.S. banking', ***Journal of Money, Credit and Banking***, May, 31 (2) : 212-234.

Zardkoohi, A. and Kolari, J., (1994), 'Branch office economies of scale and scope: Evidence from savings banks in Finland', ***Journal of Banking and Finance***, 18 : 421-432.

Reports:

Basic statistics of Reserve Bank of India, Mumbai, various issues.

Economic Survey – Ministry of Finance, Government of India, New Delhi – variuos issues.

Financial analysis of banks – Indian Banks Association - Mumbai, various issues.

Luther .J.C (1973), 'Productivity, efficiency and profitability in commercial banks', Reserve Bank of India, Mumbai.

Narasimham Committee Report (1991), Reserve Bank of India, Mumbai

Narasimham Committee Report on banking sector (1998), Reserve Bank of India, Mumbai

Report on Trend and Progress of banking in India, Reserve Bank of India, Mumbai – various issues.

Report on Currency and Finance, Reserve Bank of India, Mumbai - various issues.

Reserve Bank of India Monthly bulletin, Reserve Bank of India, Mumbai – variuos issues.

Statistical outline of India (1999-2000), Department of Economics and Statistics, Tata McGraw Hill Limited, Mumbai.

iv) Research Papers:

Berger, G.A., et al , (1983), 'Economies of scale and scope in banking – Research paper in banking and financial institutions', Board of Governor of the Federal Reserve system

Berger, A.N., and Humphrey, B.D., (1992), 'Measurement and efficiency in commercial banking in output measurement in the service sector', ***Natural Bureau of economic research studies in income and wealth***, Chicago.

Grifell, T.E. and Lovell, C.A.K., (1997), 'Rethinking bank efficiency and regulation: how off-balance sheet activities make a difference', ***Federal Reserve Bank of Dellas, Financial Industry Studies***.

Koopmans, T.C., (1951), 'An analysis of production as an efficient combination of activities', in Koopmans, T.C., (ed), Activity analysis of production and allocation, Cowles Commission for research in Economics, Monograph, No.13.

Mester, L.J., (1996), 'Measuring efficiency at U.S. Banks: accounting for heterogenity', ***Working Paper, Economic Research Division***, 11 : 1-23.

Rangarajan, C. and Mampilly, P., (1972), 'Economies of scale in banking', ***Technical Studies Prepared for the Banking Commission***, by Reserve Bank of India.

Bell, F. and Murphy .N., (1968), 'Costs in commercial banking: A quantitative analysis of bank behaviour and its relation to bank regulation', ***Federal Reserve Bank of Boston***, **Research Report**, (41).

Seiford, L.H., (1993), 'A bibliography of DEA (1978-1993) working paper'- ***University of Massachusetts***, Amherst, Massachusetts.

Shaffer, Sherrill, (1988),'A revenue restricted cost study of 100 large banks', ***Working Paper, Federal Reserve Bank of New York***.

Shaffer and Holdsworth, D.G., (1983), 'On the proper definition of bank output', **Research Paper**, ***Banking studies Department***, Federal Reserve Bank of Newyork.

Conference Volume:

Loganathan, V. (2000-01), 'Banking reforms in India', ***Peninsular Economist***, 13 (2) : 11

Newspapers:

India's best banks 1999-2000, How the ranking was done FE select, ***The Financial Express***, 2001, pp.49-55.

Sanjaya, B.,(2001), 'Banks : size, speed and service', ***The Financial Express***, Special issue on India's Best Banks Survey 2000, p.24

vii) Web site:

Structure of interest rates ***: http:/www.rbi.org.In/search/Reserve Bank of India search results***.

APPENDICES

APPENDIX I

DISCUSSION ABOUT THE PRICE OF CAPITAL

There had been long debate about the measurement of the price of capital. Murray and White (1983) in their study on 'Economies of scale and economies of scope in multiproduct financial institutions' defined price of capital as the ratio of the sum of major capital expenses such as rent, depreciation and utilities to the average dollar value of deposits. This tantamount to represent the price of an input (viz capital) as its total expenses divided by the value of another input (viz deposits). However recent studies have abandoned this method on account of the use of different inputs value as divisor.

Goldberg et al (1991) in the study on 'Economies of scale and scope in the securities market tried to represent the price of capital by the ratio of total rental expenditure to the number of square feet occupied. But Deller and Nelson (1991) in their attempt on 'Measuring the economic efficiency of producing rural road services' opined that price of capital is based on a fixed proportion of replacement cost and hence the price of capital is assumed to equal a fixed proportion of the depreciated values based on schedules of average annual equipment expenses.

In the view of Eisenbein et al (1999) price of capital is measured as the total occupancy expenses divided by fixed plant and input. Vennet (2002) in the analysis of 'Cost and profit efficiency of financial conglomerates and universal banks in Europe' defined the price of capital as the ratio of depreciation and occupancy expenses to net fixed assets.

Most of the recent studies in banking efficiency – Bumo and Eskin (1990) in the study on 'Branching restrictions and banking costs', Aly et al (1990) in the study on 'Technical, scale and allocative efficiency in US banking', Noulas et al (1990) in the study on 'Returns to scale and input substitution for large US banks', Ray and Sanyal (1995) in the study on 'Scale efficiency in Indian commercial banking' have defined price of capital as the ratio of the sum of expenses on premises, furniture and equipment to the total value of premises, furniture and equipment. Following them, the current study defined the price of capital as the ratio of the sum of expenditure on rent, furniture and equipment to the total value of premises, furniture and equipment.

APPENDIX II

ZERO ORDER CORRELATION MATRIX OF THE VARIABLES USED IN ESTIMATING TRANSLOG COST FUNCTION OF PRIVATE SECTOR BANKS (RS.12-16 CRORES)

variables	Q_1	Q_2	L	K	F	P_L	P_K	P_F	B
Q_1	1.0000	0.3423	-0.1118	0.4996	0.6913	0.6006	-0.1531	0.5028	-0.0376
Q_2	0.3423	1.0000	0.3375	-0.3209	0.7930	-0.2413	0.5250	0.0708	0.4133
L	-0.1118	0.3375	1.0000	-0.4863	0.1273	-0.4120	0.6126	0.1064	0.8203
K	0.4996	-0.3209	-0.4863	1.0000	-0.0251	0.7553	-0.7477	0.5865	0.3356
F	0.6913	0.7930	0.1273	-0.0251	1.0000	0.0498	0.1957	0.0782	0.4656
P_L	0.6006	-0.2413	-0.4120	0.7553	0.0498	1.0000	-0.5339	0.6216	0.4856
P_K	-0.1531	0.5250	0.6126	-0.7477	0.1957	-0.5339	1.0000	-0.1078	0.6042
P_F	0.5028	0.0708	0.1064	0.5865	0.0782	0.6216	-0.1078	1.0000	0.8556
B	-0.0376	0.5164	0.8203	-0.5263	0.2777	-0.3910	0.6042	0.0537	1.0000

Q_1 = Advances L = Labour P_L = Price of labour

Q_2 = Investments K = Fixed capital P_K = Price of capital

B = Number of branches F = Purchased funds P_F = Price of purchased funds

APPENDIX III

TRANSLOG COST FUNCTION FOR PUBLIC SECTOR BANKS – PLANT LEVEL HAVING THE ASSET SIZE OF RS.140-200 CRORES

Estimates for equation : Dependent Variable – Total Cost
Generalized least squares regression Weighting variable = none
Dep. Var. = C Mean = .4069401640 S.D. = .164438214
Model size : Observations = 46, Parameters = 28, Deg.Fr. = 18
Residuals : Sum of Squares = .1531710632E – 01, Std.Dev = .02917
Fit : R-squared = .967831, Adjusted R-squared = .91958
(Note: Not using OLS. R-squared is not bounded in [0,1]
Model test : F[27, 18] = 20.06, Prob value = .00000
Diagnostic : Log-L = 118.8996, Restricted (b=0) Log-L = 18.2744
LogAmeiyaPrCrt. = -6.594, Akaike Info. Crt. = -3.952

Variable	Coefficient	Standard Error	P [| Z | > z]	Mean of X
a_0	18.7562	.0126	1484.323	
Q1	.6065	.0582	10.417	-.0163
Q2	.3049	.0343	8.888	-.0770
P_L	.0186	.0433	4.288	-.0472
P_K	.0192	.0110	1.744	-.2042
P_F	.4542	.0560	8.114	-.0197
Q_1Q_1	.3908	.1458	2.681	.0341
Q_1Q_2	.2438	.2353	1.036	-.0134
Q_2Q_2	-.0333	.0483	- 0.690	.1900
LL	.1607	.0816	1.969	.0855
LK	-.1801	.0567	- 3.176	.0205
LF	.1892	.1684	1.124	.0190
KK	-.0080	.0111	- 0.720	.5373
KF	-.0344	.0666	- 0.516	-.0053
FF	-.1924	.1375	- 1.399	.0426
LQ_1	-.2908	.1625	- 1.790	-.0054
KQ_1	.0209	.0635	0.330	.0018
FQ_1	.6542	.2518	2.598	-.0095
LQ_2	-.2491	.1030	- 2.419	-.0582
KQ_2	-.0281	.0427	- 0.659	-.0871
FQ_2	.3825	.1242	3.080	-.0037
BA	.2107	.0337	6.246	-.0537
Q_1BA	-.1239	.3057	- 0.405	.0278
Q_2BA	-.1782	.0825	- 2.159	.0252
LBA	.4017	.1933	2.078	-.0235
KBA	.0336	.0553	0.608	.0533
FBA	-.4315	.2006	- 2.151	-.0336
BABA	.1217	.0963	1.260	.1185

TRANSLOG COST FUNCTION FOR PUBLIC SECTOR BANKS – FIRM LEVEL

HAVING THE ASSET SIZE OF RS.140-200 CRORES

Estimates for equation : Dependent Variable – Total Cost
Generalized least squares regression Weighting variable = none
Dep. Var. = C Mean = .4069401640 S.D. = .164438214
Model size : Observations = 46, Parameters = 21, Deg.Fr. = 25
Residuals : Sum of Squares = .446571776E-01, Std.Dev = .04226
Fit : R-squared = .93247, Adjusted R-squared = .87845
(Note: Not using OLS. R-squared is not bounded in [0,1]
Model test : F[20, 25] = 17.26, Prob value = .00000
Diagnostic : Log-L = 94.2886, Restricted (b=0) Log-L = 18.2744
LogAmeiyaPrCrt. = -5.952, Akaike Info. Crt. = 3.186

Variable	Coefficient	Standard Error	P [I Z I > z]	Mean of X
a_0	18.7735	.0146	1484.323	
Q1	.7423	.0585	10.417	-.0163
Q2	.3958	.0322	8.888	-.0770
P_L	.1360	.0523	4.288	-.0472
P_K	.0072	.0143	1.744	-.2042
P_F	.4066	.0610	8.114	-.0197
Q_1Q_1	.6812	.1685	2.681	.0341
Q_1Q_2	-.4298	.2139	1.036	-.0134
Q_2Q_2	.0422	.0540	- 0.690	.1900
LL	-.1611	.0968	1.969	.0855
LK	-.1912	.0641	- 3.176	.0205
LF	.4625	.1691	1.124	.0190
KK	-.0322	.0132	- 0.720	.5373
KF	-.0806	.0733	- 0.516	-.0053
FF	-.2213	.1243	- 1.399	.0426
LQ_1	.3440	.1775	- 1.790	-.0054
KQ_1	-.0674	.0542	0.330	.0018
FQ_1	.0636	.2706	2.598	-.0095
LQ_2	-.1603	.1127	- 2.419	-.0582
KQ_2	.0330	.0451	- 0.659	-.0871
FQ_2	.4230	.1266	3.080	-.0036

APPENDIX IV

DATA ENVELOPMENT RESULTS OF PUBLIC SECTOR BANKS HAVING THE ASSET SIZE OF BELOW RS.20 CRORES

DMU	SE	DMU	SE	DMU	SE	DMU	SE	DMU	SE
1	78.13	23	76.41	45	77.13	67	76.51	89	77.45
2	78.56	24	77.62	46	78.11	68	77.66	90	83.41
3	77.87	25	100.00	47	78.83	69	76.72	91	78.10
4	78.09	26	79.53	48	76.68	70	77.46	92	78.16
5	77.42	27	78.20	49	76.79	71	77.83	93	76.99
6	77.82	28	78.26	50	89.23	72	76.77	94	76.88
7	77.60	29	77.80	51	77.41	73	76.71	95	78.64
8	78.06	30	76.63	52	76.85	74	76.96	96	77.24
9	77.69	31	77.59	53	77.17	75	77.86	97	77.19
10	78.50	32	77.74	54	76.82	76	77.59	98	76.94
11	78.62	33	76.44	55	77.90	77	77.09	99	79.21
12	77.75	34	77.32	56	77.47	78	76.82	100	77.07
13	77.81	35	77.31	57	77.28	79	77.16		
14	77.28	36	77.85	58	78.31	80	76.88		
15	76.56	37	76.79	59	77.00	81	77.70		
16	78.48	38	76.83	60	76.59	82	78.47		
17	77.83	39	77.76	61	78.95	83	76.71		
18	79.44	40	77.23	62	75.96	84	78.05		
19	78.04	41	77.14	63	76.46	85	76.39		
20	77.75	42	76.38	64	91.88	86	77.55		
21	78.85	43	77.59	65	77.85	87	77.26		
22	77.99	44	76.67	66	76.68	88	76.81		

DMU = Decision making unit
SE = Scale efficiency

DATA ENVELOPMENT RESULTS OF PUBLIC SECTOR BANKS HAVING THE ASSET SIZE OF BELOW RS.20-60 CRORES

DMU	SE	DMU	SE	DMU	SE	DMU	SE	DMU	SE	DMU	SE	DMU	SE
1	78.08	27	77.41	53	76.86	79	77.16	105	77.53	131	77.28	157	78.27
2	76.88	28	76.85	54	77.12	80	79.14	106	92.21	132	77.74	158	76.48
3	77.57	29	77.44	55	77.32	81	76.61	107	77.45	133	77.53	159	76.94
4	77.36	30	77.17	56	77.66	82	77.80	108	77.97	134	78.23	160	77.64
5	77.24	31	77.48	57	77.93	83	77.14	109	77.04	135	77.78	161	77.11
6	77.03	32	77.63	58	77.08	84	79.09	110	77.42	136	78.37	162	100.00
7	77.42	33	77.90	59	76.98	85	77.33	111	76.83	137	77.54	163	78.04
8	77.05	34	77.89	60	96.74	86	78.93	112	77.70	138	77.75	164	77.66
9	78.75	35	77.13	61	78.19	87	77.75	113	78.01	139	77.39	165	77.40
10	77.30	36	97.52	62	76.98	88	77.90	114	77.34	140	76.58	166	77.95
11	77.33	37	78.22	63	77.08	89	78.28	115	77.61	141	77.45	167	77.34
12	77.08	38	77.40	64	77.24	90	77.90	116	78.11	142	100.00	168	77.30
13	78.07	39	77.21	65	77.69	91	77.43	117	91.06	143	77.84	169	76.71
14	77.91	40	76.96	66	77.87	92	76.71	118	100.00	144	77.66	170	77.56
15	77.39	41	77.33	67	76.70	93	78.06	119	78.03	145	77.84	171	77.04
16	77.16	42	76.82	68	77.07	94	76.84	120	78.55	146	77.39	172	78.10
17	78.39	43	77.35	69	76.74	95	79.16	121	77.87	147	77.14	173	77.36
18	79.15	44	77.77	70	76.97	96	78.14	122	77.32	148	78.03	174	78.59
19	78.55	45	77.27	71	78.09	97	95.74	123	78.15	149	77.16	175	78.00
20	76.76	46	78.13	72	77.68	98	78.14	124	77.91	150	78.10	176	77.39
21	77.41	47	77.24	73	77.71	99	77.45	125	76.75	151	77.17	177	77.49
22	77.03	48	77.73	74	77.78	100	77.57	126	76.96	152	77.82		
23	77.12	49	78.12	75	77.81	101	76.65	127	77.84	153	77.74		
24	78.49	50	77.40	76	100.00	102	93.01	128	76.52	154	77.98		
25	77.36	51	77.72	77	77.67	103	77.51	129	78.40	155	77.82		
26	100.00	52	76.95	78	78.31	104	95.98	130	79.09	156	89.90		

DATA ENVELOPMENT RESULTS OF PUBLIC SECTOR BANKS HAVING THE ASSET SIZE OF RS.60-100 CRORES

DMU	SE	DMU	SE	DMU	SE	DMU	SE	DMU	SE
1	78.62	19	79.48	37	79.10	55	79.98	73	78.51
2	100.00	20	78.92	38	78.56	56	78.57	74	78.19
3	79.27	21	78.86	39	78.29	57	78.38	75	79.62
4	79.21	22	78.53	40	78.95	58	78.24	76	78.98
5	79.21	23	78.09	41	78.53	59	79.57	77	78.98
6	78.72	24	79.14	42	79.19	60	78.97	78	80.09
7	100.00	25	79.43	43	77.84	61	78.71	79	79.55
8	79.12	26	77.88	44	79.54	62	79.34	80	78.12
9	78.56	27	80.50	45	78.63	63	79.38	81	78.34
10	79.78	28	79.27	46	78.53	64	80.08	82	79.45
11	78.66	29	77.99	47	78.02	65	79.90		
12	78.28	30	79.12	48	79.09	66	78.78		
13	78.99	31	79.86	49	80.31	67	80.24		
14	78.64	32	100.00	50	78.42	68	79.80		
15	78.60	33	77.37	51	77.90	69	78.00		
16	94.85	34	79.25	52	78.74	70	79.68		
17	78.75	35	80.68	53	78.39	71	77.98		
18	77.96	36	78.52	54	78.36	72	78.49		

DATA ENVELOPMENT RESULTS OF PUBLIC SECTOR BANKS HAVING THE ASSET SIZE OF RS.100-140 CRORES

DMU	SE	DMU	SE	DMU	SE
1	97.36	21	94.78	41	96.23
2	96.61	22	87.24	42	93.23
3	93.87	23	92.25	43	90.84
4	92.80	24	91.66	44	93.10
5	95.23	25	88.41	45	86.77
6	92.29	26	91.06	46	94.26
7	92.38	27	95.14	47	95.58
8	95.02	28	99.96	48	95.15
9	92.20	29	94.65	49	100.00
10	87.67	30	89.79		
11	100.00	31	92.46		
12	95.57	32	93.80		
13	100.00	33	95.59		
14	87.78	34	89.64		
15	94.23	35	89.35		
16	98.04	36	94.67		
17	96.92	37	96.22		
18	90.85	38	94.96		
19	91.86	39	90.12		
20	93.08	40	100.00		

DATA ENVELOPMENT RESULTS OF PUBLIC SECTOR BANKS HAVING THE ASSET SIZE OF RS.140-200 CRORES

DMU	SE	DMU	SE	DMU	SE
1	98.98	21	100.00	41	91.40
2	99.04	22	97.08	42	92.96
3	100.00	23	99.49	43	89.63
4	92.93	24	97.33	44	100.00
5	97.12	25	91.71	45	92.69
6	95.65	26	94.57		
7	88.31	27	94.74		
8	94.45	28	100.00		
9	95.91	29	93.26		
10	95.45	30	100.00		
11	94.05	31	95.78		
12	99.03	32	100.00		
13	97.23	33	96.18		
14	96.63	34	98.27		
15	100.00	35	90.52		
16	93.23	36	95.40		
17	97.64	37	98.13		
18	95.70	38	98.41		
19	99.63	39	100.00		
20	99.47	40	99.13		

DATA ENVELOPMENT RESULTS OF PUBLIC SECTOR BANKS HAVING THE ASSET SIZE OF ABOVE RS.200 CRORES

DMU	SE	DMU	SE	DMU	SE
1	77.04	21	77.57	41	76.34
2	77.06	22	76.61	42	76.21
3	76.98	23	76.75	43	76.28
4	75.61	24	77.70	44	76.36
5	77.04	25	76.28	45	76.14
6	77.26	26	77.79	46	76.32
7	76.60	27	76.96	47	75.97
8	77.25	28	77.06	48	76.11
9	77.03	29	77.33	49	76.46
10	77.45	30	77.39	50	76.59
11	77.27	31	77.32	51	76.54
12	77.30	32	98.36	52	75.93
13	77.40	33	76.42		
14	77.11	34	77.36		
15	77.20	35	100.00		
16	77.59	36	100.00		
17	77.56	37	76.91		
18	77.06	38	100.00		
19	77.54	39	77.16		
20	77.07	40	77.19		

APPENDIX V

INPUTS USED AND OUTPUT PRODUCED BY THE EFFICIENT DECISION MAKING UNITS OF PUBLIC SECTOR BANKS HAVING THE ASSET SIZE OF RS.140-200 CRORES

S.No	Input L	Input K	Input F	Output 1	Output 2
1	25690	1.2274	119.4590	77.0972	36.9399
2	44406	1.1214	128.1833	69.9740	37.9636
3	14755	0.7323	128.3099	80.9178	9.8044
4	37292	0.6142	134.1524	68.5557	33.9268
5	35713	0.6131	118.5023	63.6413	37.0155
6	37344	1.8682	118.2145	48.4821	54.7153
7	34205	3.8171	111.0742	44.7458	47.9881
8	26765	2.4300	122.5200	67.8100	38.8700
9	35496	0.6792	123.4032	77.1330	35.5334
10	39469	0.6596	140.3260	75.5493	32.0576
11	46640	0.8000	146.2841	76.1873	32.9376
12	42029	0.6564	143.5796	78.6060	35.7080
13	35386	0.6146	135.7271	74.5727	37.7961
14	48411	1.1692	135.4222	78.2762	34.7405
15	35483	0.5968	133.2972	80.2116	38.7224
16	48404	0.9291	164.7647	74.0058	52.2959
17	105212	1.4254	172.0713	111.4031	48.9978
18	48200	1.2103	146.5040	73.8566	48.5928
19	32722	0.6390	144.3633	65.0753	55.2351
20	15360	0.7696	148.7361	89.2747	11.4103
21	42362	0.7301	155.6718	82.4205	38.7282
22	94152	1.7770	162.9902	99.6936	46.9363
23	51493	0.9771	158.3770	79.8737	62.5715
24	49881	1.5372	171.7003	89.5101	51.7003
25	52736	4.4200	161.3000	59.9200	92.7700
26	55090	1.2838	186.9741	84.4765	65.5331
27	52954	6.6553	166.4900	77.9684	58.5504
28	53327	3.9617	180.0142	71.2916	61.7389
29	46419	1.7017	153.7277	762124	44.9991
30	25106	1.1394	117.5712	73.6732	32.5787
31	25312	1.1393	127.6550	75.1932	37.0406
32	27228	4.1225	139.6084	70.7113	44.4225
33	42516	0.6926	175.6004	89.6446	48.3766
34	50939	1.7841	173.2264	98.0068	52.9392
35	41524	1.5209	142.2167	82.9154	457835

INPUTS USED AND OUTPUT PRODUCED BY THE INEFFICIENT DECISION MAKING UNITS OF PUBLIC SECTOR BANKS HAVING THE ASSET SIZE OF RS.140-200 CRORES

S.No	Input L	Input K	Input F	Output 1	Output 2
1	29984	2.2090	182.8298	60.5021	48.7084
2	48734	3.9525	192.2862	71.8850	41.2232
3	59888	2.1915	190.0117	67.3972	54.6255
4	39803	2.7151	145.7740	84.7493	42.0845
5	68952	4.8062	194.1165	74.1625	85.2091
6	65962	1.4986	152.1026	85.4974	41.8256
7	49905	0.5693	193.0206	49.0147	38.8220
8	59914	1.3256	169.6821	79.6513	56.4718
9	39942	0.8205	172.2515	96.4160	13.0387
10	59896	0.6597	191.1655	106.2669	48.1757
11	38078	0.8453	123.0308	78.3795	44.9846
12	39395	0.8846	1530142	79.9493	54.9812
13	83624	1.5593	128.0273	97.7651	50.9447

APPENDIX VI

DATA ENVELOPMENT RESULTS OF PRIVATE SECTOR BANKS HAVING THE ASSET SIZE OF BELOW RS.4 CRORES

MU	SE	DMU	SE	DMU	SE	DMU	SE	DMU	SE	DMU	SE	DMU	SE	DMU	SE	DMU	SE	DMU	SE	DMU	SI
	100.00	27	90.93	53	99.13	79	95.05	105	90.20	131	96.87	157	99.13	183	94.45	209	91.38	235	100.00	261	93.
	89.05	28	95.20	54	99.13	80	89.05	106	99.13	132	100.00	158	92.01	184	94.45	210	91.08	236	99.13	262	91.
	92.01	29	93.93	55	90.30	81	99.13	107	91.38	133	98.47	159	93.93	185	96.87	211	94.45	237	97.56	263	100.
	89.76	30	93.99	56	91.08	82	90.20	108	90.93	134	94.45	160	98.35	186	92.01	212	100.00	238	96.87	264	98.
	100.00	31	98.30	57	94.85	83	97.74	109	100.00	135	94.85	161	95.05	187	97.56	213	99.13	239	94.45	265	97.
	100.00	32	100.00	58	95.05	84	89.76	110	93.99	136	97.56	162	92.19	188	97.74	214	92.01	240	99.13	266	93.
	93.99	33	96.87	59	89.77	85	89.07	111	98.47	137	94.85	163	90.20	189	99.13	215	95.20	241	92.01	267	95.
	100.00	34	93.93	60	89.77	86	100.00	112	92.19	138	90.20	164	89.77	190	96.66	216	91.38	242	95.20	268	97.
	96.66	35	92.19	61	91.38	87	94.45	113	95.05	139	92.19	165	94.85	191	98.47	217	99.13	243	95.05	269	95.
)	100.00	36	100.00	62	100.00	88	93.99	114	91.08	140	95.20	166	94.85	192	97.56	218	90.93	244	95.20	270	95.
	96.87	37	92.19	63	89.06	89	90.93	115	100.00	141	94.85	167	97.56	193	97.74	219	91.38	245	93.93	271	93.
	100.00	38	91.08	64	91.08	90	96.87	116	100.00	142	96.66	168	96.66	194	98.47	220	94.85	246	100.00	272	98.
	100.00	39	89.77	65	89.76	91	89.76	117	91.08	143	91.38	169	100.00	195	92.01	221	100.00	247	97.74	273	94.
	100.00	40	99.13	66	93.99	92	90.20	118	96.87	144	94.45	170	100.00	196	90.93	222	100.00	248	93.93	274	98.
	98.35	41	90.93	67	96.66	93	89.05	119	93.99	145	95.03	171	100.00	197	89.77	223	98.35	249	95.05	275	94.
	98.35	42	99.13	68	94.85	94	91.38	120	91.09	146	90.93	172	93.93	198	94.45	224	95.03	250	95.03	276	95.
	90.20	43	89.05	69	93.99	95	91.08	121	100.00	147	95.20	173	95.20	199	96.66	225	95.03	251	95.03	277	95.
	90.30	44	100.00	70	94.85	96	97.74	122	94.45	148	95.05	174	97.74	200	97.74	226	100.00	252	100.00	278	97.
	98.47	45	89.06	71	95.05	97	89.76	123	91.08	149	100.00	175	92.19	201	96.66	227	90.93	253	91.38	279	96.
	92.01	46	95.03	72	89.05	98	92.19	124	100.00	150	92.19	176	93.93	202	99.13	228	98.47	254	96.66	280	97.
	98.35	47	97.74	73	99.13	99	91.08	125	96.87	151	90.20	177	91.38	203	96.87	229	93.93	255	90.93	281	97.
	100.00	48	92.01	74	95.03	100	96.66	126	100.00	152	95.05	178	92.01	204	92.01	230	98.35	256	92.19	282	97.
	91.38	49	92.01	75	89.76	101	92.19	127	95.20	153	96.87	179	100.00	205	100.00	231	98.47	257	97.74	283	96.
	98.35	50	89.04	76	100.00	102	100.00	128	95.03	154	94.85	180	93.99	206	92.19	232	98.35	258	91.09		
	99.13	51	98.47	77	96.87	103	90.20	129	90.93	155	97.56	181	94.45	207	100.00	233	95.03	259	95.03		
	93.93	52	93.99	78	100.00	104	93.99	130	95.20	156	97.56	182	98.47	208	100.00	234	95.03	260	98.47		

DATA ENVELOPMENT RESULTS OF PRIVATE SECTOR BANKS HAVING THE ASSET SIZE OF RS.4-8 CRORES

DMU	SE	DMU	SE	DMU	SE	DMU	SE	DMU	SE
1	91.19	27	93.67	53	95.25	79	91.98	105	93.33
2	99.33	28	98.35	54	93.11	80	90.39	106	87.76
3	91.41	29	89.60	55	93.94	81	86.04		
4	95.54	30	93.32	56	93.56	82	94.41		
5	90.70	31	96.04	57	92.12	83	98.85		
6	91.54	32	85.73	58	95.26	84	95.54		
7	90.57	33	94.94	59	89.83	85	94.87		
8	94.83	34	93.12	60	94.08	86	90.01		
9	90.25	35	96.26	61	87.67	87	95.26		
10	96.71	36	98.58	62	93.75	88	92.71		
11	96.73	37	96.61	63	91.16	89	92.43		
12	94.46	38	92.90	64	94.16	90	91.32		
13	88.79	39	96.93	65	89.72	91	93.93		
14	98.74	40	92.70	66	95.30	92	92.84		
15	97.00	41	91.99	67	95.37	93	92.38		
16	95.58	42	98.45	68	93.10	94	91.43		
17	91.35	43	98.89	69	91.42	95	88.93		
18	93.55	44	92.26	70	91.98	96	94.11		
19	96.43	45	93.84	71	86.41	97	93.11		
20	94.26	46	95.20	72	92.69	98	89.28		
21	96.53	47	92.71	73	91.22	99	91.70		
22	100.00	48	92.30	74	92.22	100	9059		
23	93.85	49	90.10	75	93.31	101	93.71		
24	93.24	50	92.50	76	94.12	102	87.76		
25	99.11	51	96.97	77	90.02	103	100.00		
26	98.67	52	87.13	78	91.15	104	99.47		

DATA ENVELOPMENT RESULTS OF PRIVATE SECTOR BANKS HAVING THE ASSET SIZE OF RS.8-12 CRORES

DMU	SE	DMU	SE
1	92.38	23	90.68
2	94.04	24	89.96
3	89.74	25	90.83
4	99.41	26	94.08
5	100.00	27	94.15
6	94.87	28	100.00
7	88.95	29	83.93
8	90.75	30	90.77
9	91.64	31	88.25
10	89.42	32	91.83
11	86.69	33	92.80
12	89.76	34	90.48
13	91.69	35	88.40
14	89.91	36	97.25
15	90.10	37	93.48
16	100.00	38	90.80
17	89.00	39	88.58
18	95.78	40	88.36
19	96.69	41	96.34
20	89.58	42	93.77
21	87.71	43	88.85
22	90.26		

DATA ENVELOPMENT RESULTS OF PRIVATE SECTOR BANKS HAVING THE ASSET SIZE OF RS.12-16 CRORES

DMU	SE
1	93.24
2	85.16
3	93.86
4	91.72
5	97.17
6	100.00
7	93.70
8	87.67
9	93.23
10	91.05
11	94.42
12	86.04
13	100.00
14	96.24
15	92.72
16	91.43
17	94.11
18	89.83
19	85.18
20	94.60
21	95.85
22	95.45
23	86.41

DATA ENVELOPMENT RESULTS OF PRIVATE SECTOR BANKS HAVING THE ASSET SIZE OF ABOVE RS.16 CRORES

DMU	SE	DMU	SE
1	76.28	15	77.49
2	77.12	16	77.37
3	76.21	17	80.33
4	76.36	18	78.25
5	77.42	19	77.19
6	76.27	20	77.27
7	77.00	21	78.43
8	76.40	22	78.15
9	76.38	23	76.44
10	76.42	24	77.23
11	77.30	25	76.49
12	78.32	26	79.00
13	77.15	27	78.02
14	77.10	28	100.00