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FINANCIAL PERFORMANCE EVALUATION OF IT INDUSTRY THROUGH DEA WINDOW ANALYSIS APPROACH

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ABSTRACT

The increased number of business failures in the companies reflects the need to apply new tools to evaluate financial performance. Data Envelopment Analysis (DEA) is a powerful analytical tool that has the versatility to give a single measure of performance while simultaneously handling the multiple inputs and outputs that represent the most significant factors involved in a company's activities.

This paper aims to analyze the time series performance of NSE IT Index companies based on DEA methodology. This model is capable of accurate assessment the financial performance and setting stability index benchmarks. This benchmark enables in evaluating the performance levels being achieved in different years as compared to stability index benchmarks. We observed that most of the company's individual year performance rank is matching with the stability index rank. We have found that some of the companies' rankings are abnormal fluctuations, with this we try to found the reasonableness. This method potentially offers rich new insights into the performance of firms. The results of this study will provide benchmarks for auditors especially in the planning stage of the audit to find out the anomalies

Key words: IT Industry, DEA methodology, Financial Performance.

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1. INTRODUCTION

Analytical procedures (APs) have been of great interest to both accounting researchers and auditing standards-setting bodies. APs consist of "evaluations of financial information made by a study of plausible relationships among both financial and nonfinancial data. Auditors

perform analytical procedures in planning the nature, timing and extent of testing. Significant fluctuations between the every year's data and stability index results and works as a signal over an increased risk of material error and help auditors focus their planned tests on high-risk areas. This study examines decisions in revising preliminary plans after analytical procedures performed during planning period particularly under unexpected fluctuations. Specifically it examines whether the extent of corroboration for management's explanation for the fluctuation and the presence of an explicit incentive for management to misstate the financial statements by the influence of auditors' decisions to revise their audit plans or not (Sherman, 2000).

The Auditing Standards provides increased guidance on the requirements and use of APs in planning and overall review in terms of audits. The highly competitive market for audit services and the litigious nature of today's audit environment increases the need for auditors to identify ways of increasing the efficiency and effectiveness of their audits. This need demands the use of APs that are widespread comparatively the historic one. There are various parametric and non-parametric approaches to measure performance, which are widely used in all sectors of business. The best-known ratios for financial and production managers are: capital adequacy, earnings, liquidity, liability etc. Besides the advantages, they report few disadvantages as each single ratio must be compared with some benchmark ratio at a given time. By assuming that other factors are fixed and benchmarks chosen are suitable for comparison. While the calculation of a set of financial ratios is relatively easy, the aggregation of those ratios can be quite complicated that involves experienced judgment.

A number of studies have attempted to use statistical methods to develop meaningful ‘peer group analysis which is, to develop specific financial characteristics that distinguish between two or more groups with relatively ‘good’ or ‘bad’ financial conditions. Hence, if prior group of financial profiles available to compare and identifying an appropriate peer groups for analysis the will become very difficult task.

Data Envelopment Analysis (DEA) is a non-parametric method used for evaluating the relative efficiency of similar units, referred to as decision-making units (DMUs). Traditional approaches of efficiency focus on averages and estimations of parameters and utilize only a single optimized regression equation assumed to be appropriate for every DMU. In DEA, the performance measure of each DMU is optimized. DEA calculates the best possible performance for each DMU relative to all other observed measures.

This paper runs on the suggestions of Biggs et.al. and EH.Feroz (1995 and 2005) to explore the relevance of DEA as a tool for analysis. Extant studies have applied DEA to managerial decisions and have shown that DEA provides additional information over and above ratio analysis and other traditional approaches. So it can be asserted that DEA can be used as a tool for the planning stage of the audit to assess the preliminary risk level of a corporate client, and determine the extent of audit. The DEA can also be used in the overall review of financial analysis to detect any anomalies in getting insights over performance analysis and the subsequent changes.

2. METHODOLOGY

Our paper evaluates the financial performance of NSE IT Index companies stability (sensitivity) analysis and time series comparison developed through DEA. For the time series analysis window envelopment analysis model is applied.

2.1. DEA Window Analysis Model

A DEA Window analysis works on the principle of moving averages (Charnes et al. 1994B,Yue 1992) and is useful to detect performance trends of a unit over a time period. Each unit in a different period is treated as if it were a 'different' unit. In doing so, the performance of a unit in a particular period is contrasted with its performance in other periods in addition to the performance of other units. This results in an increase in the number of data points in the analysis, which can be useful when dealing with small sample sizes. Varying the window width, i.e, the number of time periods included in the analysis, more specifically covering the spectrum from contemporaneous analysis, which include only observations from one time period, to inter temporal analysis that include observations from the whole study period the analysis would be done (Tulkens and Vanden Eeckaut 1995).

The non-parametric method of DEA introduced by Charnes *et al.* (1978) and further generalized by Banker *et al.* (1984) requires no parametric specification of the production frontier. Using a sample of actually observed input–output data and a number of fairly weak assumptions, it derives a benchmark input quantity with which the actual input of a firm can be compared for (input-oriented) efficiency measurement.

An input–output bundle (*x, y*) is *feasible* when the output bundle *y* (a non-negative vector of quantities of outputs) can be produced from the input bundle *x* (a non-negative vector of quantities of inputs). The set of all such feasible input–output bundles constitute the production possibility set *T*

$T = \{(x, y) : y \text{ can be produced from } x;\ x = 0;\ y = 0\}$

We employ the DEA BCC model that utilizes a convex hull of input consumption and output production for all of the observed firms in an industry for a particular time frame such as fiscal year as in this analysis. The DEA BCC Input orientation model is as follows:

$$\min \theta$$

$$\text{s.t.} \sum_{j=1}^{N} \lambda_j x^j \le \theta x^t;$$

$$\sum_{j=1}^{N} \lambda_j y^j \ge y^t;$$

$$\sum_{j=1}^{N} \lambda_j = 1;$$

$$\lambda_j \ge 0 \ (j = 1, 2, ..., N).$$

Let $(\theta^*; \lambda_1^*, \lambda_2^*, ..., \lambda_n^*)$ be the optimal solution. Define $x_*^t = \sum_{j=1}^{N} \lambda_j^* x^j = \theta^* x^t$. Then (x_*^t, y^t) is the efficient input-oriented projection of (x^t, y^t) onto the frontier and $TE_I^V(x^t, y^t) = \theta^*$.

The outputs and inputs have been divided by the standard deviation in order to obtain units invariant model (Lovell and Pastor 1995).The income efficiency status (efficient or inefficient) for each firm is determined by comparing its costs and sales to the production possibility set. If no other firm's cost and sales, observed or hypothetical, in the set consumes the same or less costs while simultaneously producing more or the same sales and cash flows ,

then the firm is deemed income efficient and on the efficiency frontier or benchmark. Those firms not meeting the above criteria are deemed income inefficient relative to the benchmark and enveloped by the frontier.

This method presents the efficiency scores for the firms in input orientation for the ten years. Window analysis model is moving average pattern of analysis, and is described by Charnes et.al. (1985). A DMU in each period is treated as if it is a different DMU. The performance of a DMU is compared its performance in other periods, in addition to comparing it with the performance of other DMUs in the same period. Charnes et al. (1992, 1996) and Seaford and Zhu (1998) developed the sensitivity analysis for the additive DEA model. It defines the necessary simultaneous perturbations to a given firm's inputs and outputs to cause it to move to a state of virtual efficiency. Once the stability index is known for each firm, the firms can be ranked from most robustly technically efficient to most robustly inefficient. To do so, the stability indexes for inefficient firms are first negated. Then the firms can be ranked from highest to lowest based on their stability index values. A general mathematical representation of the stability index for efficient and inefficient firms is made as it is in Feroz et al. (2001).Inputs and outputs are considered as raw data as shown in table 2, these values are calculated in descriptive statistics.

2.2. Sample Size

In order to analyze properly 40 IT companies are selected from National Stock Exchange (NSE) IT Index with reference over a period of ten years from 2007 to 2016 few companies are excluded due to data unavailability. Hence data of select companies formed secondary source i.e, CMIE database.

2.3. Variables Selection

In the study the researcher selected five variables for analysis, out of which three are input variables and two are output variables, which have been used and found to be effective[*] in DEA model. The Five variables are shown through in Table 1:

Table 1 Inputs and Outputs

Inputs	Outputs
Operating Expenses(OE)	Net sales(NS)
Total Outside Liabilities(TOSL)	Cash flow from operating Activities(CFO)
Shareholder funds(sf)	

[*]Those variables are also effective in other models too, Dupont Model, Altman, Beneish M Score

3. WINDOW ANALYSIS MODEL APPLICATION TO IT COMPANIES

This section which is provides an empirical analysis of the DEA Stability Index (SI) rank, which is measured SI by DEA EMS software. SI rank, although strictly a measure of sensitivity to changes in the output (Sales and Cash flow from operations) and inputs (Operating expenses, Debt and Equity), can be interpreted as a radial measure to the efficient frontier (for firms below the frontier) or by how much the existing frontier has been ‘‘pushed out’’ for firms already on the frontier. SI values provide the rank of firms within a particular industry from the most income efficient (lowest numbered rank) to the least efficient firm (highest numbered rank). The SI efficiency rank provide the auditor with an overall or composite measure, as compared to a set of ratios with possibly conflicting signals, for

verifying the relative performance of a particular client(s) over the study period. The NSE IT Index, chosen in part because of its familiarity to most auditors, investors and researchers that provide good insights of DEA income efficiency analysis (see table 4 for details).

Table 2 Descriptive Statistics of variables data NSE IT Index companies

STATISTICS	REV {O}	NCFO {O}	OPEXP {I}	SHF {I}	TOSL {I}
MINIMUM	5.77	0	6.43	0	1.88
MAXIMUM	89623.63	17996.31	58796.05	58866.86	21020.7
AVERAGE	4030.704	672.6977	2821.206	3032.27	1129.187
SD	10838.88	2005.086	7362.796	8079.949	2525.905

Source: Calculated and compiled by the researcher

The moving pattern of analysis of firms in each period compared to the performance of its own in other periods, in addition to the comparison to other firms in the same period. Hence, the model is applied for 40 sample companies over a ten years period of time. We have used a three year window width to evaluate the performance. At first we have explained about first 3 years of window. In total the sample 40 companies and 3 years of window (40 * 3) = 120 samples are considered for the analysis. In 2007 firm 3i InfoTech is treated as a different firm as compared to 3i InfoTech in year 2008 and 2009.

Then window is shifted by one year, and DEA analysis is performed for the same 40 companies for the years 2009 through 2011. Again 120 firms (40*3) is the total sample. The efficiencies of such firms are calculated. Similarly analysis is also performed for other windows, 2010-2012, 2011-2013, 2012-2014, 2013-2015, 2014-2016 and 2016 and the DEA results are demonstrated in table 3.

In the process of stability index, the averages of the DEA are calculated and respective results and Standard deviations of all the companies for the ten year window also developed. The maximum average score is found as 0.98 and minimum average score is as 0.48. The standard deviation is as found at minimum 0.05 and 0.42 is as the maximum standard deviation.

On the other hand table 3 arrays the SI rank employed as a measure of NSE IT companies income efficiency. The companies' overall stability rank for the 2007-2016 periods appear on the left-most column of numbers. The columns to the right indicate the annual income efficiency ranks for each year individually. Comparisons of annual rankings ''wash out'' the effect of macroeconomic events that influence the industry in a uniform way. Firm (client) specific events drive the changes in rankings for the given year.

Note that on the average, the annual rankings appear quite stable relative to the combined period i.e. 2007– 2016. 63 Moons, Infosys and TCS Co Ltd., secured first 3 ranks and appears to be uniformly the most income efficient firm over the period except the year 2016, while Trigyn Technologies Ltd., secured last rank 40th, and appears to be the least efficient(most income inefficient) in the NSE IT index. From the table it can be observed that some of the companies are out performed in some years and inefficient in some other years, hence by comparison of performance ranks, the companies are found more volatile or sensitive to the industry. However, one can dig deep and extended further analysis to understand the causes in the fluctuations of stability index ranks (see table 3 for more details).

3.1. Additional Analysis

It is evident from table 3.4 that transformations of data of consign the input and output into a meaningful value through respective standard deviation. Table alphabetically listed the companies' name. The output and inputs (transformed by dividing the outputs and inputs by their respective standard deviation) of the NSE IT Index over the time period of 2007–2016. It can be noted that Wipro's transformed revenue (second row from last in table 3.4) is almost equal to the Infosys's revenue 28.163 versus 30.630, but the cash flow of Infosys from operations is 1.34 times greater than Wipro as it was 30.741 and 22.951 respectively. Common equity and debts are highly employed by Wipro when compared to Infosys as 27.961 and 52.714 index is found towards the counter party's score as 37.346 and 8.493 respectively and in the case of operating expenses, it is found higher than the counter party by 1.07 times larger (31.093 versus 28.919). Hence it is Wipro's linear program weights in terms Long term debt, Operating expenses and cash flow from operations reported a significant impact on efficiency scores. Moreover, during the study period, it is found by critical analysis that the firm's (client's) transformed revenue exceed the transformed operating expenses (col. (4) versus (2)). It is evident from Infosys Ltd. As the scores are 30.630 and 28.919 respectively, but it is distinguishable for Wipro as the scores are 28.163 and 31.093 respectively.

Though by ranks Wipro is found as the relatively most income inefficient firm (26th), it exhibits several relatively consistent and stability ranks in many years over the study period. So it can be stated that Wipro is relatively consistent company and there is a less possibility for anomalies.

For instance if 3i Infotech is found as one of the inefficient and unreliable companies and ranked as 24^{th} in stability index, by and large due to several relatively efficient years where it was ranked at top particularly, during 2009, 2015 and 2016, not only that even the company's financial reports and strategic moves of management traced the input and output changes that account for the switching of ranks. Hence, during 2009, 2015 and 2016 revenues was and cash flows from operations were found double the figure of previous year, similarly, operating expenses are not increased in accordance with as revenues, long term debt and equity. The noteworthy issue is that, Regulus Holdings Inc., a U.S. based wholly owned subsidiary of the Company acquired National Retail lock box business of J. P. Morgan Treasury services in U.S.A., with is complimentary to current operations of Regulus and it helped the Company in consolidating its position in the United States market within the payments processing area. Hence Company got a more in its stake by its own or through its subsidiaries. Another move by the management some of the subsidiary companies namely, AOK In-house BPO Services Ltd., AOK In-house Factoring Services Pvt. Ltd., HCCA Business Services Pvt. Ltd., Delta Services (India) Pvt. Ltd. Elegon Infotech Limited, a Joint Venture company in China was converted into a wholly-owned subsidiary of the Company. The entire 49% stake held by joint venture partner was acquired by the Company. Company was holding entire stake in Antariksh Interactive Private Limited (Antariksh) through the scheme of wholly-owned subsidiary. During the same year, Taxsmile signed a three year contract with a European tax, accounting solution provider. As per the contract, the shareholding of Taxsmile in Antariksh was be diluted by 2012, Hence, the first tranche of 30% Shareholding was transferred in February 2010(see table 5 for more details).

Table 3 Stability Index rank of IT companies under Window analysis model

Company (Window analysis)	2007-2016	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
3I Infotech Ltd.	24	16	29	1	16	29	38	38	37	1	1
63 Moons Technologies Ltd.	1	1	1	1	1	1	1	1	1	1	1
Accelya Kale Solutions Ltd.	25	29	23	33	23	23	1	1	1	1	1
Aurionpro Solutions Ltd.	39	30	32	37	17	39	39	36	39	36	38
Axiscades Engineering Technologies Ltd.	34	39	38	38	39	18	15	19	35	25	26
Cyient Ltd.	30	20	37	32	30	28	28	16	18	18	16
Datamatics Global Services Ltd.	38	34	30	39	38	36	32	26	30	40	29
Firstsource Solutions Ltd.	35	36	33	19	35	38	29	25	31	38	32
H C L Infosystems Ltd.	6	1	1	1	1	1	1	11	16	24	37
H C L Technologies Ltd.	17	23	16	17	26	17	1	10	1	12	10
Hexaware Technologies Ltd.	32	35	36	36	21	37	17	12	12	13	14
Infosys Ltd.	2	1	1	1	1	1	1	1	1	1	12
K P I T Technologies Ltd.	28	24	21	1	20	33	27	22	26	30	23
Lycos Internet Ltd.	29	32	20	26	1	15	37	35	40	37	40
Mastek Ltd.	23	13	1	1	37	31	33	32	29	20	31
Mindtree Ltd.	15	25	27	16	14	19	19	24	20	23	25
Moser Baer India Ltd.	10	33	35	27	28	32	16	14	1	1	1
Mphasis Ltd.	27	27	24	25	1	14	25	20	23	31	28
N I I T Ltd.	31	31	28	29	31	21	18	34	36	39	39
N I I T Technologies Ltd.	22	19	14	15	25	27	21	21	28	28	24
Nelco Ltd.	8	1	1	1	1	1	1	1	1	15	19
Nucleus Software Exports Ltd.	33	15	19	28	33	34	36	23	21	32	30
Oracle Financial Services Software Ltd.	19	28	34	31	1	1	1	1	1	1	1
Polaris Consulting & Services Ltd.	21	17	18	22	32	26	26	33	34	16	21
R S Software (India) Ltd.	4	1	1	1	1	1	1	1	1	1	35
Ramco Systems Ltd.	36	38	31	23	40	35	34	39	33	29	13
Rolta India Ltd.	7	37	17	1	1	1	1	1	1	1	1
Sasken Technologies Ltd.	16	26	26	24	29	20	31	27	17	1	1
Smartlink Network Systems Ltd.	20	18	22	34	36	1	1	37	32	22	34
Sonata Software Ltd.	14	1	1	20	27	1	35	28	25	19	17
Subex Ltd.	37	40	40	40	1	30	22	40	38	34	33
T V S Electronics Ltd.	5	14	1	30	19	13	13	1	1	1	1
Tanla Solutions Ltd.	17	1	1	1	1	1	30	30	19	35	36
Tata Consultancy Services Ltd.	3	1	1	1	1	1	1	1	1	1	11
Tata Elxsi Ltd.	9	1	13	1	18	1	14	15	14	14	1
Tech Mahindra Ltd.	13	1	1	1	13	25	24	29	24	26	22
Trigyn Technologies Ltd.	40	1	39	35	22	40	40	31	15	33	20
Vakrangee Ltd.	11	1	1	14	34	16	1	13	22	21	18
Wipro Ltd.	26	22	25	21	24	24	23	18	27	27	27
Zensar Technologies Ltd.	12	21	15	18	15	22	20	17	13	17	15

Source: Calculated and compiled by the researcher

Table 4 IT Index companies data transformed by dividing the outputs and inputs by their respective standard deviation.

Company (Transformation SD)	Revenue {O}	NCFO {O}	OPEXP {I}	SHF {I}	TOSL {I}
3I Infotech Ltd.	0.676	0.649	0.623	0.834	8.849
63 Moons Technologies Ltd.	0.773	0.466	0.241	2.528	2.521
Accelya Kale Solutions Ltd.	0.181	0.230	0.166	0.117	0.085
Aurionpro Solutions Ltd.	0.131	0.038	0.144	0.309	0.462
Axiscades Engineering Technologies Ltd	0.074	0.042	0.089	0.056	0.134
Cyient Ltd.	0.812	0.502	0.845	1.256	0.475
Datamatics Global Services Ltd.	0.158	0.112	0.176	0.415	0.219
Firstsource Solutions Ltd.	0.761	0.459	0.807	1.378	3.935
H C L Infosystems Ltd.	8.506	0.338	11.715	1.826	9.909
H C L Technologies Ltd.	9.057	12.402	8.200	11.688	12.643
Hexaware Technologies Ltd.	0.729	0.775	0.689	1.050	0.841
Infosys Ltd.	30.630	30.741	28.919	37.346	8.493
K P I T Technologies Ltd.	0.677	0.607	0.731	0.790	1.710
Lycos Internet Ltd.	0.332	0.118	0.423	0.422	1.361
Mastek Ltd.	0.483	0.245	0.593	0.423	0.208
Mindtree Ltd.	1.916	1.196	2.235	1.394	1.231
Moser Baer India Ltd.	1.651	1.289	2.008	1.232	15.442
Mphasis Ltd.	2.666	2.403	2.893	3.373	2.852
N I I T Ltd.	0.548	0.259	0.644	0.600	1.427
N I I T Technologies Ltd.	0.823	0.708	0.908	0.809	0.618
Nelco Ltd.	0.154	0.068	0.195	0.022	0.717
Nucleus Software Exports Ltd.	0.221	0.133	0.234	0.349	0.236
Oracle Financial Services Software Ltd.	2.651	3.143	2.237	5.696	2.811
Polaris Consulting & Services Ltd.	1.392	0.662	1.746	1.003	1.004
R S Software (India) Ltd.	0.199	0.115	0.239	0.116	0.068
Ramco Systems Ltd.	0.157	0.068	0.179	0.265	1.268
Rolta India Ltd.	1.241	3.968	0.585	2.435	7.499
Sasken Technologies Ltd.	0.438	0.443	0.456	0.524	0.194
Smartlink Network Systems Ltd.	0.219	0.065	0.210	0.361	0.093
Sonata Software Ltd.	0.300	0.241	0.325	0.353	0.202
Subex Ltd.	0.292	0.140	0.296	0.574	4.431
T V S Electronics Ltd.	0.249	0.079	0.347	0.051	0.492
Tanla Solutions Ltd.	0.095	0.134	0.085	0.755	0.076
Tata Consultancy Services Ltd.	40.494	41.696	39.672	33.782	20.450
Tata Elxsi Ltd.	0.538	0.361	0.627	0.248	0.419
Tech Mahindra Ltd.	8.457	5.430	9.595	6.345	10.245
Trigyn Technologies Ltd.	0.069	0.028	0.080	0.134	0.057
Vakrangee Ltd.	1.178	0.486	1.294	0.728	2.151
Wipro Ltd.	28.163	22.951	31.093	27.961	52.714
Zensar Technologies Ltd.	0.659	0.404	0.722	0.566	0.273

Source: Calculated and compiled by the researcher

Looking at 3i Infotech's long-term debt and common equity balances from 2007-2016 in Table 5, an auditor might infer an strategy of trading assets greatly affected its economic fortunes, and these can be traced through the income statements and balance sheet changes identified from Table 4.

Table 5 3i Infotech Input and Output's raw data

2007 -2016	(O)Revenue	(O)NCFO	(I)OPEXP	(I)SHF	(I)TOSL
2007	523.05	112.72	270.2	461.65	727.29
2008	570.84	199.35	373.9	644.98	1279.9
2009	890.44	414.72	501.69	746.65	1921.22
2010	950.88	194.8	551.51	895.1	1994.45
2011	917.78	233.73	606.91	1068.24	2892.4
2012	811.59	-154.46	665.57	1009.04	2594.53
2013	711.44	36.45	435.38	1026.74	2711.52
2014	564.99	49.76	417.17	590.16	3323.42
2015	517.58	73.99	407.63	-384	3601.66
2016	867.34	34.74	357.4	298.26	1131.61

Source: CMIE Database

The switching in stability rankings provide a potential attention directing red flag for auditors to be alert to possible misstatements and to verify the reliability of the reported data by the client and the operating efficiency and cash flows from operations with which the client is pursuing its strategy, as compared to other firms in the same industry (or as compared to its own performance over a defined range of time series). The client's strategies *vis-a`-vis* its competitors' strategies can be verified by obtaining additional information from inside the company and outside industry sources. The combined period column in Table 4 provides an overall summary. The auditor can observe the limits to his (her) client's profitability, quality earnings, asset utilization, and leverage *vis-à-vis*its competitors by visually observing the actual values of variables employed by the DEA analysis.

4. SUMMARY AND CONCLUSION

This paper has attempted to apply the data envelopment analysis model as a tool for the analytical procedure to find out the fluctuation / anomalies over a period of time. We observed that most of the company's individual year performance rank is matching with the stability index rank. We have found that some of the companies' rankings are abnormal fluctuations, from this we try to found the reasonableness. This method potentially offers rich new insights into the performance of firms. We have shown how the method might be used to dissect a traditional ratio, in order to identify the reasons for a firm's performance over a period of time. The method addresses some of the problems of traditional ratio analysis mentioned in the introduction. We have believed that this model will helpful for the auditors as well as analysts at the planning level and they can red flag the abnormal fluctuations and moreover it is easy method to adopt.

In this paper we have used the small numbers of observations, and the difficulty of making judgments about firms employing unusual mixes of inputs, or producing unusual mixes of outputs. Careful scrutiny is required to determine whether a high efficiency ranking arises from genuine efficiency, or simply a lack of comparable competitors.

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