INTERNATIONAL JOURNAL OF RESEARCH IN COMMERCE & MANAGEMENT

IJRCM

A Monthly Double-Blind Peer Reviewed (Refereed/Juried) Open Access International e-Journal - Included in the International Serial Directories

Indexed & Listed at:

Ulrich's Periodicals Directory ©, ProQuest, U.S.A., EBSCO Publishing, U.S.A., Cabell's Directories of Publishing Opportunities, U.S.A.

as well as in Open J-Gage, India [link of the same is duly available at Inflibnet of University Grants Commission (U.G.C.)]

Registered & Listed at: Index Copernicus Publishers Panel, Poland & number of libraries all around the world.

Circulated all over the world & Google has verified that scholars of more than 1667 Cities in 145 countries/territories are visiting our journal on regular basis.

Ground Floor, Building No. 1041-C-1, Devi Bhawan Bazar, JAGADHRI – 135 003, Yamunanagar, Haryana, INDIA

www.ijrcm.org.in

CONTENTS

CALL FOR MANUSCRIPTS

We invite unpublished novel, original, empirical and high quality research work pertaining to recent developments & practices in the area of Computer, Business, Finance, Marketing, Human Resource Management, General Management, Banking, Insurance, Corporate Governance and emerging paradigms in allied subjects like Accounting Education; Accounting Information Systems; Accounting Theory & Practice; Auditing; Behavioral Accounting; Behavioral Economics; Corporate Finance; Cost Accounting; Econometrics; Economic Development; Economic History; Financial Institutions & Markets; Financial Services; Fiscal Policy; Government & Non Profit Accounting; Industrial Organization; International Economics & Trade; International Finance; Macro Economics; Micro Economics; Monetary Policy; Portfolio & Security Analysis; Public Policy Economics; Real Estate; Regional Economics; Tax Accounting; Advertising & Promotion Management; Business Education; Management Information Systems (MIS); Business Law, Public Responsibility & Ethics; Communication; Direct Marketing; E-Commerce; Global Business; Health Care Administration; Labor Relations & Human Resource Management; Marketing Research; Marketing Theory & Applications; Non-Profit Organizations; Office Administration/Management; Operations Research/Statistics; Organizational Behavior & Theory; Organizational Development; Production/Operations; Public Administration; Purchasing/Materials Management; Retailing; Sales/Selling; Services; Small Business Entrepreneurship; Strategic Management Policy; Technology/Innovation; Tourism, Hospitality & Leisure; Transportation/Physical Distribution; Algorithms; Artificial Intelligence; Compilers & Translation; Computer Aided Design (CAD); Computer Aided Manufacturing; Computer Graphics; Computer Organization & Architecture; Database Structures & Systems; Digital Logic; Discrete Structures; Internet; Management Information Systems; Modeling & Simulation; Multimedia; Neural Systems/Neural Networks; Numerical Analysis/Scientific Computing; Object Oriented Programming; Operating Systems; Programming Languages; Robotics; Symbolic & Formal Logic and Web Design. The above mentioned tracks are only indicative, and not exhaustive.

Anybody can submit the soft copy of his/her manuscript **anytime** in M.S. Word format after preparing the same as per our submission guidelines duly available on our website under the heading guidelines for submission, at the email address: **infoijrcm@gmail.com**.

GUIDELINES FOR SUBMISSION OF MANUSCRIPT

1. **COVERING LETTER FOR SUBMISSION:**

DATED: _____

THE EDITOR
IJRCM

Subject: **SUBMISSION OF MANUSCRIPT IN THE AREA OF .**

(e.g. Finance/Marketing/HRM/General Management/Economics/Psychology/Law/Computer/IT/Engineering/Mathematics/other, please specify)

DEAR SIR/MADAM

Please find my submission of manuscript entitled '_____' for possible publication in your journals.

I hereby affirm that the contents of this manuscript are original. Furthermore, it has neither been published elsewhere in any language fully or partly, nor is it under review for publication elsewhere.

I affirm that all the author (s) have seen and agreed to the submitted version of the manuscript and their inclusion of name (s) as co-author (s).

Also, if my/our manuscript is accepted, I/We agree to comply with the formalities as given on the website of the journal & you are free to publish our contribution in any of your journals.

NAME OF CORRESPONDING AUTHOR:
Designation:
Affiliation with full address, contact numbers & Pin Code:
Residential address with Pin Code:
Mobile Number (s):
Landline Number (s):
E-mail Address:
Alternate E-mail Address:

NOTES:

a) The whole manuscript is required to be in ***ONE MS WORD FILE*** only (pdf. version is liable to be rejected without any consideration), which will start from the covering letter, inside the manuscript.
b) The sender is required to mention the following in the **SUBJECT COLUMN** of the mail:
New Manuscript for Review in the area of (Finance/Marketing/HRM/General Management/Economics/Psychology/Law/Computer/IT/ Engineering/Mathematics/other, please specify)
c) There is no need to give any text in the body of mail, except the cases where the author wishes to give any specific message w.r.t. to the manuscript.
d) The total size of the file containing the manuscript is required to be below **500 KB**.
e) Abstract alone will not be considered for review, and the author is required to submit the complete manuscript in the first instance.
f) The journal gives acknowledgement w.r.t. the receipt of every email and in case of non-receipt of acknowledgment from the journal, w.r.t. the submission of manuscript, within two days of submission, the corresponding author is required to demand for the same by sending separate mail to the journal.

2. **MANUSCRIPT TITLE:** The title of the paper should be in a 12 point Calibri Font. It should be bold typed, centered and fully capitalised.

3. **AUTHOR NAME (S) & AFFILIATIONS:** The author (s) **full name**, **designation**, **affiliation** (s), **address**, **mobile/landline numbers**, and **email/alternate email address** should be in italic & 11-point Calibri Font. It must be centered underneath the title.

4. **ABSTRACT:** Abstract should be in fully italicized text, not exceeding 250 words. The abstract must be informative and explain the background, aims, methods, results & conclusion in a single para. Abbreviations must be mentioned in full.

5. **KEYWORDS:** Abstract must be followed by a list of keywords, subject to the maximum of five. These should be arranged in alphabetic order separated by commas and full stops at the end.

6. **MANUSCRIPT:** Manuscript must be in ***BRITISH ENGLISH*** prepared on a standard A4 size ***PORTRAIT SETTING PAPER***. It must be prepared on a single space and single column with 1" margin set for top, bottom, left and right. It should be typed in 8 point Calibri Font with page numbers at the bottom and centre of every page. It should be free from grammatical, spelling and punctuation errors and must be thoroughly edited.

7. **HEADINGS:** All the headings should be in a 10 point Calibri Font. These must be bold-faced, aligned left and fully capitalised. Leave a blank line before each heading.

8. **SUB-HEADINGS:** All the sub-headings should be in a 8 point Calibri Font. These must be bold-faced, aligned left and fully capitalised.

9. **MAIN TEXT:** The main text should follow the following sequence:

INTRODUCTION

REVIEW OF LITERATURE

NEED/IMPORTANCE OF THE STUDY

STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESES

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

CONCLUSIONS

SCOPE FOR FURTHER RESEARCH

ACKNOWLEDGMENTS

REFERENCES

APPENDIX/ANNEXURE

It should be in a 8 point Calibri Font, single spaced and justified. The manuscript should preferably not exceed ***5000 WORDS***.

10. **FIGURES & TABLES:** These should be simple, crystal clear, centered, separately numbered &self explained, and **titles must be above the table/figure**. **Sources of data should be mentioned below the table/figure**. It should be ensured that the tables/figures are referred to from the main text.

11. **EQUATIONS:**These should be consecutively numbered in parentheses, horizontally centered with equation number placed at the right.

12. **REFERENCES:** The list of all references should be alphabetically arranged. The author (s) should mention only the actually utilised references in the preparation of manuscript and they are supposed to follow **Harvard Style of Referencing**. The author (s) are supposed to follow the references as per the following:

- All works cited in the text (including sources for tables and figures) should be listed alphabetically.
- Use (**ed.**) for one editor, and (**ed.s)** for multiple editors.
- When listing two or more works by one author, use --- (20xx), such as after Kohl (1997), use --- (2001), etc, in chronologically ascending order.
- Indicate (opening and closing) page numbers for articles in journals and for chapters in books.
- The title of books and journals should be in italics. Double quotation marks are used for titles of journal articles, book chapters, dissertations, reports, working papers, unpublished material, etc.
- For titles in a language other than English, provide an English translation in parentheses.
- The location of endnotes within the text should be indicated by superscript numbers.

PLEASE USE THE FOLLOWING FOR STYLE AND PUNCTUATION IN REFERENCES:

BOOKS

- Bowersox, Donald J., Closs, David J., (1996), "Logistical Management." Tata McGraw, Hill, New Delhi.
- Hunker, H.L. and A.J. Wright (1963), "Factors of Industrial Location in Ohio" Ohio State University, Nigeria.

CONTRIBUTIONS TO BOOKS

- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

JOURNAL AND OTHER ARTICLES

- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

CONFERENCE PAPERS

- Garg, Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–22 June.

UNPUBLISHED DISSERTATIONS AND THESES

- Kumar S. (2011): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, Kurukshetra University, Kurukshetra.

ONLINE RESOURCES

- Always indicate the date that the source was accessed, as online resources are frequently updated or removed.

WEBSITES

- Garg, Bhavet (2011): Towards a New Natural Gas Policy, Political Weekly, Viewed on January 01, 2012 http://epw.in/user/viewabstract.jsp

AN INQUIRY INTO THE PRODUCTIVITY OF INDIAN PHARMACEUTICAL INDUSTRY: APPLICATION OF DATA ENVELOPMENT ANALYSIS

UMANG GUPTA
ACADEMIC ASSOCIATE
INDIAN INSTITUTE OF MANAGEMENT
INDORE

ROHIT KAPOOR
ASST. PROFESSOR
OPERATIONS MANAGEMENT AND QUANTITATIVE TECHNIQUES AREA
INDIAN INSTITUTE OF MANAGEMENT
INDORE

ABSTRACT

Pharmaceutical industry is an important and significant industry in India. The common practice by experts, would-be investors and stakeholders of a pharmaceutical firm is to observe the year-end or quarterly financial figures of a firm and then use them to assess firm's future growth and competitive standing against rivals. However, over the past few years, there is a strange environment in which paid consultants and scamstersare making false and conflicting claims about the performance and future growthof the companies. The researchers, however, by means of Data Envelopment Analysis (DEA) have attempted to get past all this by benchmarking the companies based on the conversion of input to outputs. The advantage of using DEA is that by simply using the figures from the financial reports, it brings a more rigorous quantitative analysis to make a comparison of the peers with the best virtual firm in their neighborhood. The technique itself may suggest measures for improvement. It is illustrated in the analysis by observing the slacks and targets about various companies from pharmaceutical sector i.e., decision making units (DMU).

KEYWORDS
DEA, input-output, Pharmaceutical.

1. INTRODUCTION

1.1 INDUSTRY PERSPECTIVE

The pharmaceutical industry has been one of the success stories of India. The reasons are many including; that good quality essential drugs are now available at affordable prices to the vast population of the country, which is not so affluent. The Indian pharmaceutical companies are also competing with some of the best names in the global markets. The industry is capital-intensive and intellectualin nature and is in the front rank of India's science-based industries. India's pharmaceutical industry is currently the 3rd largest in the world in terms of volume and 14th in terms of value. Reason for this lower value share lays in the fact that in India, the cost of drugs ranges from 5% to 50% less as compared to the developed countries. The March 2012 estimates peg sales from pharmaceuticals to go from 11 billion US$ currently to 74 billion US$ by 2020.the increasing population of the higher- income group in the country will open a potential $ 8 billion market by 2015*. Besides this, the report said that the domestic pharmaceutical market is likely to touch $20 billion by 2015, making India a lucrative destination for clinical trials for global giants.

The accelerated growth over the years has been fuelled by exports to more than 200 countries with a sizeable share in the advancedregulated markets of US and Western Europe. 40% of the world's active ingredient requirement is met by India.

Pharmaceutical industry in India ranks very high in terms of technology, quality and range of medicines manufactured. Many different medicine varieties are now made domestically by Indian industries. The industry has made significant progress in creation of required infrastructure, meeting global needs for supply of quality medicines and active pharmaceutical ingredients (APIs), as also entering into the highly opportune area of contract research and manufacturing (CRAM) and clinical trials. Export of pharmaceutical products from India showed a compounded annual growth rate (CAGR) of 21.25% during three consecutive years ending 2008-09 but grew only by 13% in 2009-10[1].

India tops the world in exporting generic medicines worth of $11 billion. According to a report published by PricewaterhouseCoopers (PwC) in April 2010, India will join the league of top 10 global pharmaceuticals markets in terms of sales by 2020 with the total value reaching $ 50 billion. The sector is estimated to have so far created 4.2 million employment opportunities with more than 20,000 registered units. Despite the fragmentation and price competition, the leading 250 pharmaceutical companies control 70% of the market with the leader holding nearly 7% of the market share. India currently exports drug intermediates, APIs, Finished Dosage Formulations (FDFs), bio- pharmaceuticals, clinical services to various parts of the world. High quality medicines at attractive prices can easily be found in India and because of this cost of medical treatment is low promoting medical tourism. Apart from all that an increase in demand of special drugs and the niche demand for Ayurvedic drugs is also expected to rise with the current union Tourism Minister Subodh Kant Sahai recently announcing desire to double the number of tourists by promoting medical and wellness tourism.

1.2 THREATS AND CHALLENGES

Competing pharmaceutical companies have several similar bio-equivalent products in the same market manufactured at facilities that have been approved by the highest regulatory authorities. All of them stay focused on the same markets resulting into price decrease (therefore price sensitivity is tested) and margins get eroded. The challenges are greater for those Indian manufacturers who have similar production facilities. It is also common to find managers with similar talents and experiences in the industry.

1.3 POLICY ATTRACTIVENESS

FDI up to 100% is permitted for the manufacture of drugs and pharmaceuticals with some restrictions[2].The Patents Act, 2005 (Amendment to The Patents Act, 1970), introduces product patent regime for food, chemical and pharmaceutical products and made it TRIPs compliant.It has helped in making the environment favorable for MNCs to operate in India.

Consolidation is likely in the fragmented Pharmaceutical industry due to recent legislation and policy updates. Good Manufacturing Practices (GMP) outlined in Schedule M to the Drugs and Cosmetics Rules are also being revised. Manufacturing units are required to comply with the WHO and international standards of production[3].

[1]Facts and figures correspond to as reported in annual reports of GlaxoSmithKline, Ranbaxy, Cipla.(2009-10, 2010-11) and Asia-Pacific Business & Technology report October 2011 and Corporate catalyst India 2012 report.

[2] provided the activity does not attract compulsory licensing or involve the use of recombinant DNA technology and specific cell/tissue targeted formulations

Given the perspectives, threats and challenges and policy attractiveness of pharmaceutical sector, it is worthwhile to study different companies and analyze them. This will help practicing managers and investors to benchmark companies. Within a firm also, decision makers will need some targets in terms of inputs and outputs, which are well-defined and set the pace and direction of their subsequent decisions.

2. OBJECTIVE

2.1 AN ATTEMPT TOEFFECTIVELY EVALUATETHE PHARMACEUTICAL SECTOR BY FOCUSING ON INPUT-OUTPUT RELATIONSHIP

The current available reports on pharmaceutical sector seem to be lacking in the focus on the input and output relationship of the companies that they study. However this is also an important parameter to judge success and failure of Pharmaceutical firms over the years (Mazumdar and Rajeev, 2009)[1].

2.2 ISSUES WITH CURRENT BENCHMARKING METHODS SUCH AS FINANCIAL MULTIPLES/RATIOS

The finance multiples/ratios approach is focused on taking performance of a firmon a particular date. There is a tendency to come up with better numbers so as to get preference of investors and stakeholders both inside and outside the firm. In the process many financial jargons may take shape and structure with layers and layers of falsified information. It results into confusion among the investors and they may not be able to take appropriate decisions. For the decision makers in the firms also, it is a challenge to get a well-defined target so that they can channelize their efforts operationally. DEA on the other hand finds out the performance level of the firm by converting inputs to outputs. The factors (both input and output) which make the firm efficient do get known in the process. This helps the decision makers in the in-efficient firms in setting the targets for their managers.

3. DATABASE AND FIRMS

3.1 FIRMS TO INCLUDE

The common practice followed while selecting firms was to see whether they had an overall market capitalization above the median for all the firms for whom the data was available. As per the records of Sectoral Companies on Economic Times intelligence group (ETIG)as on 25 Jun 2012 the firms which did not have a minimum market capitalization of 1000 crore rupees were rejected. Also firms which did not have records for financial year 2010-11 on Capitaline[4] were rejected.

3.2 FIGURES USED

The various inputs and output headings were taken from Capitaline database and Economic Times intelligence group report available online.

4. PERIOD OF STUDY

The data was collected for the period 2010-11 from the various data sources as mentioned above. The above period for the study was chosen as latest financial results for the year 2011-2012 are not available.

5. METHODOLOGY

5.1 DATA ENVELOPMENT ANALYSIS (DEA)

DEA is a linear programming technique that produces a best practices frontier composed of efficient DMUs. (Farrell 1957) [2] attempted to measure the production efficiency in a single input and output model. His work was further extended to multi input and output model by (Charnes, Cooper and Rhodes 1978) [3] who coined the term DEA. This technique involves use of linear programming to solve a set of inter-related problems to determine the relative efficiency of DMUs. Hence the first DEA model was developed by (Charnes, Cooper and Rhodes 1978)[3]. A DMU is efficient if there exists no other DMU or linear combination of DMUs that produces the same vector of output with a smaller vector of inputs (in the input-oriented model) or produces a larger vector of outputs with the same vector of inputs (in the output-oriented model).

DEA has several desirable features that make it preferable to other performance measurement techniques such as traditional ratio analysis and Stochastic Frontier Analysis. First, being non parametric in nature, DEA does not require the specification of an a priori, well-defined functional form for the particular production process being analyzed. This “flexibility” makes it particularly useful when it is impossible to determine the mode in which a set of resources (inputs) are employed in combination to realize a multiplicity of products (outputs). Second, DEA permits the simultaneous management of more than one input and output because of its capacity to maximize the relationship between a "virtual" output and a “virtual” input; appropriately weighted sums of the vectors of inputs and outputs typical of pharmaceutical activity. Third, depending on the particular model selected, DEA can distinguish technical inefficiency from scale and scope inefficiency, since each firm is compared to a peer group homogeneous in terms of size and product mix. DEA has proven to be a popular technique for performance analysis in general. (Charnes, Cooper and Rhodes 1978)[3]define efficiency by reference to the orientation selected: (i) output orientated model, a DMU is not efficient if we canchange outputs without increasing inputs or decreasing any other output; and (ii) input orientated model, a DMU is inefficient when we can decrease inputs without increasing other inputs and without decreasing any output. The pharmaceutical sector, in this regard, has a series of characteristics that make it particularly suitable for study through DEA: Its multi-input and multi-output nature, the non-linearity of its input-output relationships, the non-physical nature of some fundamental resources and products, and the impossibility of drawing on market prices for some of them. (Charnes, Cooper and Rhodes CCR 1978)[3]suggested an input oriented model under the assumption of constant returns to scale. Let us take N DMUs (Decision making units) whose efficiency has to be compared. Let kth be the reference DMU and its efficiency can be found by solving the following CCR model (Charnes and Cooper 1962), (Charnes et.al 1978), (Coelli 1996)[4][3][5]:

$$Max\ z = \sum_{r \in s} u_{rk} * y_r;$$

Subject to;

$$\sum_{i \in m} v_{ik} * x_i = 1;$$

$$\sum_{r \in s} u_r * y_{rj} - \sum_{i \in m} v_i * x_{ij} \leq 0;\ for\ every\ j$$

$$u_r, v_j \geq 0\ , for\ every\ r, i$$

This model aims at deriving the values of the weights i.e. v_i and u_r(res being the total number of outputs)i.e. the input and output weights of the n DMUs in such a manner so that the efficiency of the k^{th} DMU is maximized subject to the condition that the efficiency measure for other DMUs with same weights are less than or equal to one.

If the efficiency score comes out to be 1, then the firm is said to be efficient and lies on the efficiency frontier. Otherwise the firm is relatively inefficient. In order to find the efficiency score for other firms, such mathematical model has to be formulated separately for each firm. (Banker, Charnes and Cooper 1984)[6] proposed that this basic CRS model can be extended to variable returns to scale i.e. VRS model by adding the convexity constraint to it as shown below where the convexity constraint variable in unrestricted and declared free of the non-negativity constraint.

$$Max\ z = \sum_{r \in s} u_{rk} * y_r + u_o;$$

[3] The TRIPS agreement of the WTO is also noteworthy of being mentioned here as the Doha declaration 2001,President's Emergency Plan for AIDS Relief (PEPFAR) 2003, and subsequent revisions of the agreement have led to changes in the role patents played in maintaining high drug costs, export of drugs and drugs for dealing with public health crisis.

[4]http://www.capitaline.com is a reputed online database.

Subject to;

$$\sum_{i\in m} v_{ik} * x_i = 1;$$

$$\sum_{r\in s} u_r * y_{rj} - \sum_{i\in m} v_i * x_{ij} + u_o \leq 0; for\ every\ j$$

$$u_r, v_j \geq 0\ , for\ every\ r, i.\ u_o\ is\ unrestircted$$

This paper uses the BCC VRS model to analyze the performance of Indian Pharmaceutical Firms.Building on the ideas of (Farrell 1957)[2],here (Charnes, Cooper & Rhodes 1978)[3] applies linear programming to estimate an empirical production technology frontier for the first time

5.2 INPUTS AND OUTPUTS

We are using the following Outputs and Inputs for comparing different firms:

Outputs	Inputs
Sales Turnover	Employee Cost
Excise Duty	Other Manufacturing Expenses
Net Sales	Selling & Administration Expenses
Other Income	Miscellaneous Expenses

6. EMPIRICAL ANALYSIS

There is an attempt here to analyze the relative efficiencies of the top pharmaceutical companies of India for the year 2010-11. The below are the findings of the empirical analysis where we have used the BCC VRS DEA model with multi stage calculation of slacks.

6.1 EFFICIENCY SUMMARY

The findings of the data envelopment analysis given in Exhibit 1 suggest that there are 14 and 19 firms out of the 26 selected which are lying on the efficient frontier and have the optimal utilization of resources by the constant returns to scale and variable returns to scale efficiencies respectively. This means that under the more realistic assumption of VRS, 5 firms which had CRS inefficiencies shifted on the efficient frontier. We can also observe the scale efficiencies. From the research of the literature done by prior investigators we know that a unit is scale efficient when any change in its size of operations will lead to undesirable change in its efficiency. The scale efficiency can be estimated from the CRS efficiency by dividing it with the VRS efficiency. The closer the firm is to 1 i.e. the highest permissible efficiency the lesser is the scope for improvement by changes in the scale of the operations of the firm. Hence the firm must improve its technical efficiency in order to improve its overall VRS efficiency. Technical efficiency can be improved by a review of the technology which the supposed virtual firm is using and how far can we go to adopt the technology which the firms constituting the virtual firm are using. Dual scores given by DEA also guides us to understand how much of each firms contribution to technology we can consider which means that it will give the managers direction to understand how much of each firm to study and try to match its new implementation with the peer firm. Peer firms have been explained in more detail in section 6.3 .from Exhibit 2 the dual scores are available for the inefficient firms upon solving the DEA linear program.Attention Directing has been attempted in the paper when DEA solutions are intended as a guide to managerial action (e.g. goal setting) or policy making, it is important to recognize that the calculated improvements in input and/or outputs are indicative of potential performance increases by DMU,s located below the efficient frontiers. In a sense, the DMU-specific solutions should be used as an attention directing device.

6.2 SUMMARY OFINPUT TARGETS

The Exhibit 2 has the changed and suggested levels for Inputs. The decision makers of the firm can take the input targets as suggestions to scale up or scale down there specific size. This can help the firm get closer to amaximum permissible scale efficiency of 1. This is because although these are very similar firms but still they operate on different technologies but nevertheless they provide a starting point and give basic idea for the direction and extent of change required to achieve operational efficiency.

6.3 SUMMARY OF PEERS

According to the DEA technique it is possible for a pharmaceutical firm (DMU) to become efficient if it achieves exceptionally better results in terms of one output but performs below average in terms of other outputs. An easy way to test these kinds of efficient units is by identifying the peers for inefficient units. As per the understanding of the researchers the term peers is used in the context that if the inefficient DMU was to scale up or scale down its inputs according to the suggestions then it can come in the vicinity of the virtual firm and hence be considered “an equal” or a “peer” to the constituent firms in its neighborhood. If the unit is genuinely efficient it is expected, that there are some inefficient units in its vicinity so that it is considered a peer for these inefficient units. However if the unit is not a peer for any efficient unit its best performance is questionable. See Exhibit 3.

6.4 DISCUSSIONS AND CONCLUSION

The efficiencies of the companies that we have tried to compare and contrast in this paper present interesting facts. The DMUs that are performing well show inefficiencies and the not so well performing DMUs show higher inefficiencies which can be attributed to the fact that efficiencies change over time (SrinivasTalluri 2000)[7].By “doing well”the researchers mean in terms of performance against competitors in their respective markets(i.e., market capitalization) and not in the conversion of inputs to outputs which DEA is concerned with. This is attributable in part to the fact that a firm’s performance is governed by both the interactions with micro and macro environment and also on the relationship that it develops with its supply chain partners. This fact is key to a good performance as the recent news report highlight the importance of marketing representatives influence on the drugs which are prescribed by the doctors.

There is also evidence both from the analysis and outside sources which suggest that the benefits of technological improvement are decreasing. (Boldrin and Levin 2005)[8]Suggest that the technology operated by the pharmaceutical industry – the manufacturing method, used to make the medicines and provide them to ultimate consumer; meet the conditions of constant returns to scale. That is, the cost of the hundredthbatch of medicine is about the same as that of the first. So the old assumption that a new technology platform for testing drugs will simplify the process and bring long-term benefits to the pharmaceutical industry has now lost its validity. Hence the policy suggestions that would help the industry to gain global dominance are that apart from the FDI cap removal it can give tax benefits on R&D because the benefits from that are decreasing. Exports need to be stressed more.

The analysis can also be used by investors and venture capitalists and the like to select which firms to invest in.

7. SCOPE FOR FURTHER RESEARCH

7.1 ALTERNATIVE METHODOLOGY AND SELECTION OF FIRMS

The alternative approach could have been to select firms that are in the same risk class of the top firms. But in that case it would have been hard to find out firms as that will require a thorough analysis of the firms fundamentals to come up if they can be put in the same risk buckets or not.

7.2 ACCOUNTING FIGURES AND PRACTICES

The researchers have tries as far as possible to maintain similarity of the figures used. All facts were taken from recognized authentic sources. However for thelack of uniform measurements e.g. Financial year ending in March for some and December for others) and different accounting assumptions taken there would be some acceptable deviation from the actual figure. However as our technique does not take into account the production function used to convert inputs into outputs the effects of variations are reduced as more than half companies are from bulk pharmaceutical companies sector or the mass generic drugs sector of India.

7.3 ALTERNATIVE FORMULATIONS OF DEA

The formulation used by the researchers is a well-recognized and time tested. There are certain variables we have not looked at. A solution for that is to complement the current analysis with a model to take in consideration returns to scale and uncertainty.

8. EXHIBITS

EXHIBIT 1

S. No.	Name of the Firm	CRSTE	VRSTE	SE
1	Sun Pharmaceuticals Industries Ltd	1	1	1
2	DrReddys Laboratories Ltd	0.543	1	0.543
3	Cipla Ltd	0.85	1	0.85
4	Ranbaxy Laboratories Ltd	0.602	1	0.602
5	GlaxosmithklinePharma Ltd	1	1	1
6	Cadila Healthcare Ltd	0.511	0.631	0.809
7	Divis Laboratories Ltd	1	1	1
8	Wockhardt Ltd	1	1	1
9	Glenmark Pharmaceuticals Ltd	0.68	0.708	0.961
10	Piramal Healthcare Ltd	1	1	1
11	Torrent Pharmaceuticals Ltd	0.59	0.671	0.879
12	Sanofi India Ltd	0.719	0.767	0.937
13	AstrazenecaPharma India Ltd	1	1	1
14	Strides Arcolab Ltd	1	1	1
15	Pfizer Ltd	0.847	1	0.847
16	AurobindoPharma Ltd	1	1	1
17	Abbott India Ltd	1	1	1
18	Jubilant Life Sciences Ltd	1	1	1
19	Novartis India Ltd	0.439	0.542	0.81
20	Wyeth Ltd	1	1	1
21	FDC Ltd	0.689	0.839	0.821
22	Plethico Pharmaceuticals Ltd	1	1	1
23	Unichem Laboratories Ltd	1	1	1
24	Claris Lifesciences Ltd	1	1	1
25	NatcoPharma Ltd	0.479	1	0.479
26	Alembic Pharmaceuticals Ltd	0.872	0.931	0.937

Note:
CRSTE = TECHNICAL EFFICIENCY FROM CRS DEA
VRSTE = TECHNICAL EFFICIENCY FROM VRS DEA
SCALE = SCALE EFFICIENCY = CRSTE/VRSTE'

EXHIBIT 2

	Sun Pharma.	GlaxoSmith.P	PiramalHC	Abbott (I)	Jubilant Lif
CadilaHealt	325.96	70.57	23.12	248.55	9.97
Employee Cost[5]	80.11	20.08	5.89	78.43	3.79
Other Manufacturing Expenses	41.55	5.35	1.63	5.51	3.14
Selling and Administration Expenses	194.92	19.90	10.43	146.46	2.99
Miscellaneous Expenses	9.39	25.23	5.17	18.15	0.05

	Divi's Lab	Piramal HC	Strides Arco	Abbott (I)
GlenmarkPha	75.39	45.20	48.27	187.41
Employee Cost	26.90	11.52	15.21	59.14
Other Manufacturing Expenses	13.84	3.18	4.79	4.15
Selling and Administration Expenses	29.30	20.39	24.64	110.43
Miscellaneous Expenses	5.36	10.11	3.64	13.69

	Sun Pharma.	GlaxoSmith.P	Divi's Lab	Wockhardt	Abbott (I)
Torrent Phar	145.51	40.88	92.42	20.25	182.38
Employee Cost	35.76	11.63	32.97	3.78	57.55
Other Manufacturing Expenses	18.55	3.1	16.96	0.83	4.04
Selling and Administration Expenses	87.01	11.53	35.92	5.23	107.46
Miscellaneous Expenses	4.19	14.62	6.57	10.4	13.32

[5]The target employee cost contribution from Sun Pharma (efficient firm) for Cadila (inefficient firm) was obtained by multiplying the dual score from solution of the VRS DEA linear program. The same was for the other efficient firms in the vicinity of inefficient firm and the gross input target for employee cost for the inefficient firm or in another understanding the virtual firm can be obtained by summing up the employee cost row. The same has been done for all firms and all other output targets respectively.

	GlaxoSmith.P	Piramal	Abbott	Jubilant	Wyeth	PlethicoPhrm
Sanofi India	28.73	6.35	153.09	82.98	89.49	5.48
Employee Cost	8.17	1.62	48.31	31.55	25.29	4.74
Other Manufacturing Expenses	2.18	0.45	3.39	26.14	5.54	0.11
Selling and Administration Expenses	8.1	2.86	90.21	24.84	55.98	0.52
Miscellaneous Expenses	10.27	1.42	11.18	0.45	2.69	0.12

	Divi's Lab	PiramalHC	Strides Arco	NatcoPharma
Novartis (I)	45.61	1.16	73.49	46.25
Employee Cost	16.27	0.30	23.15	17.14
Other Manufacturing Expenses	8.37	0.08	7.29	9.68
Selling and Administration Expenses	17.73	0.52	37.51	15.42
Miscellaneous Expenses	3.24	0.26	5.54	4.01

	Strides Arco	Jubilant Lif	Wyeth	PlethicoPhr	NatcoPharma
FDC	87.16	29.50	18.48	17.75	32.43
Employee Cost	27.45	11.22	5.22	15.35	12.02
Other Manufacturing Expenses	8.65	9.29	1.14	0.35	6.79
Selling and Administration Expenses	44.48	8.83	11.56	1.67	10.81
Miscellaneous Expenses	6.57	0.16	0.56	0.37	2.81

	Sun Pharma.	Wyeth	Unichem Lab
Alembic Pharma	167.88	133.99	34.40
Employee Cost	41.26	37.86	9.48
Other Manufacturing Expenses	21.40	8.29	2.49
Selling and Administration Expenses	100.39	83.81	22.23
Miscellaneous Expenses	4.83	4.03	0.21

EXHIBIT 3

Firm	Peers					
Cadila Health	Sun Pharma.	GlaxoSmith.P	Piramal HC	Abbott (I)	Jubilant Lif	
GlenmarkPha	Divi's Lab	Piramal HC	Strides Arco	Abbott (I)		
Torrent Phar	Sun Pharma.	GlaxoSmith.P	Divi's Lab	Wockhardt	Abbott (I)	
Sanofi India	GlaxoSmith.P	Piramal HC	Abbott (I)	Jubilant Lif	Wyeth	PlethicoPhr
Novartis (I)	Divi's Lab	Piramal HC	Strides Arco	NatcoPharma		
FDC	Strides Arco	Jubilant Lif	Wyeth	PlethicoPhr	NatcoPharma	
Alembic Phar	Sun Pharma.	Wyeth	Unichem Lab			

EXHIBIT 4

Firm	Employee Cost	Other ManufacturingExpenses	Selling and Administration Expenses	Miscellaneous Expenses
Sun Pharma.	207.5	107.61	504.87	24.31
Dr.Reddy's	700.6	271.4	1,252.30	96.7
Cipla	445.6	538.84	913.03	120.44
Ranbaxy Lab.	859.2	313.08	2,716.96	3,838.53
GlaxoSmith.P	279.48	74.5	277.03	351.22
CadilaHealt	335.7	90.6	752.1	91.9
Divi's Lab	80.48	41.4	87.68	16.03
Wockhardt	154.31	34.08	213.51	424.58
GlenmarkPha	143.1	32.21	338.85	60.75
Piramal HC	144.92	40	256.55	127.12
Torrent Phar	211.08	64.78	368.19	73.14
Sanofi India	173.74	49.28	237.88	34.05
Astrazen.Ph.	148.15	9.17	142.79	7.06
Strides Arco	50.11	15.79	81.19	12
Pfizer	224.41	65.95	261.17	37.57
AurobindoPh	300.13	257.3	210.85	51.01
Abbott (I)	163.56	11.49	305.43	37.86
Jubilant Lif	173.18	143.5	136.33	2.45
Novartis (I)	104.89	46.97	131.32	28.44
Wyeth	54.46	11.93	120.56	5.79
FDC	84.9	31.24	92.16	23.17
PlethicoPhr	267.27	6.05	29.11	6.48
Unichem Lab	89.44	23.49	209.76	1.96
Claris Life	40.48	26.33	95.79	9.85
NatcoPharma	51.34	28.99	46.2	12.02
Alembic Phar	141.48	34.57	231.72	9.74

The Input data for chosen firms from our secondary data sources

EXHIBIT 5

Firm	Sales Turnover	Excise Duty	Net Sales	Other Income
Sun Pharma.	3,157.36	52.66	3,104.70	194.76
Dr.Reddy's	5,340.10	97.3	5,242.80	119.6
Cipla	6,183.87	48.71	6,135.16	298.72
Ranbaxy Lab.	7,609.23	19.05	7,590.18	446.2
GlaxoSmith.P	2,391.73	53.7	2,338.03	199.21
CadilaHealt	2,211.30	35.1	2,176.20	801.8
Divi's Lab	1,319.49	14.05	1,305.44	38.6
Wockhardt	1,740.85	3.98	1,736.87	85.13
GlenmarkPha	1,212.25	10.9	1,201.35	81.14
Piramal HC	827.02	12.58	814.44	16,895.93
Torrent Phar	1,747.41	3.27	1,744.14	66.47
Sanofi India	1,258.61	28.86	1,229.75	227.19
Astrazen.Ph.	605.34	11.83	593.51	6
Strides Arco	714.32	4.81	709.51	119.57
Pfizer	1,215.01	45.45	1,169.56	175.79
AurobindoPh	4,179.57	96.87	4,082.70	107.44
Abbott (I)	1,536.93	18.18	1,518.75	51.24
Jubilant Lif	2,277.70	76.81	2,200.89	29.58
Novartis (I)	710.07	1.66	708.41	100.59
Wyeth	653.03	16.55	636.48	23.12
FDC	707.1	10.79	696.31	31.89
PlethicoPhr	412.94	5.74	407.2	84.26
Unichem Lab	766.29	5.48	760.81	11.89
Claris Life	658.92	9.25	649.67	17.64
NatcoPharma	349.97	5.4	344.57	8.96
Alembic Phar	1,154.75	14.3	1,140.45	21.62

The Output data for chosen firms from our secondary data sources

9. ACKNOWLEDGEMENT

The authors are grateful to Professor Dipayan Datta Chaudhuri of Indian Institute of Management, Indore for his comments.

10. LIST OF REFERENCES

1. Majumdar SK,."Assessing firms capabilities—theory and measurement—a study of Indian pharmaceutical industry". Economic and Political review 1994; 2:89.
2. Farrell, M.J, 1957, "The measurement of productive efficiency", Journal of Royal StatisticalSociety A 120, 253-281.
3. Charnes, A., Cooper, W.W. and Rhodes, E., "Measuring the efficiency of decision-makingunits", European Journal of Operations Research, Vol. 2, 1978, pp. 429-44.
4. Charnes, A. and W.W. Cooper, 1962, Programming with linear fractional functionals, Naval Research Logistics Quarterly 9, 181-185.
5. Tim Coelli, "A guide to DEAP version 2.1: A data envelopment analysis computer program". CEPA working paper 96/08.
6. Banker, R., A. Charnes and W.W. Cooper, 1984, Some models for estimating technical and scale inefficiencies in data envelopment analysis, Management Science 30, 1078-1092.
7. SrinivasTalluri: Data Envelopment Analysis: Models and Extensions Data Envelopment Analysis. Decision Line, May 2000.
8. Boldrin& Levine: Against Intellectual Monopoly, Chapter 9 Nov 2005.

REQUEST FOR FEEDBACK

Dear Readers

At the very outset, International Journal of Research in Commerce and Management (IJRCM) acknowledges & appreciates your efforts in showing interest in our present issue under your kind perusal.

I would like to request you to supply your critical comments and suggestions about the material published in this issue as well as on the journal as a whole, on our E-mail i.e. **infoijrcm@gmail.com** for further improvements in the interest of research.

If you have any queries please feel free to contact us on our E-mail **infoijrcm@gmail.com**.

I am sure that your feedback and deliberations would make future issues better – a result of our joint effort.

Looking forward an appropriate consideration.

With sincere regards

Thanking you profoundly

Academically yours

Sd/-

Co-ordinator

ABOUT THE JOURNAL

In this age of Commerce, Economics, Computer, I.T. & Management and cut throat competition, a group of intellectuals felt the need to have some platform, where young and budding managers and academicians could express their views and discuss the problems among their peers. This journal was conceived with this noble intention in view. This journal has been introduced to give an opportunity for expressing refined and innovative ideas in this field. It is our humble endeavour to provide a springboard to the upcoming specialists and give a chance to know about the latest in the sphere of research and knowledge. We have taken a small step and we hope that with the active co-operation of like-minded scholars, we shall be able to serve the society with our humble efforts.

Our Other Journals