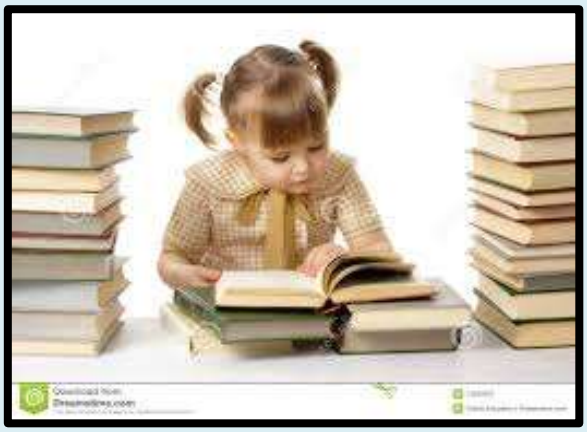
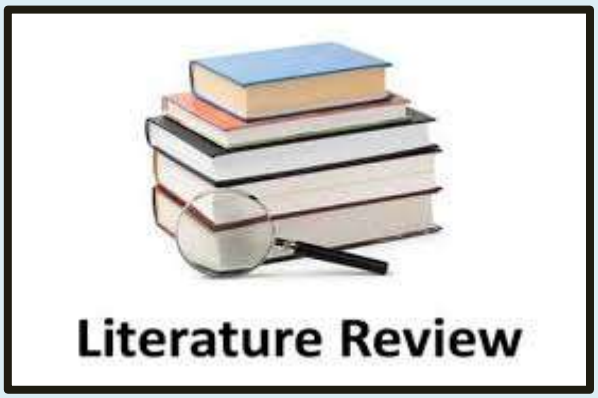
CHAPTER-3

REVIEW OF LITERATURE





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[3.1] INTRODUCTION:

This Review of Literature chapter provides a summary of previous research on the topic at hand, namely the Data Envelopment Analysis Model. It emphasizes the primary emphasis of the research discussed or detailed in the dissertation. Any study activity begins with the identification of the problem, and as soon as the problem is identified, a quick explanation of it should be written down. Once the final topic has been determined, each researcher must delve deeply into the previous studies undertaken on that issue, as well as the findings and conclusions obtained from those studies. Additionally, researchers must consider the future extent of their study effort on that topic. And for Review of Literature, one needs to refer

- **Abstract of research paper,**
- **Published and unpublished bibliographies,**
- **Academic journals,**
- **Conference proceedings ,**
- **Government reports,**
- **Books etc.**

As the core of any research project, the literature review should include several key objectives. It establishes the overall concept of the study, clearly stating what is and is not within the scope of examination, and justifies the decisions. Along with the claims of the research, it allows the researcher to understand the procedures used to achieve the results. Such a review of the literature allows the author to discern between what has been learned and accomplished in the field of study and what remains to be studied and done. Thus, a good literature review helps in both i.e.

- **Theoretical**
- **Methodological**

Thus, a literature review is one of the most significant processes in the research process since it reflects what is previously known about a specific phenomenon. So, this will help to improve the quality and utility of future studies. It will benefit the researcher like a decent library.

[3.2] MEANING OF LITERATURE REVIEW:

A literature review is a complete summary of past research on a particular topic. The literature review includes scholarly articles, books, magazines, reports, as well as other sources relevant to a particular area of research work.

The review for a particular topic should define, summarize, objectively evaluate and clarify the previous research work.

[3.3] DEFINITION OF LITERATURE REVIEW:

According to Polit and Hungler:

"Review of Literature is defined as an extensive, exhaustive and systematic examination of publications to the research project" Review of Literature is critical summary of research on a topic of interest usually prepared to put a research problem in context or to identify gaps and weakness in previous studies so as to justify a new investigation."

According to H.M. Copper, 1998:

"A literature reviews are used as its database reports of primary or original work. The primary reports used in the literature may be verbal, but in majority cases reports are in written form, this types of scholarship may be empirical, theoretical, critical, analytic or methodological in nature. Second a literature review finds to describe, summarize, evaluate, clarify or integrate the content of primary reports.

According to J. Shaw:

The process of the review should "clarify how one piece of research work builds on another".

According to Lawerence & McEvoy (2008)

"Literature review means an evidence based review of relevant reference material"

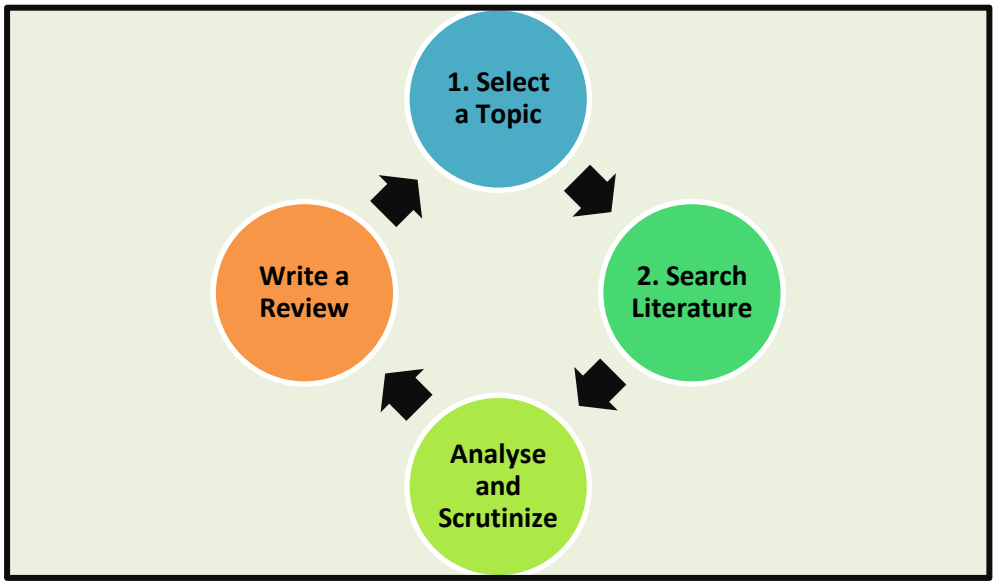
According to Galvan (2005)

Literature review define as "a process of finding the sources or data of relevant material for particular topic or for a particular subject"

[3.4] PROCESS OF LITERATURE REVIEW:

The steps for literature review are as under:

Figure-3.1: Process of Literature Review



[**Source:** Self-Constructed]

[3.5] PURPOSE OF LITERATURE REVIEW:

Literature review is beyond research information and includes the identification and compilation of literature and research relations although the literature review changes in a variety of studies, but the main objectives remain the same:

- The main objective of the literature review is to understand the existing research related to a particular subject or field of study and to present it in written form.
- Using literature review, he gets knowledge in his own field. One is known about important concepts, research methods and techniques that are used in the field. It can also be learned how researchers use various research in the study.
- The second importance is that a reader gets a better understanding of the research findings discussed in a specific discipline.
- To judge the investigation.
- It enables that the research has not been done before.
- It also helps in purifying, redoing or altering the subject.
- Helps to know the research gap.

- Gives the outline about how the subject has been studied.
- Helps to develop research investigative tools and to improve research methodologies.
- It also outlines the problems faced by previous researchers while studying the same topic.
- Gives a path for future research.
- Develop a general explanation for the diversity seen in behavior or extraordinary event.
- Helps to identify the sources of data used by the researchers.
- Develop alternative projects of research.
- Delimiting the problem.

[3.6] TYPES OF LITERATURE REVIEW:

A review of literature is the text of articles, research papers, books, reports and so on. Which includes the current knowledge including substantive findings as well as theatrical and mathematical contribution in the particular topic or area. There are 4 types of literature review.

1. **Systematic Review**
2. **Evaluative Review**
3. **Exploratory Review**
4. **Instrumental Review**

Figure 3.2: Types of Literature Review

[Source: Self- Constructed**]**

[3.7] IMPORTANCE OF LITERATURE REVIEW:

Literature review is an important step for research work. It is important due to following reasons.

- Review of literature provides a handy guide to particular topic. It helps to know the current situation prevailing in the field of research.
- It reveals the gap that exist in a past literature
- It locates own research with existing research
- Reviewing literature can be helpful for achievement of following objectives:
  - ✓ For Identifying the research problem and development of research questions.
  - ✓ Development of hypothesis which are to be tested in research studies.
  - ✓ It also helps in formatting research methodology for present study.
  - ✓ It describes the originality and relevance of particular research problem

[3.8] LITERATURE REVIEW FOR RESEARCH WORK:

For this study review of literature is divided into two parts i.e.

1. **Review of Research Report**
2. **Review of Research Papers**

PART-1 RESEARCH REPORT REVIEW

Review of Literature: 1

Ishita Dodia (2018)[15] in the present research report titled "A Study of financial performance of fertilizer industry of India (using DEA model) the researcher has made an attempt to analyze the financial performance of fertilizer industry. Fertilizer industry is considered as the backbone of the economy so its evaluation is of much importance. The study was mainly model based and ratio analysis was used. The researcher has selected seven fertilizers companies which were listed in BSE. The main objective of the study was to study the financial ratios of the selected companies and to know the important benchmark of financial performance of selected companies. The researcher took the study period of ten years i.e. from 2008-09 to

2017-18. The method used for collection of data was secondary data collection method. The researcher took the data from the annual reports of the selected companies. Mainly DEA model was used in which ratios are bifurcated as input and output ratios. In the input four ratios are included i.e. Liquidity ratio, Activity Ratio, Leverage Ratio and Economic Indicator while in Output Profitability ratio was included. Based on the analysis the researcher reached at the conclusion and concluded that CFL Company stood first while the NFL Company was at last and needs improvement.

Review of Literature: 2

Shivanisinh Parmar (2017)[59] has done research report entitle "A study on Financial Performance Evaluation of Selected FMCG Companies in India with reference to Data Envelopment Analysis (DEA)" This paper intended to assess the financial performance of selected Indian FMCG companies. The analysis included all listed businesses on the NSE and BSE. The sample size for this study was the top ten FMCG companies based on revenue and profit in 2016. The study period lasted ten years, from 2006-07 to 2015-16. The data was analyzed using the Mean, ANOVA, and DEA Models. This research report concludes that CPL was more efficient according to the DEA Model during the study period.

PART-2 RESEARCH PAPER REVIEW

Review of Literature: 1

Khajavi Shikro Allah, Ghauori Moghadam, Ghafari Mohammad Javad (2020)[38] the paper entitle "Data envelopment analysis technique ; A complementary method for traditional analysis of financial ratio" was published in the Iranian accounting and auditing review. The goal of this research was to demonstrate DEA as a performance evaluation tool in comparison to established techniques. The traditional way of analysis had a drawback in that it only showed one part of the finances. As a result, they selected 267 companies from the Tehran stock exchange for their study, which took place between 2005 and 2007. They generated four inputs and seven outputs using the BCC model and concluded that 235 were inefficient, implying that the DEA model technique was superior to traditional analysis.

Review of Literature: 2

Natthan Singh and Millie Pant (2020)[50] conducted a research work entitled "Efficiency assessment of Indian Paper Mills through Fuzzy DEA". They selected 8 paper mills of India for research work. The efficiency of selected paper mills was assessed using three input parameters: raw material, energy consumption, and water consumption; and four output parameters: paper production, biochemical oxygen demand, chemical oxygen demand, and greenhouse gas emissions. This study report examined how negative outputs such as biochemical oxygen demand, chemical oxygen demand, and greenhouse gas emissions affect the efficiency of paper mills. According to the study, the Fuzzy Data Envelopment Analysis Model is a useful tool for measuring organizational efficiency.

Review of Literature: 3

Jeon –Hun Sin (2019)[60] the paper entitled "A study on the financial efficiency analysis method by redesigning the DEA model" published in Springer. The purpose of this study was measure the financial efficiency of firms considering both input and procurement capital. They devised a new method known as the three-dimensional data envelopment analysis model and performed research to analyze the efficiency of 33 Korean car parts manufacturing organizations. The findings of the investigation were summarized as follows. Even if the company's business performance was more efficient than the input assets, there are still many inefficient enterprises in comparison to the procurement capital. Meanwhile, management performance was inefficient as compared to input assets; nonetheless, certain organizations were efficient in terms of procurement capital. This study proposed a new measurement approach based on this premise, analyzed each decision-making unit's existing financial status using return-to-scale analysis, and suggested financial development directions.

Review of Literature: 4

Teg Alam & Rupesh Rastgi (2019)[65] research paper entitle, "Trend Analysis of Cost Efficiency for the Pharmaceutical Industry: A DEA Approach" was aimed to evaluate efficiency of Indian Pharmaceutical Companies. Top 5 Indian Pharmaceutical Companies were selected. Inputs were Net Block, Cash and Bank

Balance, Share Capital, R & D, Secure loan & Unsecure loan whereas Investment, Loans and Advances were selected as output. The study period was 2001 to 2011. The results have indicated that all most all companies were efficient during the study period.

Review of Literature: 5

Maryam Tabasi & Mehrzad Navabakhsh (2019)[45] conducted a research paper entitle, "Performance Evaluation Using Network Data Envelopment Analysis Approach With Game Theory Under Mixed Grey-Fuzzy Uncertainty In Iran Khodro Company". The case study of this article was on Iran Khodro Company which was one of the most important companies at automobile industry and had a wide process of delivering for automobiles. So the Iran Khordo Company was selected for the research work. It produced 21 types of cars. Study conclude that Samand SE and Soren P2 have the highest efficiency while Whils Peugeot 206 had lowest efficiency.

Review of Literature: 6

Tagdira Naznin Smriti & Md. Hasinur Rahaman Khan(2018)[63] the research title "Efficiency analysis of manufacturing firms using data envelopment analysis technique". This study was published in Journal of Data Science, pp. 69-76. Efficiency scores were obtained using the non-parametric data envelopment analysis technique for 1007 manufacturing firms in Bangladesh from enterprise survey data, with 29 firms found to be efficient under variable returns to scale assumption. The significant determinants factors for inefficient units found in the research work were firm size, manager experience in respective sector, annual losses due to power outages, and number of production workers.

Review of Literature: 7

R.P. Shreedevi (2018)[54] the research paper entitle "Efficiency of private bank using Bcc model through DEA Approach" based on DEA Approach Which implied to measure efficiency of Selected Private Sectors banks. Ten private sector banks in Hyderabad were selected for study purposes. The study lasted four years, from 2010 to 2013. The efficiency score was determined using the data envelopment analysis approach. In this study, seven inputs and six outputs were used. The inputs were customer deposits, balance credit capital interest commission staff

expenditure net administrative expenditure, and the outputs were loan securities income from commission profit and total margin of interest. It was discovered that 60% of the bank used 90% of the inputs to proceed, with the remaining 10% freely disposed.

Review of Literature: 8

Vanessa, Carlos & Cristiano (2018)[69] conducted a research paper entitle, "Evaluation of technical efficiency of Brazilian distribution companies of electrical energy through Data Envelopment Analysis". The goal of this study paper was to evaluate the efficiency of electrical energy firms. The survey included a total of 18 firms. The study was conducted in 2012. This study paper concludes that 7 out of 18 enterprises were efficient according to the DEA Model.

Review of Literature: 9

Hossein, Reza and Mohmmad (2018)[34] conducted research paper entitled "Evaluating the Efficiency of Power Companies Using Data Envelopment Analysis based on SBM Models: A Case Study in Power Industry of Iran". This research sought to assess the efficiency of Iran's power industry. Sixteen regional electricity companies were chosen for research. This report concludes that three of the companies were efficient, while the remaining 13 were inefficient according to the DEA Model during the study period.

Review of Literature: 10

L.Kishor & S.G.Varun Kumar (2018) This paper was published in International Journal of Pure and Applied Mathematics. Power Distribution Utilities in India were selected for research work. As per the methodology, the scores were assigned by the performance on each of the Power Distribution Utilities considering various operational & reforms parameters, external parameters as well as financial parameters broadly. Each of these parameters with the weight of 47%, 33%, and 20% respectively.

Review of Literature: 11

Eva Garmanova & Herbert Strunz (2017)[20] the aim of research paper entitle "Efficiency of Insurance Companies: Application of DEA and Tobit Analysis"

was to determine the relationship between technical efficiency and profitability of selected insurance companies. The investigation involved a total of 15 Solvakis commercial insurance businesses. The study was conducted from 2013 to 2015. Data was analyzed using the Data Envelopment Analysis Model, the Mann-Whitney U-test, and the Tobit Regression. It concludes that there is a statistically significant variation in average technical efficiency scores among the selected commercial insurance companies.

Review of Literature: 12

Martin Telecky (2017)[66] the research paper entitle "Application of DEA Method to Evaluate Financial Health of Selected Transport Companies" was published in MATEC Web of Conferences in 2017. The goal of this report was to assess the financial performance of chosen transportation companies. The study was conducted in 2016. Eight transportation companies were chosen for the study. It concludes that just three transport companies were efficient among the selected enterprises during the study period.

Review of Literature: 13

Sunil Kumar & Chary (2017)[11] the research paper entitle **"**Financial performance evaluation of IT industry through DEA window analysis approach" aim was to analyze the time series performance of NSE listed IT companies based on individual company's FP with stability index benchmark. It is possible that the majority of companies' individual rankings correspond to the stability index rank 40 IT enterprises. The study was conducted over a 10-year period (2007-2016). The DEA Model's inputs were operating expenses, total outside liabilities, and shareholder funds, while the outputs were net sales and cash flow from operating activities.

Review of Literature: 14

F. Gascon, J. Lozano, B. Ponte, D. Fuente (2017)[22] research paper entitled "Measuring the efficiency of large pharmaceutical companies: An industry analysis" was conducted to measure relative efficiency of pharmaceutical laboratories. For research purposes, 37 large pharmaceutical facilities were chosen. The study was conducted from 2008 to 2013. The data was analyzed using the data envelopment analysis approach. The final DEA model employed a total of seven variables. There

are three inputs, three outputs, and one input/output. The inputs were workforce size, total assets, and investment in R&D, while the outputs were net profit, market capitalization, and total sales. Number of days for authorized new medications in France, taking into account both input and output effects. According to the data envelopment analysis model, the average degree of efficiency was 93.45%, and 10 of the companies were deemed to be inefficient.

Review of Literature: 15

Lam Weng, Fai & Hoe (2017)[42] research paper and title "An empirical investigation on the efficiency of healthcare companies in Malaysia with DEA model" was conducted to evaluate and compare the assistance of healthcare companies which were listed in Malaysia Stock Market. 12 Companies were selected for research work the period of study work was 2011 to 2015. The study determined that a AHEALTH, HAIO, IHH, PHARMA and YSPSAHARE identified as efficient companies during study period.

Review of Literature: 16

Aysegul Yilmaz & Kursat Capraz (2017)[7] research measure efficiency of free zones in Turkey. 12 Free Zones were selected for research work. So, 12 free zones were compared, and their performance was evaluated using the Data Envelopment Analysis Model. According to Data Envelopment Analysis Mode, 8 of the 12 free zones were judged to be efficient, while the remaining zones need improvement.

Review of Literature: 17

Hari Krishna Tata, Vijaya Sai Nimmagadda (2016)[32] This research work was published in International Journal of Industrial Engineering Research and Development, Volume-7, Issue-1, p- 24-34. This research work conducted to know the financial health of Indian public sector banks. The period of the study was 2009 to 2014. The data was collected from IBA bulletins and statistics published by RBI as well as annual reports published by the particular bank. 26 Public sector banks were selected for the research work. The four Input Attributes were Debt-Equity Ratio, NPA to Net Advances, NPA to Total Assets and Total Investment to Total Assets and output attributes were Capital Adequacy Ratio, Advances to Assets, Government

Securities to Total Investment, Business per Employee, Profit per Employee and Operating Profit to Total Assets Ratio. It concludes that Bank of Baroda stood at 1st position and United Bank of India stood at last position.

Review of Literature: 18

Edsel B. Calica & Nelson Bool (2016)[17] research paper entitled "Measuring the effect of parallel information of the efficiency of selected multinational pharmaceutical companies operations in the Philippines" was conducted to measure operational efficiency of multinational pharmaceutical companies. Total eight multinational companies were selected for research work. Inputs were investment, operating expense and cost of goods whereas total assets and sales selected as output. ANOVA was used for data analyses. ANOVA result indicated that parallel information did not significantly affect their financial performance.

Review of Literature: 19

Subir Kumar Sen & Joy Das (2016)[62] they have examined the overall efficiency of the public sector enterprise Steel Companies using DEA Model. The study period was 2010-11 to 2013-14. Sample size for the study was five steel companies. This paper accomplishes that SRCL stood at 1st position and FSNL stood at last position during the study period.

Review of Literature: 20

Veronika Fenyves, Tibor Tarnocui, Kinga Zsido (2015)[71] paper, Financial Performance Evaluation of Agricultural Enterprises with DEA Method was based on Data Envelopment Analysis Model. This research work was done for the period of 5 years i.e. 2008-2012. For this investigation, 82 agricultural companies were chosen. They chose the liquidity ratio, risk indicators, growth opportunity indicators, and asset management efficiency ratios as inputs, and Return on Assets as outputs. Out of the 82 selected agricultural enterprises, 33 were efficient, while the remaining 49 were inefficient units.

Review of Literature: 21

Ram Pratap Sinha (2015)[53] the study titled "A dynamic DEA Model for Indian Life Insurance Companies" related to evaluation of Life Insurance Companies

by using DEA Model. 15 Life Insurance Companies were selected for the study. The study period was seven years. This paper accomplishes that significant fluctuations in mean technical efficiency over the period of observation.

Review of Literature: 22

Babak Mazandaranian & Maryam Mosleh (2015)[8] the research paper Evaluate the Financial Performance of Pharmaceutical Companies using Fuzzy DEA. It was published in Journal of Data Envelopment Analysis and Decision Science. The researcher chose 22 pharmaceutical companies that have been accepted by the stock exchange. Average cost of raw material, average discount for the entire order, cost of repair and maintenance, cost deriving from payer's return of products, and total outbound goods were chosen as inputs, and Net Profit Ratio, Gross Profit Ratio, Cash Flow were chosen as outputs. It concludes that just six of the selected 22 pharmaceutical companies were efficient, while the rest pharmaceutical companies were deemed to be inefficient units according to the DEA Model.

Review of Literature: 23

Mihir Dash and Arunabhas Bose (2015)[46] paper Measuring an efficiency of marketing efforts in the Indian pharmaceutical industry using the DEA Model. It was done to assess the efficiency of pharmaceutical companies' marketing activities in India. The study focused on nine of the top pharmaceutical corporations. The study ran from 2003 to 2011. The data was obtained from the capitaline database. According to the study, ABBOTT had the highest efficiency score during the study period, while MERCK had the lowest.

Review of Literature: 24

M.Khodabakhshi, A.Barani, F.Kho., M.Nem. (2015)[43] conducted a research work entitle “Performance Evaluation of Iranian Electricity Distribution Units with Stochastic Data Envelopment Analysis”. This study was published in the International Journal of Applied Operations Research. A total of 38 electricity companies were selected. BCC Model inputs were utilized. According to the research paper, 89% of resources are required to make Iranian Power Distribution Units technically efficient.

Review of Literature: 25

Mohmmad Reza & Kambiz (2015)[48] conducted a research work entitle "Applying Network DEA to determine a Criterion for Banchmarking in Regional Electricity Companies of Iran". The study period was year 2011. Total 16 Regional Electricity Companies were selected for the research study. It accomplishes that Regional Electricity of Khozestan stood at last position and Regional Electricity of Zanjan stood at first position in case of overall efficiency during the study period as per DEA Model.

Review of Literature: 26

Cie-Fen-Zou(2015)[13] the research paper entitle, "Study on Efficiency of FMCG Industry" was based on the public company's efficiency evaluation model of Data Envelopment Analysis of FMCG industries. The year selected for study the study was only one year i.e..2009. This study article is based on 78 samples. There were 25 beverage companies, 15 agriculture-based enterprises, 32 food companies, and 6 commodity-based companies. It concludes that FMCG listed companies must increase their overall operational efficiency.

Review of Literature: 27

Elena Toma, Carina Dohre, Ion Dona & Elena Cofas (2015)[19] research paper entitle, "DEA Applicability in assessment of Agriculture Efficiency on areas with similar Geographically Patterns" was published in Agriculture and Agricultural Science Procedia. The objective of this paper was to use DEA at the regional level to examine the performance of agriculture in the Plains, Hills, and Mountains. 36 countries were classed. According to the findings of the research paper, only 14 countries have attained 100% DEA efficiency. As a result, the bulk of locations were not covered at an efficient level.

Review of Literature: 28

Ritika Singh, Biswaranjita Mahapatra, Kampan Mukherjee and Chandan Bhar (2014)[56] research paper was published in Asian Journal of Management Research Volume 4, Issue 3. They used a special approach of Data Envelopment Analysis Model for evaluation performance of Indian Microfinance

Institution. 20 Indian Microfinance Companies were taken into consideration. They employed the constant Return to Scale DEA Model. Financial and operational precautions were taken into account. The three inputs that were considered were offices, personnel, and operational expenses. The outputs included interest and fee income, the Gross Loan Portfolio, and the amount of loans outstanding. The study found that the MFIs Bandhan, EMFPL, and FFSL performed well or efficiently. The remaining 17 were inefficient units. The results clearly illustrate that DEA not only defines DMUs as efficient or inefficient, but it also serves as a yardstick for unproductive units by creating peer groups.

Review of Literature: 29

Chiranjeevi Gudala & E.S.V.Narayana Rao (2014)[12] they have written research on Performance Evaluation and Ranking of Private Sector Banks using Data Analysis and Super-Affirmative Models. Major Private Sector banks were considered to measure their performance using the Data Analysis Model, in which a super-efficient model was used to rank the private sector banks. The Indian economy plays a major role in banking, so it is very important to measure the efficiency of private sector banks which will be useful for the common man. 13 private sector banks were considered for performance evaluation. The first researcher worked with a Constant Return to Scale (CRS), Variable Return to Scale (VRS) and Scale Efficiency Reference, with a DEA model. More researchers have used super efficiency models for ranking private sector banks.

Review of Literature: 30

Jelena Titko, Stankeviciene & Lace (2014)[37] the research paper entitle "Measuring bank efficiency: DEA application". Was aim to improve the methodology of evaluating efficiency of Latvian banks. 15 Latvian Banks where selected for the study. Study period was only one year i.e.2012. Data Analysis was done with the help of DEA Model. It conclude that there is no significant evidence that deposit have the significant impact on Data Envelopment Analysis score.

Review of Literature: 31

Javad Razmi, Hosseini ,Arani &Ali Zarif (2014)[47] the study entitle "Study of the Firms Size Effect on Their Efficiency Based on DEA Approach (Case Study:

Firms in Tehran Stock Exchange During 2007 to 2011) was based on DEA Model. This study examined the effect of firm size on efficiency in Tehran Stock Exchange enterprises over a five-year period (2007-2011), using a sample of 75 firms registered on the exchange. For this aim, the Data Envelopment Analysis technique was employed to evaluate the firm's efficiency, and the firm size was calculated by the number of sales. The results show that there is a considerable inverse link between the efficiency of the selected firm and its size.

Review of Literature: 32

Varun Mahajan, Nauriyal & S.P.Singh (2014)[70] paper entitled "Technical efficiency analysis of the Indian drugs and pharmaceutical industry" was conducted to measure technical efficiency of Indian pharmaceutical firms. 50 large Indian pharmaceutical firms were selected for the study. The study period was 2010 -2011. The researcher selected salaries and wages, raw material, advertisement and marketing selected as input variables and net sales revenue as output variable. The research paper Conclude that nine companies were overall technical efficient and 19 companies were pure technical efficient.

Review of Literature: 33

Aradhana Gandhi, Ravi Shankar (2014)[5] research paper entitled "Efficiency measurement of Indian retailers Using data envelopment analysis was done to measure efficiency of Indian retailers by data envelopment analysis model". They used data envelopment analysis model, MPI - Malmquist productivity index and Tobit regression. 18 companies were found efficient as per CCR model and seven companies were found efficient as per DEA – BCC model.

Review of Literature: 34

A.R.Hernandez & M.S.Sebastian (2014)[1] paper entitle "Assessing the technical efficiency of Health of Posts in Rural Guatemala: A Data Envelopment Analysis" have determined the efficiency of 34 health posts in rural Guatemala from year 2008 to 2009 by Data Envelopment Analysis model. The research paper accomplish that the number of efficient health posts were 10 in the year 2008 and 8 in the year 2009 as per Data Envelopment Analysis Model.

Review of Literature: 35

C.Jehu Appiah (2014)[3] conducted a research title "Ownership and Technical Efficiency of Hospitals: Evidence from Ghana Using DEA". The aim was to evaluate the efficiency of 128 district hospitals in Ghana for the year 2005 by using the DEA model. The hospitals chosen included government, mission, quasi-government, and private institutions. This report concludes that 31 of the 128 district hospitals were efficient. The quasi-government hospitals had the greatest efficiency score (0.839). The public hospitals achieved an efficiency score of 0.704. During the study period, mission hospitals and private hospitals had efficiency scores of 0.686 and 0.558, respectively.

Review of Literature: 36

V.Alpagut Yaunuz & Sinan Demirch (2013)[68] paper entitle "An Emperical Analysis of the Efficiencies of Turkish Iron and Steel Companies during the Global Financial Crisis" was conducted an analysis of iron and steel companies located in the same geographic region. The study ran from 2005 to 2010. The survey included 22 firms. The data came from the Istanbul Stock Exchange database. This article concludes that Ozkul Celik Company was efficient during the study period, according to the Data Envelopment Analysis Model.

Review of Literature: 37

Z.Kalantary & Adel Azar (2013)[77] paper entitled "A Robust Data Envelopment Analysis for Ranking: A Case of Hospitals of Tehran" was done to measure the effectiveness of Tehran's hospitals. A total of 23 Tehran hospitals were selected and analyzed in order to assess their effectiveness in 2011. The research papers suggest that only 9 of the 23 units were technically efficient according to the Data Envelopment Analysis Model, with the remaining units receiving efficiency scores ranging from 0.349 to 0.927.

Review of Literature: 38

Ayhan Golcukcu & Hasan Bal (2013)[6] paper entitle "Customer Efficiency Versus Firms Efficiency: A Banking Example". In this paper six variables were selected for the study. TL, USD and DM as inputs and KON, TST and TKT as output.

A total of 21 banks were chosen for research work. The paper concludes that efficiency was prioritized for both businesses and customers. According to the Management-Based Approach, 7 banks were efficient, whereas the Customer-Based Approach revealed 8 banks to be efficient.

Review of Literature: 39

Marli Theunissen & Merwe Oberholzer (2013)[44] research paper entitle, "An Application of Data Envelopment Analysis to Benchmark CEO Remuneration: A South African Study" was done to determine the technical efficiencies of Johannesburg Stock Exchange-listed enterprises. An empirical investigation was conducted on 221 JSE-listed companies. The investigation was conducted in the year 2010. According to the survey, 80 of the 221 organizations in the sample emerged as the benchmark CEOs.

Review of Literature: 40

Jamshid Salehi, Maghsood & Farjan (2013)[58] research paper entitle, "Performance measurement of companies of Pharmaceutical substances industry in Tehran Stock Exchangewith the approach of COLS and DEA" was done to evaluate the performance of pharmaceutical companies. 24 pharmaceutical businesses listed on the Tehran stock exchange were examined using both DEA and corrected ordinary least squares methodologies. The study ran from 2003 to 2009. The results of this efficiency measure show that Iran Drug Company and parenteral products in 2003 and 2004, Iran Drug Company in 2005, Osveh Pharmaceutical Company and new in 2006, Abu Reihan and Osveh Pharmaceutical Companies in 2007, common drug company and Osveh Pharmaceutical in 2008, and Tehran-chemistry and common drug company in 2009 have the highest efficiency ratio in input and output.

Review of Literature: 41

Nur Aziz, Rozich & Rasidah (2013)[51] conducted a research work on entitle, "The Efficiency Analysis Of Academic Departments Using DEA Window Analysis". This paper adopted DEA window analysis to evaluate efficiencies of 24 academic departments of a public university in Malaysia. The study period was 2007-2011. The study exposed that the performance for most departments fluctuated between decrease and increase.

Review of Literature: 42

Zijiang Yang (2013)[76] research paper entitle, "Performance Analysis of Canadian Power Industry using Data Envelopment Analysis" was conducted to analyze performance of Canadian Power Industry. The research analyzed the performance of 19 Canadian power companies. The data was analyzed using the DEA Model. The findings indicate that Canadian power firms worked highly effectively during the research period, and that company size had a detrimental impact on performance.

Review of Literature: 43

Reza Tehrani, Mohmmad Reza Meghragan, Mohammad Reza Golkani (2012)[55] conducted a research work on "A model for evaluating financial performance of companies by Data Envelopment Analysis". This research paper was published in International Business Research, Volume-5, Issue- 8, p-8-16. Its purpose was to create a model for evaluating a company's success. The Data Envelopment Model's input variables were Liquidity Ratio, Activity Ratio, Leverage Ratio, and Economic Indicator, while the Profitability Ratio was chosen as the output variable. In this investigation, 36 private companies were chosen. The researcher discovered that nine out of 36 organizations were efficient, while the remaining 27 were inefficient.

Review of Literature: 44

George & Nickolaos (2012)[27] In data envelopment analysis (DEA) context financial data/ratios have been used in order to measure of performance metric of industry. Using bootstrap approaches, the article presented an application for analyzing the performance of 23 Greek manufacturing sectors. The findings suggest that the efficiencies attained in the first round of sensitivity analysis were biased. However, after applying the bootstrap techniques, the sensitivity analysis shows that the efficiency scores have greatly improved.

Review of Literature: 45

Sohn and Kim (2012)[61] in their research article, they have mainly examined two major problems of existing promotional systems in academics using an example of a professor evaluation system, which do not take into account the input aspects and focus on short-term operations. Considering the use of super-efficiency DEA and

multi-period output, it shows that the timing attitudes of input factors and results need to include professors fair evaluation and display for their research

Review of Literature: 46

Dr. Manas Kr. Baidya (2012)[40] the study entitle "Multiple aspects of Indian Efficiency through DEA Approach" aim was to assess the efficiency of commercial banks. 30 Indian commercial banks were chosen for the study. The researcher studied four components of banking operational efficiency: deposit, mobilization, fund conversion, off-balance-sheet activity, and cost revenue management. The study period lasted two years, from 2009-10 to 2010-11. This article concludes that corporation banks and IDBI banks were found to be efficient in all sectors, while Federal Bank, Axis Bank, and ICICI were efficient in only two.

Review of Literature: 47

Roshani Patel (2012)[52] She has done research work entitled, Measuring financial health using Z Score: "Study of selected companies in India" The investigation was conducted to determine the financial health of companies that had declared losses on the NSE and BSE, as well as poor performance on the stock market in 2011. During this 78-study, it was discovered that the companies had performed poorly in terms of financial health. As Z-scores dropped to 1.8, more enterprises were discovered to be financially distressed. As a result, this urges that top management take steps to improve financial management. As a result, increasing efficiency is unnecessary; else, firms will become dividends, causing major problems in the corporate world.

Review of Literature: 48

G.S. Beriba, B. Patnaik and S.S. Mahapatra (2011)[25] conducted a research work on titled " Safety performance evaluation of Indian organizations using Data envelopment analysis", Benchmarking: An International Journal which is published by Emerald Group Publishing Limited have organized with a view to develop appropriate concept to benchmark occupational health and safety performance in industrial setting so that dearth can be focused and possible strategies can be adopted to enhance the performance of an enterprise. They have made use of the Data Envelopment Analysis to measure the safety performance of the industries. To

calculate the technical efficiencies they have taken into consideration the input and output components of DEA. TE is treated as a barometer for safety performance of DMUs and collation has been made among them. For the present study 30 Indian organizations under 3 industrial categories such as construction, refractory and steel were selected for comparison purpose. It was seen that safety performance of construction industries was continuously low as compared to other classification of industries. TE was calculated on the basis of Constant Return to Scale (CRS) and Variable Return to Scale (VRS). TEs obtained with the help of 2 model was significantly different was indicated by the paired 2 sample t-test. Mean efficiency of 30 samples was observed as 0.898 under CRS and it was 0.942 under VRS.

Review of Literature: 49

Givanni Abramo, Tindaro Cicero, Ciriaco Andrea D'Angleo (2011)[29] the paper entitled "A field standardized to national-Scale research assessment of Universities" was based on an application of Data Envelopment Analysis Model to measure technical efficiency as well as allocated efficiency of university research activity. It was based on the bibliometric data. The study was done for the period of 5 years that was from 2004 to 2008. The input considered as a university research staff. It was classified according to academic rank and output was field standardized impact of the research product realized.

Review of Literature: 50

Gumus & Celikkol (2011)[74] they made the studies between 2005-2008 for measuring the performance of firms in Istanbul. They evaluated the effectiveness of data envelopment analysis to financial ratios. Their research found that the standard deviation of DEA efficiency has a statistically significant relationship with the standard deviation of fast ratios, net profit to sales, return on assets (ROA), and return of owners' equity (ROE), implying that DEA and financial ratios complement each other in liquidation ratios and profitability.

Review of Literature: 51

Dr. Sumninder Kaur Bawa and Miss Ruchita (2011)[57] conducted a research work entitle Efficiencies of health insurance business in India: An application of DEA. In order to measure the efficiency of companies many numbers of methods

have been developed and applied. Out of these the principal methods used in this research work was Data Envelopment Analysis (DEA) and Stochastic Frontier. This paper used DEA Model to evaluate the efficiencies of selected health insurance business of general insurance companies in India. For research purposes, ten general insurance companies in India, four of which are public sector, were chosen, and this study spans an eight-year period from 2002-03 to 2009-10. This study's input variables are equity capital and labor (including commissions, agents' fees, referrals, and other expenses), while the output variable is net premium. It was discovered that overall general insurers doing health insurance business had an average technical efficiency of 73%, pure technical efficiency of 92%, and scale efficiency of 78%. On the other hand, sector-specific performance research revealed that the technical efficiency of all private sector enterprises is 77%, which is 10% higher than that of public sector companies. It accomplishes that private sector companies were operating on increasing return to scale and taking the advantages of pure technical efficiency as well as scale efficiency.

Review of Literature: 52

Zhou Fengmin, Huiyuan & Hai Sun (2011)[80] conducted a research work entitle, "Efficiency Evaluation of Commercial Banks in China based on Rational Two-stage DEA Model". The study focused on 15 Chinese commercial banks. The study was conducted during a five-year period, from 2003 to 2007. The researchers discovered that state-owned banks had worse technical efficiency than joint stock banks, and that this inefficiency was influenced by the stage of capital management. Technical inefficiency in all banks was caused by scale inefficiency.

Review of Literature: 53

Cristian Barra & Roberto Zotti (2010)[14] the research paper entitled "Measuring Teaching and Research Efficiency in Higher Education DEA. A case study from the University of Salerno" conducted to measure efficiency, technical and scale of Science and Technology and Humanity and Social Science Sector. Study period was 2005-2009. According to Data Envelopment Analysis Model Science and Technology sector was more efficient in terms of research than Humanity and Social Science.

Review of Literature: 54

Edirisinghe and Zhang (2010)[16] in their research work entitle "Input/output selection in DEA under expert information, with application to financial markets" analyzed a study on fundamental analysis of business firms through the employment of periodical financial data to determine an optimized fundamental empowerment index based on the Data Envelopment Analysis method. Over 800 business organizations including a large part of the US Stock Market were employed to evaluate the Data Envelopment Analysis Model.

Review of Literature: 55

Ali Emrouznerjad & Emilyan Cabanda (2010)[4] conducted a research paper entitle, "An Aggregate Measure of Financial Ratio using a Multiplicative DEA Model. The purpose of this research paper was to evaluate performance of UK Industries by GNCP and MNCP. 27 UK industries were selected. Six variables were used for application of DEA Model.

Cash Position (Cash/Total Assets),

Liquidity (Current Assets/Current Liabilities),

Working Capital Position (Working Capital/Total Assets),

Leverage (Long term liability/Total Assets),

Profitability (Net Income/Total Assets),

Turnover (Sales/Total Assets)

Review of Literature: 56

Teresa Garcia, Eva & Daniel (2009)[67] research paper entitle, "Relating the perspectives of the balanced scorecard for R&D by means of DEA" was published in European Journal of Operational Research. The impartial of this article was to propose a framework for analysis of the relationships between the four perspectives of the balanced scorecard (BSC) of Kaplan and Norton. Data Envelopment Analysis (DEA) was used for analysis of data. Each of the variables has been extracted from a model of the BSC for research and development activities. A study has been carried out with 90 companies for year 2002 and 2004.

Review of Literature: 57

Jackson, Fethi and Inal (2009)[36] they have dispense research paper on "Data Envelopment Analysis for Performance Measurement of Bank Branches", in which they studied the efficiency and productivity growth in the Turkish banking system using DEA 80 based Malmqist TFP index. They explored the efficiency and productivity changes of each bank over the period from 1992-1996. Here to model the bank operations the value added model was used. The inputs used were total number of employees and non-labour operating expenses. The outputs used were Total loans, total demand deposits and total time deposits. The result proved that except during the financial crisis period of 1993-1994 foreign and private banks were more efficient than their state counterparts.

Review of Literature: 58

Akihiro Hashimoto & Shoko Haneda (2008)[2] this research paper entitled Measuring the efficiency of the Japanese pharmaceutical industry for this one input, research and development expenditure whereas three outputs patents, operating profit and pharmaceutical sales were selected for the study. 10 firms were selected for the study. For research work the study period was 1982 to 2001. This research paper conclude that firms have continued to increase research and development expenditure every year despite that research and development efficiency has not improved.

Review of Literature: 59

Zhao, Wang and Lai (2007)[79] in their research paper entitled "Evaluation of Mutual Funds based on Endogenous Benchmarks". They developed 2 second order Data Envelopment Analysis Model to evaluate the exposure of investment fund based on internal measurement. There were risks among the two key factors associated with the impact of investment fund in this study it was risk and productivity. This method was adopted in a sample of 25 investment funds which was active in the China market. The results of the study conclude that the ranking of investment funds was more related to risk management of the system than other factors.

Review of Literature: 60

Zhao and Wang (2007)[78] this paper assessed the performance of the investment fund which is active in China with the help of DEA model. The sample consists of 24 institutions with open investment and 54 institutions with closed investment in the year 2004 and 2005. The result showed that majority of the investment funds working in China are not efficient.

Review of Literature: 61

Fotis Pasiouras, Emmanouil Sifodaskalakis, Constantin Zopounidis (2007)[23] conducted a research paper entitled "Estimating and Analyzing the cost efficiency of Greek Co-operative Banks: An Application of Two-Stage Data Envelopment Analysis". In this paper Greek co-operative banks performance was analyzed. The study period was 2000-2004. 16 banks were selected as sample. They used Tobit-regression to determine the impact of internal and external factors on efficiency of bank. It concludes that Greek Co-Operative Bank could implement cost efficiency by 17.7%. The impact of capital branches and ATM depends on efficiency measure. GDP has negative and significant impact call measure unemployment rate has also a negative as well as significant impact on technical and cost efficiency but not on a allocated efficiency.

Review of Literature: 62

Mohammadi (2007)[49] He selected Medicine Companies for the research work. This paper conclude that Liquidity Ratio, Growth, Increase in Proportion of owners' equity, Operational Ratio and Inventory Ratio had highest significant in selected medicine companies.

Review of Literature: 63

Kao & Hwang (2006)[33] in their research paper applied a two-stage Data Envelopment Analysis model to evaluate the performance of Non-life Insurance Companies of Taiwan. They selected 24 non-life insurance companies of Taiwan and data collected for the years 2001 and 2002. The study revealed the activity of selected insurance firms into two sub-processes. The result of this research study reveals some unusual findings compared to the black box model. Particularly, none of the insurers

included in this study were found to have full efficiency in both the stages that is stage 1 and stage 2 of Data Envelopment Analysis Model.

Review of Literature: 64

Zijiang (2006)[75] used a two-stage data envelopment analysis model for evaluating the performance Canadian life and health (L&H) insurance industry. He made use of two separate models (production and investment) for the computation of efficiency (first stage) with both input and output orientations. In the next stage, a dummy input with value 1 was used and the production and (inverse of) investment efficiency scores were used as outputs. This methodology enables insurance companies to integrate their production and investment performance. The research demonstrated that the Canadian life and health insurance business performed efficiently over the time period under consideration.

Review of Literature: 65

Kimiagari and Farhad (2006)[21] the paper entitled "Development of a model to measure, evaluate and rank the financial performance of urban water and drainage companies" have introduced and analyzed many methods to evaluate performance of companies. Finally they have introduced a model with flexibility and comparability i.e. Data Envelopment Analysis Model.

Review of Literature: 66

Khajavi, SalimiFard and Rabiyesh (2005)[39] they undertook a study on "The employment of the data envelopment analysis for entertaining portfolios of highly efficient companies which were accepted in Tehran's Stock Market". CCR model with envelopment form was employed in the study. The study's findings revealed that of the 90 enterprises under examination (32%), 81 were deemed efficient, while the remaining 61 did not perform well.

Review of Literature: 67

Wen Cheng, Chin Feng and Ching Wu (2005)[72] This study aimed to design an efficient assessment for a shipping industry using financial indicators, because the major goal of this paper was to measure the operational efficiency of a shipping industry and highlight the status of operation performance. In this study, they apply a

data envelopment analysis methodology to assess the operational efficiency of 14 shipping enterprises. The empirical findings show that taking financial ratios into account can help with performance evaluation in the shipping business.

Review of Literature: 68

George Emm. Halkos & Dimitrios Salamouris (2004)[28] conducted a research paper entitled "Efficiency Measurement of the Greek Commercial Banks with the use of Financial Ratio: A DEA ApproachIt used the Data Envelopment Analysis approach to assess the performance of the Greek banking system. The study was conducted from 1997 to 1999. This study is based on input and output variables. It discovered that the larger the size of overall assets, the higher the efficiency. It also concludes that the number of small banks has decreased as a result of mergers and acquisitions, and that there is no consistent association between ownership and performance over the study period.

Review of Literature: 69

IslamiBidgoli and Kashani Poor (2004)[35] in a research paper entitle "Comparing and evaluating methods performance evaluation of bank branches and suggesting a suitable model" evaluate an efficiency of selected bank branches. They chose 142 Tejart Bank branches for their investigation and used triple data envelopment analysis, stochastic frontier approaches, and financial ratios. They classified 142 branches according to branch efficiency for each of the three approaches. The results show that among these three novel models, data envelopment analysis is best appropriate for measuring the efficiency of bank branches.

Review of Literature: 70

Panayiotis (2004)[24] in a research study entitled "Performance Evaluation of the Bond Mutual Funds Operating in Greece". It was based on DEA Model's performance evaluation. 39 Greek joint investment funds in financial markets were selected for the study between March 15, 1999 and December 31, 1999. 6 months. These investment funds were ranked differently based on their average return and overall risk.

Review of Literature: 71

Halkos and Salamouris (2004)[31] evaluated the performance of Greek banking sector and determined the efficiency of banking industry using data envelopment analysis and financial ratios. The research paper conclude that DEA can be used as both a substitute for and a supplement to traditional methods of financial analysis or performance evaluation of organizations.

Review of Literature: 72

Feroz, Kim and Raab (2003)[18] conducted a research work on titled "Financial Statement Analysis: A Data Envelopment Analysis Approach" studied financial statements of oil and gas industry by data envelopment analysis model. They tested the null hypothesis that there is no significant difference between DEA and traditional accounting ratio. This research work concludes that DEA functions as a reliable and stable basis for evaluation of managerial as well as operational efficiency of selected companies.

Review of Literature: 73

Haghighat and Nassiri (2003)[30] the research paper entitled "An investigation of banking system performance using Data Envelopment Analysis (A Case Study of Agricultural Bank)" was related to performance evaluation of Agricultural Companies based on the Data Envelopment Analysis Model. 172 Agricultural Bank branches were selected for the research work. Out of that some branches selected as inefficient units as per Data Envelopment Analysis Model.

Review of Literature: 74

Keung (2002)[64] examined a whether Data Envelopment Analysis based on risk return consideration can indomitable stock price which relative to bad stocks. In this research paper 4 industries were selected i.e. telecommunications, telecommunication equipment, hardware and software and computer services at the end of 1997 and 1998. It concludes that software industry had the lowest pricing efficiency while the telecommunications industry stood at a first position in case of efficiency.

Review of Literature: 75

Galagedera and Silvapulle (2002)[26] paper entitle "Australian Mutual Fund Performance Appraisal Using Data Envelopment Analysis" they measure the relative efficiency of investment funds in Australia. The researchers examined 257 investment funds for the study. They also used the Data Envelopment Analysis Model to determine how these funds' efficiency was influenced by their characteristics, management strategies, and operational environment. The efficiency of selected investment funds was assessed utilizing a variety of input and outcome parameters.

Review of Literature: 76

Basso and Funari (2001)[9] in a research study entitled "Theory and methodology a Date Envelopment Analysis approach to measure the mutual fund performance" established a model that can be used for performance evaluation of investment funds. This model works as a kind of operational research methodology it is known as Data Envelopment Analysis (DEA). In this method, many inputs and variables can be manipulated and, as a result it concludes that, it is possible to examine various risk measures. This study concludes that by using this process it is possible to define a mixed portfolio for each specific fund to be used as a specific benchmark for the investment fund.

Review of Literature: 77

Worthington (1998)[73] matched the performance of 30 selected gold generating companies with the help of Data Envelopment Analysis. The results of the study indicated that simple ratios are not useful in comparing and ranking the performance of the companies therefore, multiple input and output methods should be applied for performance evaluation.

Review of Literature: 78

Nagarajan and Bruthwal (1990)[10] in their research work titled "profitability and structure: A firm level study of Indian Pharmaceutical Industry" intensively examined the relationship between profitability and structure with the help of 38 pharmaceutical firms in between the period 1970- 1982. To determine profitability ratio of net profit to total sales revenue and the ratio of net profits to total assets have

been used. The coefficient of growth rate of sales was significant and favorable, suggesting that factors on the demand side of a firm had greater impact of profitability than on the supply side.

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