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Assessing Firm Performance using Data Envelopment Analysis Technique: a Study of Firms in India

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ABSTRACT

This study is an attempt to assess performance of firms pursuing two different business strategies namely, focus and diversification. 36 firms were selected on a random basis for the study. Of these 18 were pursuing focus strategy and the remaining diversification strategy. Firms pursuing these strategies were further categorized as small (INR<5 billion), medium (INR 5-10 billion) and large (INR >10 billion). The three measures considered for analysis were total sales, total expenses and profit after tax. Data envelopment analysis (DEA) technique was employed to analyze data and assess firm performance. Data were collected for two points in time, financial year 2002-03 and 2013-14 to observe performance of focused as well as diversified firms factoring in size. It was observed that based on size small firms performed the best; on the criterion of strategy diversified firms fared better. Lack of panel data, which prevented longitudinal investigation and small sample size were major limitations of the study.

Keywords: *Firm Performance, Diversification, Data Envelopment Analysis*

INTRODUCTION

Modern firms get financial support from a wide section of society, particularly retail investors, who invest in a firm through its initial public offering (IPO) or purchase its debentures. Whether it be individual shareholder, domestic financial institutions, foreign institutional investors or others, all expect an attractive return on investment primarily through receipt of dividends and appreciation in stock prices. Management of firms on their part are aware that they have to conduct their business to earn sufficient profits to satisfy the needs of investors and of course meet all expenses.

Firms have the choice to remain focused on a particular line of business to generate sales and profit volumes. Some firms manage to do so, while others prefer to enter multiple lines of business to earn higher returns. The strategy of being focused has its advantages of being close to customers, understanding business dynamics and thereby develop core competencies and becoming a preferred brand of customers. One has only to look at focused firms like Toyota Motors, Wal-Mart or Nestlé. At the same time there are firms that have diversified into several businesses to benefit from entering high growth businesses, seeking opportunity in new businesses and spreading business risk. GE, Google and Berkshire Hathaway are firms that have diversified successfully either through green-field or brown-field initiatives.

Besides the issue of focus versus diversification, there is also the aspect of size to be considered. Firms may remain small or grow large and in both situations register high ROI (return on investment) and EVA (economic value added). The converse is also true. Generally large firms cover a vast area for its operations and also serve plenty of customers. It is normally perceived that a diversified firm is engaged in unrelated businesses. This need not be the case always. The concept and practice of core competency has taken firms into multiple businesses even while maintaining a clear set of capabilities. Honda Motors is a case in point of a firm getting into businesses as diverse as motorized two wheelers, passenger cars, generator sets, marine engines, etc., with well entrenched underlying competencies in engine technologies.

Therefore, we found it necessary to study and assess firms in terms of their business strategy (focus versus diversity) as well as size and link these to their economic performance.

Review of Literature

Diversification and Firm Performance

The linkage between diversification and performance has been the subject of numerous studies over the years. These studies can be categorized into three groups. One set of studies have indicated negative relationship (Bettis, 1981; Rumelt, 1974, 1982; Palepu, 1985; Varadrajan, 1986; Varadarajan and Ramanujan, 1987). While another set of studies done by Lubatkin (1987), Micheal and Shaked (1984), and Weston and Mansinghka (1971) have shown positive relationship between diversification and performance. A third set of research have revealed lack of relationship between these variables (Grant et al., 1988).

An important strand of research has focused on firm profitability leading to diversification. Such studies have put forth arguments that profitable firms tend to diversify and consequently such firms are likely to maintain their profit making capability post diversification as well. Grant et al., (1988) suggest that high profits from existing business can be used to finance diversification. They conclude that profitability induces diversification rather than diversification resulting in higher profitability. Second, firms with higher profitability would find it easier to expand compared to its competitors. However a saturation point comes after which any increase in market share may not lead to a corresponding increase in profitability. On the contrary, rather, it reduces it. Hence, it becomes imperative for the firm to diversify. Besides, the erstwhile Monopolies and Restrictive Trade Practices Act (popularly known as MRTP) in India never allowed a firm to grow sufficiently big to have monopolistic power. Hence even in that case, the firms were left with no choice but to diversify.

Third, highly profitable firms are usually the first movers into less developed countries. Evidences from highly successful companies in the west suggests that when they find the market in the home country is saturated or has reached a level of near saturation, they quickly identify a foreign market and suitably modify the product to suit the local conditions. Fourth, due to the core competency, which a firm would have developed in its pursuit of excellence, it would like to diversify into related areas or related industry. Chandler (1962) suggests that firms considering diversification will likely choose to diversify on related basis rather than on an unrelated basis. Rumelt (1974) likewise found that related diversifiers outperformed firms diversifying into unrelated areas.

A related strand of research points out that diversification results in improved performance. The argument is that firms when they decide to diversify, select those area or industry where returns would be definitely higher than those earned currently. Hence when diversified, the overall profitability would go up. In accordance with this view Grant et al. (1988) offer supporting evidence by arguing that low prospects of future profitability in existing activities might be expected to create incentives for diversification. Likewise, Burgelman (1983) argues that diversification may lead to increased performance. When prospects looked not so good, top management seemed to be ready, to jump into just anything. This attitude indicates the general assumption that diversification will lead to better performance.

Second, diversification provides synergy benefits to the firm. The major areas of synergy are marketing, operational and financial. This would lead to exploring economies of scale and thereby reduction of overall cost. However, the level of synergy derived would depend upon the nature of industry, nature of integration (horizontal, vertical) etc. Studies by Rumelt (1974, 1982) suggest that the firms going for related diversification derive more synergy benefit than the ones opting for unrelated diversification. However Hall (1995) found that it's difficult to determine which diversification strategy will result in maximum improvement in performance.

Third, diversified firms are in a better position to handle internal resources. This results in optimum utilization of factors of production, which in turn enhances operational efficiencies. This is directly reflected in higher profitability (Alchian and Demsetz, 1972). The level of management information system (MIS) generated would also be superior to the firms less diversified. Hence, this further contributes to working efficiency (Williamson, 1981). When it comes to management of finance, a diversified firm is in a much better position to efficiently deploy the available funds within its business units. Put together these factors result in pulling the overall profitability of the firm

northwards. Fourth, benefit drawn from diversification is separation of strategic and operation controls within the organization. This results in better management of specific business units. This also results in insulation of top executives from agency problems (Williamson, 1979, 1981).

However, some studies have come up with contradictory findings. The logic behind these findings is that firms experiencing superior profitability may not desire to engage in diversification, since such a strategy would require a large amount of capital. This would put additional pressures on the business and eventually may lower the performance. This view has been advocated by studies of Burgelman (1983). He argues that firms with higher levels of profitability may choose to focus on maintaining their current performance rather than seeking to increase profits through diversification. In summarizing his research, he stated, when things were going well in the main stream areas of business, only lip service was paid to diversification. Hall (1995) found that profitability does not play an important role in deciding whether a firm will go for diversification or not.

Regardless of how diversification is measured, as relatedness (Rumelt, 1974) or in terms of level of diversification (Jacquemin and Berry, 1979; Palepu, 1985, Raghunathan, 1995), the corporate diversification literature has failed to reach consensus between diversification and firm performance. In spite of great volume of research on diversification not all issues of diversification have been fully investigated. This is so because all these studies have tried to look the issue only from a single dimension.

Size and Firm Performance

Several studies have been conducted to determine the relationship between firm size and performance. Jim Lee (2009) in his paper examined the determinants of firm performance and, in particular, the role that firm size plays in profitability. A fixed-effects dynamic panel data model for over 7,000 US publicly-held firms during the period 1987–2006 provided evidence that profit rates are positively correlated with firm size in a non-linear manner, holding an array of firm- and industry-specific characteristics constant.

Mesut Dogan (2013) investigated the effect of firm size on profitability. In this study, data of 200 companies which were active in Istanbul Stock Exchange (ISE) between the years 2008-2011 were used. Return on Asset (ROA) was used as indicator of firm profitability and total assets, total sales and number of employees have been used as indicators of size. Multiple regression and correlation methods were used in empirical analyses. The result of analysis indicated a positive relation between size indicators and profitability of firms.

Anna Matras-Bolibok's (2014) paper aimed at the evaluation of the impact of firm's size on innovative performance especially during the 2008 global economic crisis, based on the results of the analysis conducted for Polish industrial enterprises. The results of the analysis indicated that larger enterprises achieved better results of innovative activity. The analysis showed that the uncertainty caused by the global economic crisis affected adversely the innovative performance of each size class of enterprises. However, larger enterprises proved relatively more resistant to economic turbulences.

In our study we compare the performance of single business firms with multi-business firms operating in India. We brought in another dimension of size to examine whether firm size has any impact on the performance of focused or diversified firms.

Data Envelopment Analysis – Concept and Application

It is an established fact that one way of measuring performance of a process is by calculating its efficiency (Debreu, G.1951; Koopmans, T. C. 1951; Farrell, 1957). Efficiency is measured as ratio of output to input. If each unit of input is converted into desired output, the efficiency is 100%, else it indicates that part of input was wasted. The waste or inability to convert every unit of input to output is inherent to any process and it depends on technology, skills of personsemployed or on the very nature of the overall process. For many years, attempts were made to capture the relationship between output and inputs *(Cobb, C. W. & Douglas, P. H. 1928;Silberberg et al., 2001).*Where inputs include appropriate raw materials, working conditions or any other setup. These combinations are expressed as production function, and output is predicted as a combination of inputs. It is possible to compare two or more processes using these production functions and identify the best among the lot. This identification helps in improving the other processes, which are relatively inefficient.

Whenever any mixture of inputs or setups have given better results, they have been used as benchmarks and replicated everywhere (Chranes et al, 1978). This logic is extended to compare two or more firms or economies.

Since the 80s two popular approaches have been used to compare the performances of firms (TaptukEmreErkoc,2001; Hjalmarsson et al, 1996). They are stochastic frontier analysis (SFA) based on econometrics and data envelopment analysis (DEA) based on linear programming. The application of DEA is straight forward but lacks the capability to separate the fluctuations arising from external shocks in calculating efficiency. In spite of this draw back DEA has found wide applications across fields of study. DEA is used extensively in finance research as well (Gonzalo Rodriguez-Perez et al, 2011).

DEA is basically a ratio based approach used to measure the relative efficiency of a homogeneous set of firms (Chranes et al, 1978). The firms being compared are referred to as decision making units (DMU). In DEA, production function frontier is drawn for single (or multiple) input(s) and for single (or multiple) output(s). All the points lying on the production function frontier are termed efficient and others inefficient. Many of the DEA soft wares like EMS: Efficiency Measurement System (Ver 1.3, HolgerScheel,2000) and MaxDEA (Ver 6.9, Beijing Real world Software Company Ltd,2016)report inefficiencies of firms (X-inefficiencies) instead of efficiencies.

If production function frontier is drawn keeping in mind the output it is called output oriented approach. In output oriented approach one tries to improve output by using the same amount of inputs. Where all the firms with maximum output lie on the production function frontier. If the inefficient firms produce same output as efficient firms they also become efficient. Similarly, if the focus is on using lesser inputs to produce same level of output the approach is called input oriented and all the firms on the frontier areefficient (Cheng G, 2014).

Inefficient firms can become efficient by using same level of inputs as efficient firms. Whereas in non-oriented approach, both input and outputs are altered to get maximum efficiency (Silva Portela et al, 2003). Hence, under non-oriented approach, both firms producing maximum output for a given input or using minimum input for a given output areconsidered efficient.

Inefficient firms can reach efficient production frontier by traversing radial distance (equi-proportional) or by following non-radial path (Charnes et al., 1978, Tone, 2001). When firms traverse radial distance they increase their output and reduce the input in the same proportion, i.e. if afirm increases its output by 10% it reduces inputs by 10%.

It is possible to rank all the efficient firms by calculating super efficiency. The super efficiency of a firm can be more than 100%. The firm with highest score gets first rank among all efficient firms without affecting the scores of inefficient firms.

An advantage of DEA over competing methodology like SFA is that, a scale of returns can be included (Banker et al.,1984). That is, if there is a scope for the selected firms to invest more in terms of inputs to get more output, then increasing returns to scale exists and it can be modelled. Similarly, constant returns to scale and decreasing returns to scale can be incorporated while constructing production functions. The mathematical model used for this study is 'Super Efficiency with Variable Returns to Scale (SE-VRS)' and can be represented as follows,

$$\min \frac{1-w'\propto}{1+w\,\beta}$$

s.t $\sum_{\substack{j=1\\ j=k}}^{n} \lambda_j\, x_{ij} \le (1 - f(w') * \propto) x_{ik}$, i = 1,2,…..,m

s.t $\sum_{\substack{j=1\\ j=k}}^{n} \lambda_j\, y_{rj} \ge (1 + f\,(\,w^0\,) * \beta) y_{rk}$, r= 1,2,…..,s

$$\sum_{\substack{j=1\\ j=k}}^{n} \lambda_j = 1$$

$$\alpha, \beta \le 0, \lambda \ge 0\ j = 1,2,\dots,n\ (j \ne k)$$

$$w' + w^0 > 0$$

$$f(\mathrm{w}) = \begin{matrix} 0 & if\ w = 0 \\ 1 & if\ w > 0 \end{matrix}$$

Where,

Alpha input and beta output, α*: used to denote the degree of inefficiency of inputs, equal to 1-θ* and β*: used to denote the degree of inefficiency of outputs, equal to φ*- 1.λ, represents the linear coefficient of a DMU, W^0 =1 and W^1 =1.

Advances in DEA allow one to compare the performance of the same DMU at two different points. The same can be extended to perform comparisons across technologies, time or industries. Such an approach is called windows

analysis. Windows analysis is used to compare and identify better or worse performing firms (DMUs). If windows analysis is used along with super efficiencies, it becomes possible to compare and rank the performance of the DMUs. On the other hand not using super efficiency helps only in identifying efficient firms. We have used windows analysis to compare firm performance using PAT, total income and total expenditure for base year and terminal year. To examine the following research questions: Whether performance of firms vary based on size? Whether strategy (focus vs diversified) adopted by firms impacts performance? How have firms performed in the base year vis-à-vis the terminal year?

METHODOLOGY

In this study selected firms were ranked using super efficiencies and compared using windows analysis. The weights for inputs and outputs were calculated using non-oriented, variable to scale, radial distance technology. For this study we randomly selected 36 firms also known as DMUs in DEA terminology. The data were collected for two points of time, financial years2002-03 and 2013-14. This was done to observe changes in performance (if any) of the sets of firms over a twelve-year period. Choice of this period is because India experienced relatively high GDP growth rate during the base year and relatively low GDP growth rate during the terminal year. The firms were classified into two broad categories depending on their scope of business as focused(where firms dealt in a single product line) and diversified, (where firms dealt with two or more product lines). Each set has further data of firms categorized as small, medium and large. Firms with revenue of INR < 5 billion were classified as small, with INR 5 - 10 billion as medium and INR > 10 billion as large. Of the 36 firms selected for study, 18 were focused and the remaining 18 were diversified. In all we collected 72 observations. This research is designed to collect essentially objective data on performance of afore mentioned two sets of firms operating in India and to carry out analyses with a view to establish performance of one set of firms vis-à-vis the other. The scheme is given in Table 1.

Table1. *Sample Scheme*

	2003		2014		Total
	Diversified	Focused	Diversified	Focused	
Small (INR <500 cr.)	6	6	6	6	24
Medium (INR 500 – 1000 cr.)	6	6	6	6	24
Large (INR >1000 cr.)	6	6	6	6	24
Total	18	18	18	18	72

We wanted to study the following relationship: PAT = Total Income – Total Expenditure by comparing base year performance with terminal year performance. We also intended to compare performances of small, medium and large firms pursuing focused and diversified strategies. We assumed that if income or expenditure vary, the output (PAT) will also vary. But, change may not be proportionate to change in income and expenditure. Hence, we used variable returns to scale. We have calculated super efficiency, as it not only helps us identify efficient firms but also rank the firm. In other words, any firm small, medium or large either using focused or diversified strategy can become number one based on its performance. If a firm's performance in base year is far superior to rest of the firms compared to the terminal year, then that firm's base year performance becomes the benchmark for all other firms considered for the study.

ANALYSIS, DISCUSSION AND FINDINGS

As shown in the scheme in Table 1, there were in total 72 observations of which 36 were from base year (2003) and another 36 from the terminal year (2014). Similarly, of the total 72 observations, 36 observation represent firms following focused business strategy and remaining 36 observations represent firms that have adopted diversification strategy. Small, medium and large firms each have 24 observations. This scheme allows us to have six observations each for size, type and focus year. The non-oriented, convex and radial super efficiencies are shown in Table 3.

We performed a windows analysis using EMS software for 12 periods and width. Each period represents six firms for size, type and year. For example the first six observations represent small, focused firms for base year and so on (Table 4). Then average efficiencies were calculated for each period using six observations (Table 2). Using the same method, averages were calculated for focused and diversified firms as well as small, medium and large firms. This was done for base as well as terminal years. The findings are as follows,

Table2. *Windows Analysis of Firms*

	SF1	SD1	MF1	MD1	LF1	LD1	SF2	SD2	MF2	MD2	LF2	LD2
SF1	30.38%	152.87%	42.15%	38.98%	43.81%	61.32%	38.63%	37.47%	45.26%	42.30%	52.16%	56.28%
SD1	152.87%	152.87%	42.15%	38.98%	43.81%	61.32%	38.63%	37.47%	45.26%	42.30%	52.16%	56.28%
MF1	42.15%	42.15%	52.89%	56.55%	51.61%	67.06%	44.32%	118.81%	47.70%	45.66%	52.60%	58.09%
MD1	38.98%	38.98%	56.55%	56.55%	51.61%	67.06%	44.32%	118.81%	47.70%	45.66%	52.60%	58.09%
LF1	43.81%	43.81%	51.61%	51.61%	51.61%	67.06%	44.32%	118.81%	47.70%	45.66%	52.60%	58.09%
LD1	61.32%	61.32%	67.06%	67.06%	67.06%	67.06%	44.32%	118.81%	47.70%	45.66%	52.60%	58.12%
SF2	38.63%	38.63%	44.32%	44.32%	44.32%	44.32%	46.99%	129.29%	51.32%	48.68%	54.77%	60.84%
SD2	37.47%	37.47%	118.81%	118.81%	118.81%	118.81%	129.29%	129.29%	51.32%	48.68%	54.77%	60.84%
MF2	45.26%	45.26%	47.70%	47.70%	47.70%	47.70%	51.32%	51.32%	70.35%	75.47%	58.46%	73.32%
MD2	42.30%	42.30%	45.66%	45.66%	45.66%	45.66%	48.68%	48.68%	75.47%	76.88%	58.46%	73.51%
LF2	52.16%	52.16%	52.60%	52.60%	52.60%	52.60%	54.77%	54.77%	58.46%	58.46%	58.46%	95.45%
LD2	56.28%	56.28%	58.09%	58.09%	58.09%	58.12%	60.84%	60.84%	73.32%	73.51%	95.45%	115.51%

Source: compiled output of EMS Software

Legends used: SF1 = Small focused firm (base year);SD1= Small diversified firm (base year);MF1= Medium focused firm (base year);MD1=Medium diversified firm (base year);LF1= Large focused firm (base year);LD1=Larger diversified firm (base year);SF2 = Small focused firm (terminal year);SD2= Small diversified firm (terminal year);MF2= Medium focused firm (terminal year);MD2=Medium diversified firm (terminal year);LF2= Large focused firm (terminal year);LD2=Larger diversified firm (terminal year)

The table shows super efficiencies along the diagonal. For example, the super efficiency of small focused firm (SF1) in the base year is 30.38% and that for terminal year (SF2) is 46.99%. The large diversified firm (LD2) (115.51%) performed the best in terminal year. The comparative performance of firms can be seen at the intersection of the cells. For instance, large diversified firm with respect to small focused firm for base year is 61.32%(where, LD1 intersects SF1).

1. Small diversified firms (152.87%) performed better than small focused firms (30.38%) in the base year. Average performance of small firms was better in base year (Average of 30.38% and 152.87%= 91.62%) than terminal year (58.76%)
2. The performance of medium diversified firms in terminal year (76.88%) was better compared to its performance in base year (56.55%).The overall average performance of terminal year (99.82%) was better than base year (54.72%) for medium sized firms.
3. In case of large firms, average performance of diversified firms across the years (91.29%) was superior to large focused firms (55.04%).

   We can further summarize table 2 and calculate the average performances of firms for the base and terminal years as follows.In terms of size:small firms 89.88%, medium firms 64.17%, and large firms 73.16%. In terms of business strategy focused firms 51.78%, diversified firms 99.69%. Performance for the base year was 68.56% and terminal year 82.91%.
4. Overall, small firms performed the best (89.88%); large firms were second best (73.16%).
5. Performance of all the firms taken together was better in the terminal year (82.91%) than the base year (68.56%).
6. Firms pursuing the strategy of diversification performed better (99.69%) than firms following focused strategy (51.78%).

CONCLUSION

The study found that, the overall average performance of firms during terminal year (82.91%) was better than base year (68.56%).Experience in managing challenges over a twelve-year time frame might have resulted in superior performance of firms. The average performance of firms having adopted diversification strategy (99.69%) was better than firms pursuing strategy of remaining focused (51.78%). Benefits indicated earlier (introduction) seem to have accrued to the diversified firms. That small firms fared better (89.88%) compared to large firms (73.16%) and medium firms performed the least (64.17%).Advantages of large size apparently could not be fully exploited by large firms, while relatively smaller firms used their flexibility to achieve higher performance. This study focused on two points in time and for a limited sample size, which can be limitations of this study. There is, therefore, scope to extend the study using panel data for larger number of firms leading to a longitudinal study to verify these preliminary findings.

APPENDICES

Table3. *Super Efficiencies*

DMU	Name	income	expenditure	pat	Score	Income	Expenditure	PAT	Bench Marks	Slack Income	Slack Expenditure	Slack PAT
DMU 1 T0	Akzo Nobel India Ltd.	7871.10	6937.90	471.80	0.65	0.82	0.00	0.18	12 (0.9655) 35 (0.0345)	0.00	752.06	0.00
DMU 2 T0	Bata India Ltd.	7257.49	6879.22	124.91	-0.88	0.94	0.00	0.06	0.00			
DMU 3 T0	Blue Star Ltd.	9309.15	8629.16	391.58	-0.74	0.87	0.00	0.13	0.00			
DMU 4 T0	Britannia Industries Ltd.	15899.01	13237.25	1487.69	-0.50	0.75	0.00	0.25	0.00			
DMU 5 T0	Nilkamal Ltd.	3253.90	2907.45	129.58	-0.75	0.87	0.00	0.13	0.00			
DMU 6 T0	Rallis India Ltd.	5953.88	5246.53	334.95	-0.66	0.83	0.00	0.17	0.00			
DMU 7 T0	3M India Ltd.	3830.60	3150.66	384.18	-0.47	0.73	0.00	0.27	0.00			
DMU 8 T0	Gillette India Ltd.	4716.03	3465.64	687.19	-0.31	0.66	0.00	0.34	0.00			
DMU 9 T0	Jayant Agro-Organics Ltd.	5958.17	5858.18	33.99	-0.96	0.98	0.00	0.02	0.00			
DMU 10 T0	Ramco Industries Ltd.	2637.29	2045.18	288.36	-0.05	0.10	0.42	0.48	1.00			
DMU 11 T0	Procter & Gamble Hygiene & Health Care Ltd.	7315.40	5515.09	1246.11	-0.44	0.72	0.00	0.28	0.00			
DMU 12 T0	SRS Ltd.	76.36	38.83	21.91	5.40	0.00	1.00	0.00	3.00	34.92	0.00	203.63
DMU 13 T0	ABB India Ltd.	30141.38	26381.21	2186.77	-0.59	0.79	0.00	0.21	0.00			
DMU 14 T0	Alstom India Ltd.	8378.41	7900.21	479.27	-0.66	0.83	0.00	0.17	0.00			
DMU 15 T0	Asian Paints Ltd.	19861.70	16572.91	1734.82	-0.52	0.76	0.00	0.24	0.00			
DMU 16 T0	Exide Industries Ltd.	11876.03	10032.50	772.82	-0.62	0.81	0.00	0.19	0.00			
DMU 17 T0	SKF India Ltd.	8213.00	6917.70	640.70	-0.52	0.76	0.00	0.24	0.00			
DMU 18 T0	Godfrey Phillips India Ltd.	7126.35	5904.10	635.99	-0.56	0.78	0.00	0.22	0.00			
DMU 19 T0	Dabur India Ltd.	12382.01	10514.23	1480.20	-0.40	0.70	0.00	0.30	0.00			
DMU 20 T0	Marico Ltd.	9562.90	8640.70	737.90	-0.51	0.76	0.00	0.24	0.00			
DMU 21 T0	Titan Company Ltd.	11009.63	9830.70	249.49	-0.57	0.78	0.00	0.22	0.00			
DMU 22 T0	Phoenix Mills Ltd.	453.98	248.61	107.17	-0.36	0.68	0.00	0.32	0.00			
DMU 23 T0	Ruchi Soya Industries Ltd.	39585.74	38311.70	435.94	-0.92	0.96	0.00	0.04	0.00			
DMU 24 T0	Godrej Consumer Products Ltd.	4774.20	4073.63	535.57	-0.90	0.95	0.00	0.05	0.00			
DMU 25 T0	Arvind Ltd.	16619.90	12735.30	1273.50	-0.57	0.78	0.00	0.22	0.00			
DMU 26 T0	Bajaj Auto Ltd.	80541.60	65108.10	10642.40	-0.36	0.68	0.00	0.32	0.00			
DMU 27 T0	Maruti Suzuki India Ltd.	113583.00	95606.00	8536.00	-0.57	0.79	0.00	0.21	0.00			
DMU 28 T0	Tata Steel Ltd.	147697.70	85343.80	34741.60	-0.03	0.00	0.50	0.50	1.00			
DMU 29 T0	Lupin Ltd	9598.60	7744.40	1459.80	-0.85	0.92	0.00	0.08	0.00			
DMU 30 T0	Ultratech Cement Ltd.	26279.70	23329.10	28.50	-0.99	1.00	0.00	0.00	0.00			
DMU 31 T0	Aditya Birla Nuvo Ltd.	18817.10	16161.70	1137.20	-0.64	0.82	0.00	0.18	0.00			
DMU 32 T0	Bosch Ltd.	31949.83	24624.28	3430.70	-0.44	0.72	0.00	0.28	0.00			
DMU 33 T0	Century Textiles & Industries Ltd.	25674.70	22577.20	1225.50	-0.71	0.85	0.00	0.15	0.00			
DMU 34 T0	Grasim Industries Ltd.	64164.50	46317.60	8857.10	-0.34	0.67	0.00	0.33	0.00			
DMU 35 T0	ITC Ltd.	78805.80	48438.40	21914.00	0.05	0.48	0.00	0.52	2.00	0.00	760.61	0.00
DMU 36 T0	Piramal Enterprises Ltd.	12841.00	10844.80	1695.70	-0.24	0.62	0.00	0.38	0.00			
DMU 1 T1	Akzo Nobel India Ltd.	25934.00	22670.00	1863.00	-0.59	0.79	0.00	0.21	0.00			
DMU 2 T1	Bata India Ltd.	27372.28	23430.81	2311.72	-0.53	0.77	0.00	0.23	0.00			
DMU 3 T1	Blue Star Ltd.	30909.38	29072.08	1525.28	-0.70	0.85	0.00	0.15	0.00			
DMU 4 T1	Britannia Industries Ltd.	72635.20	64044.90	6224.10	-0.53	0.76	0.00	0.24	0.00			
DMU 5 T1	Nilkamal Ltd.	17929.09	16466.62	424.61	-0.84	0.92	0.00	0.08	0.00			
DMU 6 T1	Rallis India Ltd.	15191.25	12622.35	1454.17	-0.49	0.74	0.00	0.26	0.00			
DMU 7 T1	3M India Ltd.	18547.76	16365.93	1083.42	-0.65	0.83	0.00	0.17	0.00			

DMU 8 T1	Gillette India Ltd.	20046.50	17152.00	1581.30	-0.56	0.78	0.00	0.22	0.00			
DMU 9 T1	Jayant Agro-Organics Ltd.	6621.61	6163.98	113.17	-0.88	0.94	0.00	0.06	0.00			
DMU 10 T1	Ramco Industries Ltd.	7609.50	6953.97	209.31	0.09	0.00	0.45	0.55	12 (0.9754) 35 (0.0246)	2497.33	0.00	0.00
DMU 11 T1	Procter & Gamble Hygiene & Health Care Ltd.	24093.50	18502.90	3461.40	-0.82	0.91	0.00	0.09	0.00			
DMU 12 T1	SRS Ltd.	38379.77	36901.83	388.14	-0.93	0.96	0.00	0.04	0.00			
DMU 13 T1	ABB India Ltd.	81540.50	74189.90	2998.80	-0.77	0.88	0.00	0.12	0.00			
DMU 14 T1	Alstom India Ltd.	22475.20	19463.00	1770.70	-0.56	0.78	0.00	0.22	0.00			
DMU 15 T1	Asian Paints Ltd.	118356.50	96342.80	13274.00	-0.43	0.71	0.00	0.29	0.00			
DMU 16 T1	Exide Industries Ltd.	68975.50	59567.10	5458.70	-0.56	0.78	0.00	0.22	0.00			
DMU 17 T1	SKF India Ltd.	24925.30	21324.10	2027.70	-0.43	0.72	0.00	0.29	0.00			
DMU 18 T1	Godfrey Phillips India Ltd.	26192.06	22264.12	1830.84	-0.55	0.77	0.00	0.23	0.00			
DMU 19 T1	Dabur India Ltd.	55691.30	44927.80	7625.80	-0.34	0.67	0.00	0.33	0.00			
DMU 20 T1	Marico Ltd.	48253.60	40194.40	5451.70	-0.60	0.80	0.00	0.20	0.00			
DMU 21 T1	Titan Company Ltd.	119737.90	107498.50	8230.70	-0.42	0.71	0.00	0.29	0.00			
DMU 22 T1	Phoenix Mills Ltd.	4121.90	1123.38	618.52	-0.34	0.67	0.00	0.33	0.00			
DMU 23 T1	Ruchi Soya Industries Ltd.	284116.20	277258.69	609.28	-0.98	0.99	0.00	0.01	0.00			
DMU 24 T1	Godrej Consumer Products Ltd.	44873.10	35884.00	6544.50	-0.78	0.89	0.00	0.11	0.00			
DMU 25 T1	Arvind Ltd.	53657.30	43924.10	3774.30	-0.60	0.80	0.00	0.20	0.00			
DMU 26 T1	Bajaj Auto Ltd.	221989.30	175031.90	28137.40	-0.35	0.66	0.00	0.34	0.00			
DMU 27 T1	Maruti Suzuki India Ltd.	508713.00	433268.00	37112.00	-0.56	0.77	0.00	0.23	0.00			
DMU 28 T1	Tata Steel Ltd.	424451.90	318536.10	64391.20	-0.25	0.62	0.00	0.38	1.00			
DMU 29 T1	Lupin Ltd	99331.60	63792.20	23973.50	-0.60	0.80	0.00	0.20	0.00			
DMU 30 T1	Ultratech Cement Ltd.	232989.70	187321.60	20147.30	-0.51	0.74	0.00	0.26	0.00			
DMU 31 T1	Aditya Birla Nuvo Ltd.	91097.70	79148.10	5276.90	-0.66	0.83	0.00	0.17	0.00			
DMU 32 T1	Bosch Ltd.	126508.00	101042.00	13377.00	-0.45	0.72	0.00	0.28	0.00			
DMU 33 T1	Century Textiles & Industries Ltd.	76770.40	69769.00	154.90	-0.99	0.99	0.00	0.01	0.00			
DMU 34 T1	Grasim Industries Ltd.	66806.50	56676.10	5299.00	-0.56	0.78	0.00	0.22	0.00			
DMU 35 T1	ITC Ltd.	381208.50	230831.40	96077.30	0.34	0.00	0.23	0.77	28 (0.0380) 64 (0.9620)	97476.75	0.00	0.00
DMU 36 T1	Piramal Enterprises Ltd.	27000.00	19567.50	3727.40	-0.32	0.66	0.00	0.34	0.00			

Table4. *Windows Analysis*

	1	2	3	4	5	6	7	8	9	10	11	12
DMU 1	35.44%											
DMU 2	11.63%											
DMU 3	26.26%											
DMU 4	50.34%											
DMU 5	24.99%											
DMU 6	33.62%											
DMU 7	52.97%	52.97%										
DMU 8	68.73%	68.73%										
DMU 9	3.98%	3.98%										
DMU 10	94.90%	94.90%										
DMU 11	56.38%	56.38%										
DMU 12	640.25%	640.25%										
DMU 13	41.38%	41.38%	45.73%									
DMU 14	34.10%	34.10%	52.83%									
DMU 15	47.80%	47.80%	54.42%									
DMU 16	37.91%	37.91%	50.55%									
DMU 17	47.93%	47.93%	52.17%									
DMU 18	43.79%	43.79%	61.63%									
DMU 19	60.12%	60.12%	70.19%	70.19%								
DMU 20	48.57%	48.57%	68.54%	68.54%								
DMU 21	43.42%	43.42%	58.67%	58.67%								
DMU 22	64.38%	64.38%	73.70%	73.70%								
DMU 23	7.61%	7.61%	12.19%	12.19%								
DMU 24	9.77%	9.77%	56.00%	56.00%								
DMU 25	43.20%	43.20%	51.62%	51.62%	51.62%							
DMU 26	64.42%	64.42%	64.99%	64.99%	64.99%							
DMU 27	42.55%	42.55%	43.08%	43.08%	43.08%							
DMU 28	96.86%	96.86%	96.86%	96.86%	96.86%							

DMU 29	15.05%	15.05%	37.44%	37.44%	37.44%							
DMU 30	0.77%	0.77%	15.68%	15.68%	15.68%							
DMU 31	35.70%	35.70%	43.54%	43.54%	43.54%	43.54%						
DMU 32	55.71%	55.71%	59.15%	59.15%	59.15%	59.15%						
DMU 33	29.29%	29.29%	35.19%	35.19%	35.19%	35.19%						
DMU 34	66.34%	66.34%	67.29%	67.29%	67.29%	67.29%						
DMU 35	104.91%	104.91%	105.71%	105.71%	105.71%	105.71%						
DMU 36	75.96%	75.96%	91.51%	91.51%	91.51%	91.51%						
DMU 37	41.05%	41.05%	46.26%	46.26%	46.26%	46.26%	49.25%					
DMU 38	46.59%	46.59%	51.20%	51.20%	51.20%	51.20%	54.63%					
DMU 39	30.14%	30.14%	34.89%	34.89%	34.89%	34.89%	37.17%					
DMU 40	47.11%	47.11%	48.28%	48.28%	48.28%	48.28%	52.31%					
DMU 41	15.68%	15.68%	25.39%	25.39%	25.39%	25.39%	25.67%					
DMU 42	51.21%	51.21%	59.89%	59.89%	59.89%	59.89%	62.89%					
DMU 43	34.71%	34.71%	42.74%	42.74%	42.74%	42.74%	44.85%	44.85%				
DMU 44	44.19%	44.19%	50.97%	50.97%	50.97%	50.97%	53.90%	53.90%				
DMU 45	11.55%	11.55%	62.25%	62.25%	62.25%	62.25%	62.25%	62.25%				
DMU 46	109.41%	109.41%	490.94%	490.94%	490.94%	490.94%	548.70%	548.70%				
DMU 47	17.97%	17.97%	54.17%	54.17%	54.17%	54.17%	54.17%	54.17%				
DMU 48	7.01%	7.01%	11.76%	11.76%	11.76%	11.76%	11.89%	11.89%				
DMU 49	23.36%	23.36%	24.97%	24.97%	24.97%	24.97%	27.17%	27.17%	36.38%			
DMU 50	44.15%	44.15%	50.10%	50.10%	50.10%	50.10%	53.17%	53.17%	101.54%			
DMU 51	57.48%	57.48%	57.64%	57.64%	57.64%	57.64%	62.39%	62.39%	66.72%			
DMU 52	44.31%	44.31%	45.67%	45.67%	45.67%	45.67%	49.49%	49.49%	58.70%			
DMU 53	57.01%	57.01%	57.31%	57.31%	57.31%	57.31%	62.00%	62.00%	66.94%			
DMU 54	45.26%	45.26%	50.49%	50.49%	50.49%	50.49%	53.74%	53.74%	91.80%			
DMU 55	65.99%	65.99%	67.25%	67.25%	67.25%	67.25%	72.16%	72.16%	81.74%	81.74%		
DMU 56	40.17%	40.17%	45.36%	45.36%	45.36%	45.36%	48.30%	48.30%	86.91%	88.00%		
DMU 57	57.78%	57.78%	59.66%	59.66%	59.66%	59.66%	64.12%	64.12%	76.20%	76.20%		
DMU 58	66.35%	66.35%	70.12%	70.12%	70.12%	70.12%	74.60%	74.60%	98.38%	98.38%		
DMU 59	1.53%	1.53%	2.18%	2.18%	2.18%	2.18%	2.27%	2.27%	7.83%	7.88%		
DMU 60	22.00%	22.00%	29.41%	29.41%	29.41%	29.41%	30.60%	30.60%	101.74%	109.06%		
DMU 61	40.37%	40.37%	42.49%	42.49%	42.49%	42.49%	45.94%	45.94%	58.43%	58.43%	58.43%	
DMU 62	65.01%	65.01%	65.01%	65.01%	65.01%	65.01%	67.23%	67.23%	68.91%	68.91%	68.91%	
DMU 63	44.26%	44.26%	44.26%	44.26%	44.26%	44.26%	45.00%	45.00%	45.56%	45.56%	45.56%	
DMU 64	74.90%	74.90%	74.90%	74.90%	74.90%	74.90%	75.19%	75.19%	75.41%	75.41%	75.41%	
DMU 65	39.64%	39.64%	40.16%	40.16%	40.16%	40.16%	43.81%	43.81%	49.00%	49.00%	49.00%	
DMU 66	48.79%	48.79%	48.79%	48.79%	48.79%	48.79%	51.46%	51.46%	53.47%	53.47%	53.47%	
DMU 67	34.48%	34.48%	35.55%	35.55%	35.55%	35.55%	38.74%	38.74%	46.16%	46.16%	46.16%	46.16%
DMU 68	55.10%	55.10%	55.23%	55.23%	55.23%	55.23%	59.86%	59.86%	63.96%	63.96%	63.96%	63.96%
DMU 69	1.44%	1.44%	5.37%	5.37%	5.37%	5.37%	5.37%	5.37%	28.85%	28.90%	31.38%	31.38%
DMU 70	44.39%	44.39%	45.81%	45.81%	45.81%	45.81%	49.63%	49.63%	59.16%	59.16%	59.16%	59.16%
DMU 71	134.15%	134.15%	134.15%	134.15%	134.15%	134.36%	134.61%	134.61%	134.62%	134.62%	134.62%	186.08%
DMU 72	68.12%	68.12%	72.40%	72.40%	72.40%	72.40%	76.85%	76.85%	107.14%	108.27%	237.39%	306.31%

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