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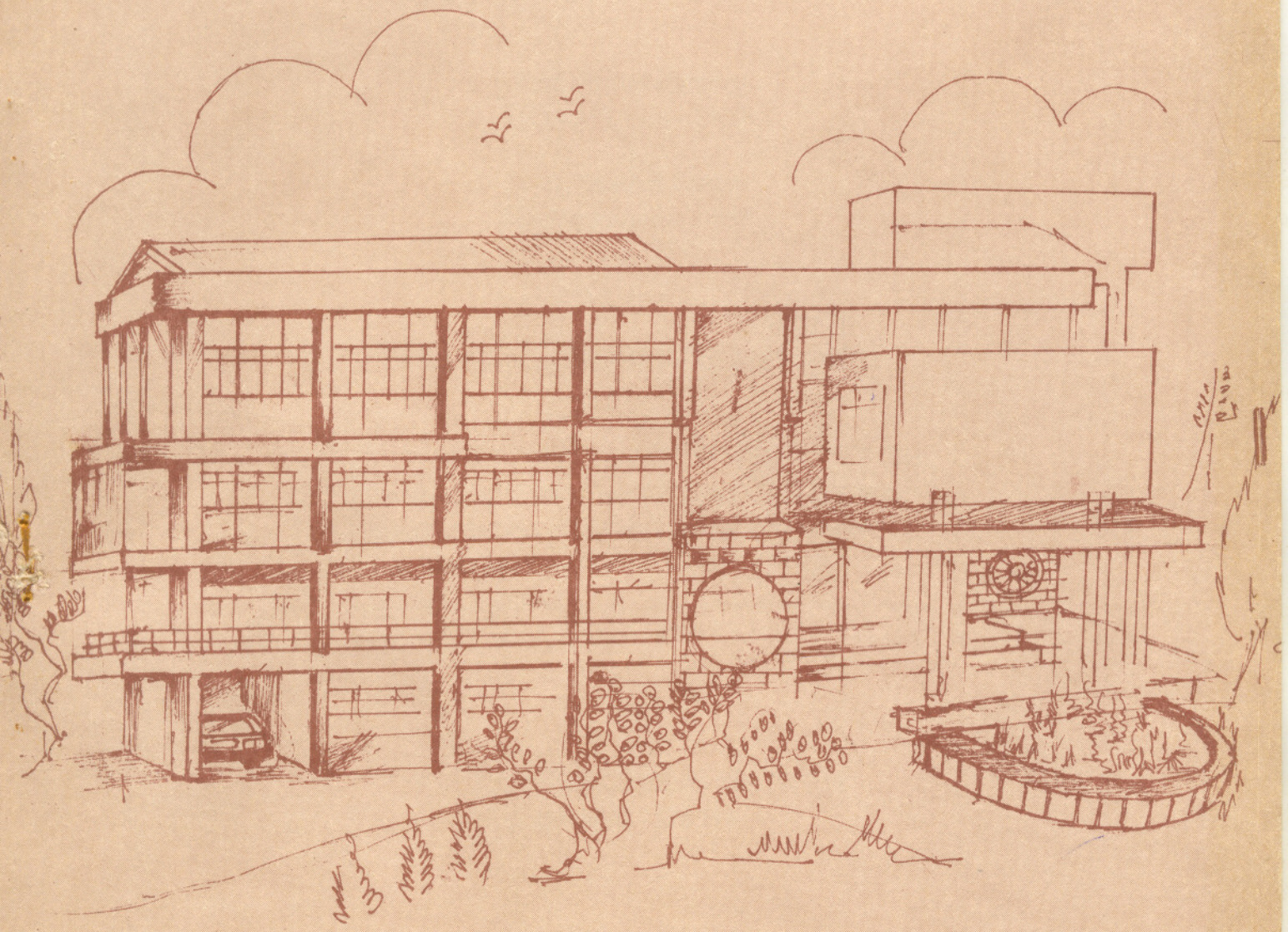
Financial Performance Index and Economic Value Added: A Comparison



Financial Performance Index and Economic Value Added: A Comparison

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Abstract

Though Economic Value Added (EVA) is being increasingly used by the companies world over for performance measurement, it has certain limitations. In this paper an attempt is made to develop an alternative measure of firm performance, Financial Performance Index (FPI), using data envelopment analysis. We here retain the desirable features of EVA and at the same time attempt to address some of the limitations of EVA. The results reveal that our performance index outperforms EVA as a performance measurement tool. We also find that FPI is a better predictor of stock returns. Therefore, FPI tells us not only which companies have performed well, it also tells us which stocks to invest our money in.

Key Words: EVA; FPI; DEA; AFRs.

1. Introduction

With the increasing recognition in the corporate circle that maximizing shareholders' wealth is the best corporate objective, companies world over have started taking strategic decisions that maximize the economic value added (EVA), and hence the shareholders' wealth. EVA quantifies the investors' wealth that the company generates in a particular year. EVA is based on a very simple and intuitive notion that firms create value for their investors only if they generate returns that are higher than what the investors expect.

EVA (of one particular year) however does not give due recognition to the forward-looking expenditures such as capital expenditure and 'research and development' expenditure. This is particularly serious in companies where the performance evaluation system is based on EVA. An EVA-based performance evaluation system works well in most of the situations. Thus for example, it prevents the top management from going for costly diversification. However, it is sometimes possible that EVA of future years could be increased by decreasing current year's EVA. Therefore, if the management is excessively preoccupied with maximizing a particular year's EVA (thereby ignoring future EVAs), then there is every possibility that it will take value-destroying decisions. Thus for example, the management may ignore any capital expenditure that has a longer gestation period. It might discourage the management from launching any new product or spending money on research and development.

To date we have not come across any paper, which addresses the above shortcomings of EVA. In this paper we are proposing an alternative performance evaluation measure which is based on an operations research tool called data envelopment analysis (DEA). DEA is a linear fractional programming based technique, which measures the relative performance of companies where presence of multiple inputs and outputs makes the comparison difficult. DEA (Charnes *et al.*, 1978) provides a system of weights allowing the

reduction of multiple accounting and financial ratios (AFRs) into a scalar performance measure. So the use of DEA in developing this scalar measure of performance allows us to weight the AFRs to create an optimal performance measure for the company. In the DEA literature this is usually dubbed as financial performance index (FPI) (Ozcan and McCue, (1996)). The companies that have the highest FPI are those that do the best in optimizing the AFRs being analyzed. In essence, the FPI becomes a financial report card for the institution.

While the DEA literature that addresses the efficiency/productivity is relatively abundant, the research on using DEA to evaluate FPI in manufacturing sector is quite sparse and fairly recent. Baring one study (Ozcan and McCue, 1996), we have not come across any paper that addresses the merits of FPI over AFRs. However, ours is the first empirical attempt to address the merits of FPI over EVA and compare them.

While computing FPI the choice of AFRs is very crucial because an arbitrary selection of the AFRs may lead to an FPI measure that does not truly reflect the actual performance of the company. In the study of Ozcan and McCue, only four accounting ratios, viz. Return on Assets (ROA), cash per bed, profit margin, and total asset turnover have been used to compute FPI. The use of ROA here is actually redundant because it is just the product of margin and total asset turnover. We have used eight AFRs, keeping in mind the objective of developing a comprehensive performance measure, superior to EVA and at the same time retaining the desirable features of EVA. Thus for example, we have included variables like research and development expenditure and capital expenditure having long gestation period, the true importance of which does not get reflected in EVA.

Ideally a firm performance measure should be highly correlated with stock returns. For only then the management would be encouraged to take decisions that maximize shareholders' value. Since investors are interested in knowing the efficiency of the firm to decide where to invest their money, we should also expect a high correlation between any measure of efficiency and stock returns. We have not come across any paper, which attempts to find out the underlying causal relationship between firm performance measure and the stock return. Our performance measure is found to be highly correlated with future stock returns. In an efficient market one should expect efficient firms to reward their shareholders more than the inefficient firms. If a firm uses our measure of performance to assess the performance of its top management, then it could properly align the interests of the management with those of the shareholders. EVA here is found to have no relationship with future stock returns. This clearly shows that an EVA-based performance measurement system does not always encourage the management to take value-maximizing decisions.

We have also compared the performance of the Indian companies with that of the multinationals. We find that the two sets of companies do not exhibit any difference in their performance pattern. This shows that

the structural adjustment processes initiated in 1991 in India have proved to be beneficial to the Indian companies.

The rest of the paper is organized as follows. Section II reviews the relevant literature and develops the hypothesis. Section III defines variables used in the DEA model. It also discusses the features of the sample used for this purpose. The major findings are reported in Section IV. Finally, Section V concludes the paper after discussing the various implications of the findings.

2. Development of Hypothesis

Fischer (1930)'s classic work has set the tune for the investors' wealth maximization objective. Since the modern industrial economy is characterized by a separation of ownership from management, there is a need for a performance evaluation system that encourages the management to maximize the shareholders' wealth. Traditionally, people use accounting-based measures to measure the performance of the management. These measures vary from a simple operating profit approach to more complex ones such as residual income approach and ROA approach. (For a detailed discussion of the different performance measures, see Horngren, Foster, and Datar (2000)). However, since these accounting based measures are not related at all to the stock returns, the use of such performance measures often becomes dysfunctional because sometimes they encourage the management to take value-destroying decisions. (For example, see Chapter 2 in Stewart (1991))

Economists recommend an alternative metric of performance, namely, economic profit. They define economic profit as the excess of total revenue over all opportunity costs of doing business during a given time period. This definition is different from that of accounting profit in that the accountant does not exclude the implicit costs of doing business. Thus for example, the accountants while computing the accounting profit do not subtract the return expected by the shareholders. Similarly, they subtract the actual interest expenses of the company and not the interest the company will pay if it borrows the amount *now*. Marshall (1890), for example, has commented "What remains of his (the owner or manager's) profits after deducting interest on his capital at the *current rate* may be called his earnings of undertaking or management" (Emphasis added). The economist's definition of profit is also known as EVA.

Miller and Modigliani (1961) further reinforce this definition of profit in the classic paper on dividend policy irrelevance. They show that a firm that generates a return, which is higher than what the investors expect, experiences an increase in its share price with growth. The dollar amount of difference between the wealth the company creates in a particular year and the wealth the investors expect to generate is called Economic Value Added (EVA).[1]

[1] Modigliani and Miller (1961) called it goodwill.

Stern Stewart and Co. made EVA very popular among the investors and the companies (For a detailed discussion on EVA, see Stewart (1991), and Copeland, Koller, and Murrin (1996)). EVA is directly related to the value of the company. If we add the present value of all the EVAs to the current book value of the company, then we will get the current market value of the company. This particular relationship between EVA and the value of the company tells us why there is a difference between the book and the market value of the company. It also tells us why some companies are more valuable compared to others. Another advantage of EVA is that it explains why some growing companies destroy value. It can be proved that if the EVA is negative, then a company's growth destroys value. Only those companies that earn a return that is higher than the minimum expected return add value by growing.

Since EVA is directly related to the value of the company, companies world over use it to measure the performance of the top management. Horngren, Foster, and Datar (2000)[2] have quoted a study from Schlank where it is found that most of the US companies use an EVA based performance system. This directly aligns the interests of the investors with that of the top management. This also reduces the agency costs inherent in any large company (See Jensen and Meckling (1976)).

Though the system works quite well in most instances, it has certain limitations, however. A Company reaps the benefits of capital expenditure and research and development expenditure only over a long time period. In this time period, as the company spends more on capital expenditure, its OIC increases. However, the Return on Capital Employed (ROIC) will not increase proportionately and hence will bring down EVA. Thus for example, the dot.com companies have to spend a lot of money on content development, and customer acquisition in the initial years of their existence. Since these expenditures get added to the book value of the assets, the EVA often turns out to be negative for such companies. Similarly, if a company spends more on research and development expenditure, it brings down ROIC unless of course all the R&D expenditures get capitalized. Hence it is possible that a company can increase the EVA by spending less on vital expenditures like research and development expenditure and capital expenditure. Such shortsighted actions though increase the EVA in one year, nevertheless decrease the wealth creating abilities of the companies. Most of the successful companies are using an EVA based compensation system in their companies. Given the above limitations of EVA, it is possible that the employees will take decisions that are detrimental to the long-term interests of a company.

This problem becomes particularly serious when the company uses an EVA-based performance evaluation system. The top management may not feel motivated to spend money on very essential items like research and development expenditure or product development. Such expenditures add to the book value of the

[2] See page 831.

company without adding substantially to the short-term profit reported by the company. This brings down the EVA reported by the company.

This creates serious problems for an organization. On the one hand, it must have a performance evaluation system that encourages the management to take decisions to maximize the value of the company. On the other, the very same performance evaluation system may discourage the management to take value-maximizing decisions. It is therefore necessary to develop an alternative performance evaluation system that retains all the desirable features of EVA and at the same time is free from the problems that an EVA-based performance evaluation system has. What is required is therefore a performance evaluation system that encourages the management to take strategic decisions that maximize the value for the shareholders.

Ratio analysis typically involves the use of a number of AFRs and it has traditionally been the standard method of choice in measurement of performance. In single input and single output contexts an AFR is a meaningful, easy to use measure of performance. However, this is not the case where multiple non-commensurate inputs and/or outputs are involved. The difficulty, highlighted also by Barrow and Wagstaff (1989) and Greenberg and Nunamaker (1987) among others, stems from the fact that each AFR reflects only one input and one output level and so it is difficult to gain an overall view of the performance of a company when not all of its AFRs indicate a similar level of performance.

The concepts underlying DEA and AFRs as instruments of performance measurements differ fundamentally. DEA rests on the economic notion of a production technology transforming inputs into outputs. It is a non-parametric approach for estimating maximum output levels for given input levels or minimum input levels for given output levels. These estimated levels are feasible under efficient operation within the transformation technology of the companies being assessed. The estimates lead not only to a measure of relative efficiency but also to other information, notably input and output levels, which would render a company relatively efficient.

There are a few numbers of studies in the literature that compare DEA and AFRs as alternative instruments of assessment of performance of companies. Thanassoulis et al. (1996) and Yeh (1996) in their studies find that these two methods disagree substantially on the relative performance of individual units. This is mainly due to the fact that DEA takes simultaneous account of all resources and outputs in assessing performance while ratio analysis relates only one resource to one output at a time.

However, as pointed out by Smith (1990) subjectivity is a major weakness with ratio analysis when evaluating overall firm performance. Ratio analysis combines or weights several AFRs into one overall performance indicator, often in an arbitrary manner. To over come this weakness, Ozcan and McCue (1996) use DEA that seeks a weighting system that results in the optimal financial performance measures

(called FPI) for the company. Their results show that FPI has captured what various AFRs indicate independently.

Recent applications of this new variant of DEA model include target setting of bank branch network by Lovell and Pastor (1997), measurement of macroeconomic performance of Taiwanese economy by Lovell (1995) and comparison of European and non-European countries in measuring macroeconomic performance by Lovell et al. (1995).

Keeping in mind the relative merits of DEA over other methods, we develop an alternative performance measurement indicator, FPI, that is based on the very same variables that define EVA and at the same time does not discourage the management from making value maximizing decisions. We also test the following hypothesis "efficient companies will reward their investors more, that is, they will generate higher stock returns compared to the inefficient companies."

3. Data and Methodology

We obtain the accounting and stock price data from the Prowess database prepared by the Center for Monitoring Indian Economy (CMIE) on the Indian companies. We obtain data on the cost of capital from the Indian business magazine, Business Today (BT).[3] As Table 1 suggests, in the Bombay Stock Exchange, around 90% of the stocks trade less than 15 times a day. Since we use stock price data, we restrict our sample to the most liquid stocks.

Table 1: Liquidity of Stocks in Bombay Stock Exchange

Number of trades less than or equal to	% of companies
1	56
2	71
4	80
15	90

Our final sample consists of 361 companies. This has been obtained in the following fashion. Initially we obtain data on all the companies comprising the BSE 500 Index and S&P CNX 500 index[4]. There are altogether 601 companies. Computation of EVA requires estimation of cost of capital of the companies. In India there is no public database that gives reliable estimates of beta (β) and cost of debt of the companies. Secondly, most of the Indian companies have borrowed working capital and term loans from banks and financial institutions, and since these instruments are illiquid, it is difficult to find the yield to maturity of

[3] Prepared by Stern, Stewart, and Co. Published in the Business Today in February 22 - March 6, 2000 issue. For details visit http://www.business-today.com.

[4] These indices are prepared by Bombay Stock Exchange and National Stock Exchange respectively. These are the two premier stock exchanges in India.

such instruments. There is no vibrant debt market in India either and this makes it very difficult to estimate the yield to maturity of bonds issued to the public. Since we find the cost of capital figures for 500 Indian companies from the February 22-March 6 issue of Business Today, we decide to include only those companies for which the data on cost of capital are available. There are no data on cost of capital for the pre-1998 figure. Hence we restrict our sample period to that year. We include only those companies lying at the intersection of the above 601 companies and BT's 500 companies. We obtain accounting data for the period ending March 1998.

3.1. Definition of the Variables

We have taken seven appropriate AFRs as the output variables in our DEA model (5). They are as follows.

1. Profit Margin
2. Asset Turnover
3. Sales Growth Rate
4. Return on Equity
5. Reciprocal of Past Returns
6. Sales / Capital Expenditure
7. Sales / Research and Development Expenditure

We do not include ratios like current ratio and coverage ratios though the financial analysts while analyzing the performance of the companies extensively use them. Though a high current ratio is good for the creditors, it may sometimes mean blocking of funds in non-return generating assets. Hence we can by no means generalize by linking a high current ratio with better performance by the company. Similarly, we do not include coverage ratio because the information contained in coverage ratio can be easily captured from ROE and asset turnover.

Our basic objective has been to develop a performance measure that encourages the management to take decisions, which maximize the shareholders' wealth. We have taken the above criterion into consideration while choosing the seven AFRs.

The first two AFRs are profit margin and asset turnover. It has been shown here that return on asset is actually the product of profit margin and asset turnover. Hence instead of taking ROA as one of the AFR, we decide to include both the components of ROA. By including margin and asset turnover, we try to capture one of the *best* features of EVA. This is because one of the major components of EVA is return on assets. It can be shown that for a given cost of capital, higher the return on assets, higher will be the value of the company, and hence, higher the stock price. Ozcan and McCue (1996) have used ROA, margin, turnover among other variables as output indicators to compute FPI. Since ROA is the product of margin

and turnover, we do not include all the three variables. ROA is defined as Profit before interest and taxes (multiplied by one-minus tax rate) divided by the total operating assets of the company.

$$ROA = \frac{EBIT * (1-t)}{Total\_Operating\_Assets}$$
$$= \frac{EBIT * (1-t)}{Sales} * \frac{Sales}{Total\_Operating\_Assets}$$
$$= margin * assets\_turnover$$

The above definition of ROA does not make any discrimination between levered and unlevered companies. As can be seen in the numerator of ROA, we multiplied EBIT with (1-*tax rate (t)*). Actually a company does not pay taxes on its EBIT. In most of the countries (including India), interest expenses are tax deductible expenses and hence the tax is computed on Profit before tax (PBT). However, the above definition is a preferred one because it does not make any discrimination between levered and unlevered companies and hence is a good measure of the operating performance of the company. We have subtracted the non-interest-bearing liabilities from the total operating assets because the implicit interests in the non-operating liabilities have already been deducted while computing EBIT.

Sales Growth Rate: Companies often attempt to increase their sales to increase their share prices. Growth, however, always does not add value. Growth in sales adds value only when the return on assets is higher than the cost of capital. Since we have included both profit margin and asset turnover as the two AFRs, we decide to include sales growth rate also as another AFR.

Sales/capital expenditure has been used as a proxy for assets expansion for a company. This ratio measures the effectiveness of the capital expenditure program of a company. As already explained, a company does not add value by merely spending money on capital expenditure. Capital expenditure will add to the value of the company if the return on assets is greater than the cost of capital. The financial performance of a company will therefore depend on both the return on assets, and the capital expenditure made by a company. It appears as if both sales growth rate and sales/capital expenditure capture the same information about a company, however they are actually different. The difference lies in the fact that the capital expenditure does not always immediately translate into sales because of its longer gestation period. If we ignore return on assets, then we will not be able to perceive the relationship between the financial performance of a company and the capital expenditure. Since we want all the AFRs to be maximized with single dummy input variable (to be explained later), we defined it as the ratio of sales and capital expenditure. Capital expenditure is defined as the change in net fixed assets plus depreciation. This definition computes the net capital expenditure for a company.

Sales / Research and Development Expenditure: In certain industries like the pharmaceutical industries, research and development expenditure plays a key role in determining the success of a company. We have included sales / research and development expenditure as another AFR in our model. For a company to grow in the long run, this ratio gives the effectiveness of the R&D activities of a company. This in turn leads to better financial viability and success.

Return on Equity

Return on Equity is defined as the ratio of the net profit for a year and the book value of equity. It is the product of profit margin, asset turnover, and leverage. We decide to include ROE as an additional AFR despite having included profit margin and asset turnover because of the leverage effect. We do not include leverage as a separate AFR because a high leverage does not always imply better performance. However, a judicious use of leverage can increase the market value of the company. ROE captures the effect of these three AFRs better. If a company actually uses high leverage, then the profit margin will get reduced, thereby reducing the ROE. Another reason for including ROE is that once we control for the cost of equity, it is positively related to the stock prices (For proof see Gordon (1963)).

Reciprocal of Past Return

All the above AFRs are dependent on the accounting profits made by a company. However, accounting profits do not always move with stock returns. Bajaj Auto, an Indian two-wheeler company, for example, has reported a 20% increase in profit in 1999-2000, but experienced a 37% decline in market value over the same period. Telco, an Indian automobile company, on the other hand generated an increase of 22% in the market value despite having reported a 67% decrease in profit. The last AFR that we have included in our DEA model is the reciprocal of past stock returns. This is a variable that is not directly linked to the performance of a company. However, we include this variable because of its close proximity to future stock returns. One of our objectives for the development of an alternative performance measure is also to find out an index that is capable of forecasting the stock returns of a company. Only such a performance measure can align the interests of management with those of the shareholders. Debondt and Thaler (1985) report that the market overreacts to the earnings announcements made by the companies. Lakonishok, Shleifer, and Vishny (1994) also report similar findings from US. If the stock market actually overreacts to earnings announcements, then one must expect a mean reversion in stock prices. Hence this AFR.

Definition of EVA

EVA measures the dollar (or rupee) amount of shareholders' wealth created in a particular year. It is defined as:

$$EVA = OIC * (ROIC - WACC)$$

where,

OIC = Operating Invested Capital,

ROIC = Return on Invested Capital, and

WACC = Weighted Average Cost of Capital.

It is based on sound economic principles, that is, a company creates value for shareholders only if it generates return that is higher than the minimum return expected by the shareholders of the company. The value of a company can be computed by adding the current book value of the company to the present value of the EVA expected to be created by the management over the life of the company.

It is directly linked to the value of the company by the following equation:

Value = OIC + PV (EVA).

Certain accounting adjustments are also made while computing EVA. One can refer to Stewart (1991) for further details.

3.2. Empirical Estimation Procedure

The following linear programming equivalent model of Charnes et al. (1978) is used, where E_j represents financial performance index (FPI) for a group of companies ($j = 1, 2, \ldots\ldots, n$), y_{rj} ($r = 1, 2, \ldots, s$) represents selected outputs and x_{ij} ($i = 1, 2, \ldots\ldots, m$) represents selected inputs (in this case a single dummy variable):

$$\max \quad E_o = \frac{\sum_{r=1}^{s} u_r^* y_{ro}}{\sum_{i=1}^{m} v_i^* x_{io}} \qquad \ldots\ldots(1)$$

$$subject \quad to: \frac{\sum_{r=1}^{s} u_r^* y_{rj}}{\sum_{i=1}^{m} v_i^* x_{ij}} \leq 1 \forall \quad j$$

$$u_r, \quad v_i > 0 \forall \quad r, \quad i$$

In this formulation, the weights for the outputs and inputs, respectively, are u_r and v_i. The notation '0' denotes a focal company. Each company becomes a focal company, in turn, when its efficiency score is computed. It is to be noted here that that inputs and output values as well as weights are assumed to be greater than or equal to zero. The weights used for each company are determined entirely from output data of all hospitals in the peer group. The values of x_{ij} were a single dummy input value of 1. Therefore, the weights used for each company are those that maximize the focal company's FPI. This model is based on the assumption of constant returns to scale (CRS), with a single dummy input of '1' for each company. Alternatively, model (1) can be equivalently stated as:

$$\min \quad G_o = \frac{\sum_{i=1}^{m} v_i^* x_{io}}{\sum_{r=1}^{s} u_r^* y_{ro}} \qquad \text{.....(2)}$$

$$subject \quad to: \frac{\sum_{i=1}^{m} v_i^* x_{ij}}{\sum_{r=1}^{s} u_r^* y_{rj}} \geq 1 \forall \quad j$$

$$u_r, \quad v_i > 0 \forall \quad r, \quad i$$

The DEA model (1) or (2) is a fractional linear program but may be converted into linear form in a straight forward way so that the methods of linear programming can be applied. The linear programming version of the model (2) is shown in model (3):

$$\min \quad G_o = \sum_{i}^{m} v_i^* x_{io} \qquad \text{.....(3)}$$

$$subject \quad to \sum_{r=1}^{s} u_r^* y_{ro} = 1$$

$$\sum_{i}^{m} v_i^* x_{ij} - \sum_{r=1}^{s} u_r^* y_{rj} \geq 0 \forall \quad j$$

$$u_r \quad v_i \quad > 0, \forall \quad r \quad i$$

The objective function has been linearised by recognizing that in minimizing a ratio it is the relative magnitudes of numerator and denominator that are important and not their actual values. Thus, in model (3) the denominator has been set equal to a constant (arbitrarily set at 1) and the numerator is being minimized. Since the model (3) has s + m variables and $n + m + s + 1$ constraints, it will be more time consuming to solve it than its dual. The dual of model (3) can be written as follows:

$$\max_{\theta,\lambda} \quad \theta^o \qquad \text{.....(4)}$$

$$s.t. \quad \sum_{j=1}^{n} \lambda_j y_{rj} \geq \theta^o y_{ro}, r = 1,2,....., s,$$

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq x_{io}, i = 1,2,....., m,$$

$$\lambda_j \geq 0$$

This dual need not be seen as a mere construct for computational convenience. It throws further light into the nature of the test of relative efficiency being undertaken in DEA. Model (4) seeks values of λ_j to construct a composite unit, with outputs $\Sigma\lambda_j y_{rj}$, $r = 1, 2, \ldots\ldots, s$, and inputs $\Sigma\lambda_j x_{ij}$, $i = 1, 2, \ldots\ldots, m$, outperforming unit '0'. The unit '0' will be efficient if slacks are zero and θ^o is equal to one. Conversely, if unit '0' will be inefficient θ^o will be greater than one and/or slacks are positive.

Assuming all the values of output variables as AFRs and value of single input as single dummy input value of 1 in the variable returns to scale (VRS) model, the model (4) can be modified into the following linear programming problem:

$$\max_{\theta,\lambda} \quad \theta^o \qquad \ldots\ldots\ldots\ldots(5)$$

$$s.t. \quad \sum_{j=1}^{n} \lambda_j y_{rj} \geq \theta^o y_{ro}, r = 1,2,\ldots\ldots,s,$$

$$\sum_{j=1}^{n} \lambda_j x_{ij} \leq x_{i0}, \quad i = 1,2,\ldots\ldots,m$$

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

$$\lambda_j \geq 0$$

The input constraint in this model (5) becomes $\Sigma_j\lambda_j \leq 1$ since $x_i = 1$ for all companies, which becomes redundant since the convexity constraint $\Sigma_j\lambda_j = 1$.

This is a simplified version of the Banker et al. (1984) output oriented model with a unique constant input, or equivalently, with no input. The objective of the problem is to maximize the radial expansion of the vector of AFRs for the company '0' being evaluated. The constraints of the problem limit this expansion to a convex combination of AFRs of other companies in the sample. Thus company managers select a mix of success ratio indicators, and this mix is allowed to vary from one company to another, reflecting variation in age, size and location of companies. The maximization problem then determines the proportion by which the success ratio indicators can be feasibly expanded in each company. The solution to the maximization problem provides a comprehensive performance indicator for the company '0', which Ozcan and McCue (1996) dubbed it as financial performance index (FPI). It is to be noted here that FPI is taken as the inverse of θ^o because θ^o is always greater than or equal to one by construction.

This model also identifies a set of optimally performing companies that are defined as perfect FPI and assigns them a score of one. These perfect FPI companies are then used to create a frontier, against which

other companies are compared. The companies that produce less weighted output per weighted inputs, than do companies defined by the model to be on the frontier, are considered technically poor performers. They are given FPI scores of less than unity, but greater than zero. Once a company is classified as having a perfect FPI relative to its peers, any sub-standard ratio, i.e. negative ROE or margin ratio, is not considered as deficient from the performance perspective. However, if a company is classified as a non-frontier company, one or more ratios of that company might be deficient with respect to companies on the frontier. It is important to be noted here that all outputs are treated as equivalent in the model, so that a high score on any one factor can offset a low score on another; hence the frontier companies need not excel on all fronts, provided they are very good on at least one.

4. Discussion of the Results

Descriptive statistics for each of the seven AFRs of our sample of Indian companies are presented in Table 2. Here the product of margin and turnover will not be exactly equal to ROE because ROE also captures additional information about leverage. The following seven AFRs are not exhaustive, however. We have included them for reasons of common sense. They are not derived from any theory.

Table 2: Descriptive Statistics of AFRs

AFRs	Average	Median	Standard Deviation
Sales/Capital Expenditure	33.92	14.4	167.99
ROE	12.77%	12.52%	23.45%
Margin	5.93%	5.48%	11.04%
Turnover	19.32 times	13.82 times	27.7 times
Reciprocal of return	1.71	3.03	23.25
Sales growth rate	19.81%	14.76%	26.34%
Sales/R&D	682.6	79.31	2438.69

4.1. Computation of FPI

Using the model 5, we compute the FPI scores for all the 361 companies assuming VRS technology. The DEA model generated FPI scores based on seven maximizing AFRs as given in Table 2. The FPI is defined as the reciprocal of the efficiency value. Since the above AFRs do not fall in any pre-specified range, we choose not to restrict the weights for observing the financial performance of the firms.

As already mentioned, we select the seven AFRs for reasons based on common sense. Our main objective is to find a measure that can be used to measure the performance of the management of the company. It is possible that we might have included a redundant AFR in our model in the sense that information contained in can be captured from other variables. In other words we are testing their collinearity. To get additional

evidence on the influence of the AFRs on FPI we regress the FPI scores on the actual values of the seven AFRs. A step-wise regression is run to find out the AFRs that have significant influence on the FPI scores.

Table 3: Regression Output: Dependent Variable FPI on outputs

	Independent Variables							
		1	2	3	4	5	6	7
Model	Const.	SRD	MGN	SGR	RRT	SCP	TNO	ROE
1	0.276	0.479						
	21.463	12.375						
2	0.23	0.436	0.0009					
	19.862	13.114	11.657					
3	0.223	0.424	0.0009	0.0003				
	21.791	14.436	14.008	10.138				
4	0.213	0.433	0.0009	0.0003	0.00003			
	21.515	15.451	14.529	10.554	6.083			
5	0.205	0.414	0.0007	0.0003	0.00003	0.0002		
	21.385	15.353	9.566	10.53	6.144	5.884		
6	0.19	0.416	0.0007	0.0003	0.00003	0.0002	0.000002	
	20.302	16.213	10.189	10.471	6.65	6.534	6.2	
7	0.174	0.418	0.0008	0.0003	0.00003	0.0002	0.000002	0.00009
	17.067	16.6	10.717	10.621	6.745	5.848	6.279	3.766

Legend:
SRD: Sales / R&D Expenditure
MGN: Profit Margin
SGR: Growth rate in net sales
RRT: Reciprocal of stock return
SCP: Sales / Capital Expenditure
TNO: Asset Turnover
ROE: Return on Equity

The figures in the parentheses represent *t*-statistics. All the coefficients are found to be significant at $p < 001$.

As can be seen from Table 3, Sales-to-research and development expenditure is the most significant amongst the seven variables. The remaining six AFRs in order of their significance are profit margin, sales growth rate, reciprocal of stock return, sales to capital expenditure, asset turnover, and return on equity respectively. As can be seen from the t-values, all the seven AFRs are statistically significant. We can see some interesting patterns from Table 3.

Here we find a positive relationship between FPI score and sales growth rate. This means our model is rating companies with high sales growth as highly efficient. This is one place why our model scores over EVA. Usually one should expect no relationship between sales growth rate and EVA. This is because the difference between the return on assets and the cost of capital is a confounding variable in any regression of EVA on sales growth rate. Since we adjusted for the different components of cost of capital (margin and turnover), we could find a positive relationship between our performance measure and sales growth rate.

We also find that ROE is the least important variable. This is because the information contained in ROE is partly captured in margin and turnover. ROE also captures the effect of leverage. Leverage is positively

related to the performance of a firm. Modigliani and Miller (1963) have found that leverage adds value to the company. It is also possible that the well performing companies are confident of future and therefore are more levered.

Table 4: The Top 15 Companies Ranked as per FPI

Company Name	FPI	EVA	SCP	ROE	MGN	TNO	RRT	SGR	SRD
B F L Software Ltd.	1	4.624	8.872	94.410	27.470	12.728	0.980	0.667	0.000
Floatglass India Ltd.	1	-36.203	10.003	-109.430	-19.630	0.890	9.091	2.029	0.000
Grindwell Norton Ltd.	1	-0.691	30.089	9.220	5.540	11.218	100.000	0.118	304.431
Gujarat Sidhee Cement Ltd.	1	-64.669	52.964	196.450	-34.920	1.047	1.852	-0.042	0.000
Ispat Industries Ltd.	1	-57.878	1.421	1.800	1.150	3.277	50.000	0.227	32743.250
Krebs Biochemicals Ltd.	1	0.610	1.371	36.080	41.430	4.256	2.222	0.610	18.162
M R F Ltd.	1	0.933	18.290	30.900	4.390	438.748	20.000	0.121	136.786
Mahavir Spinning Mills Ltd.	1	0.489	8.702	14.420	7.440	23.805	100.000	0.152	460.707
S S I Ltd.	1	1.062	3.458	40.650	24.060	16.845	1.176	1.369	0.000
Sierra Optima Ltd.	1	0.864	13.078	46.950	26.090	4.597	1.538	1.302	0.000
Supreme Petrochem Ltd.	1	-0.881	13.970	20.910	3.480	3.728	4.000	2.019	0.000
Su-Raj Diamonds (India) Ltd.	1	-1.819	2943.563	5.390	4.910	12.145	2.273	-0.047	0.000
Thermax Ltd.	1	-1.344	45.811	8.870	6.070	19.034	100.000	0.085	79.306
Trent Ltd.	1	-1.507	0.389	4.590	80.450	0.720	-100.000	-0.477	0.000
Varun Shipping Co. Ltd.	1	-2.570	1.625	4.370	4.130	3.847	100.000	0.146	0.000

FPI: Financial Performance Index
EVA: Economic Value Added
SCP: Sales/Capital Expenditure
ROE: Return on Equity
MGN: Profit Margin
TNO: Asset Turnover
RRT: Reciprocal of Return
SGR: Sales Growth Rate
SRD: Sales/Research and Development Expenditure

4.2. Comparison of FPI and EVA

The DEA results in Table 4 reveal that fifteen of the 361 companies are qualified to be top performers. We also present the EVA and the values of the seven AFRs of these fifteen companies. Ideally, one should expect these efficient companies to generate high EVA during the sample period. But as the results indicate, as many as nine companies with an FPI score of unity have generated negative EVA. The sign of EVA is entirely dependent on the spread between return on assets and the cost of capital of a company. However, our measure of performance is dependent on seven AFRs and hence this result is not surprising. If one looks at Table 4, one will find that companies that have got negative EVA are the ones with either negative margin or a lower (or negative sales growth rate) sales growth rate. These companies have been rated efficient as per our measure because they have scored high on other AFRs. Thus for example, Ispat Industries Limited has reported an abnormally high value of sales to research and development expenditure of 32743.5, which might have caused this firm to be on the frontier. Hence despite a negative EVA, it has been rated efficient by our performance measure.

Table 5: The Bottom 15 Companies Ranked as per FPI									
Company Name	FPI	EVA	SCP	ROE	MGN	TNO	RRT	SGR	SRD
Sri Vishnu Cement Ltd.	0.06429	-0.830	27.628	2.870	0.300	5.162	1.299	0.049	0.000
Cable Corpn. Of India Ltd.	0.06256	-3.761	42.567	-18.780	-13.470	8.659	-5.000	0.032	523.161
Birla V X L Ltd.	0.06240	-0.299	1.070	-1.060	-0.440	2.860	5.000	-0.101	598.119
Tata Engineering & Loco. Co. Ltd.	0.06187	-27.583	6.248	-2.580	-1.250	21.428	-11.111	0.026	52.847
Sandvik Asia Ltd.	0.05831	-2.936	13.293	-9.220	-2.860	8.583	-11.111	0.065	143.586
Max India Ltd.	0.05451	-1.226	-4.291	-4.310	-4.980	9.862	1.471	0.053	0.000
Ambalal Sarabhai Enterprises Ltd.	0.05143	-28.143	-132.168	-45.050	-12.070	3.746	3.448	0.026	199.336
Goetze (India) Ltd.	0.05122	-2.238	12.397	2.230	1.830	6.152	-11.111	-0.029	0.000
Alpha Drug India Ltd.	0.04716	-11.391	12.238	-23.480	-11.700	1.100	3.030	0.032	0.000
J C T Electronics Ltd.	0.04486	-6.082	1.696	-19.710	-8.810	4.969	3.704	-0.069	0.000
Kesoram Industries Ltd.	0.03368	-4.990	24.040	0.960	0.450	8.702	-20.000	0.001	0.000
Mafatlal Industries Ltd.	0.02996	-14.082	8.223	-95.150	-31.970	8.218	-6.250	-0.112	287.280
Wimco Ltd.	0.01454	-2.626	-47.146	-42.670	-4.620	5.635	-11.111	0.005	0.000
Timex Watches Ltd.	0.00922	-9.512	14.780	-50.110	-25.750	1.526	-100.000	0.002	0.000
Fujitsu Icim Ltd.	0.00766	-3.729	-11.913	-67.550	-30.000	0.423	0.719	-0.519	0.000

FPI: Financial Performance Index
EVA: Economic Value Added
SCP: Sales/Capital Expenditure
ROE: Return on Equity
MGN: Profit Margin
TNO: Asset Turnover
RRT: Reciprocal of Return
SGR: Sales Growth Rate
SRD: Sales/Research and Development Expenditure

Companies that are the least efficient as per the FPI criterion are found to have generated negative EVA. This shows that as far as the bottom (the inefficient) firms are concerned, there is not much of difference between the two criteria. One possible explanation for this is that most of the inefficient companies spend hardly any amount on research and development expenditure. Since this AFR explains the difference between the efficient companies as per the FPI criteria and the companies with negative EVA, the above result is not surprising. We find that there are only two companies, namely Tata Electronic and Locomotive Company Limited and Ambalal Sarabhai Enterprises Limited that have been rated inefficient by both FPI and EVA criteria.

Table 6: The Top 15 Companies Ranked as per EVA									
Company Name	FPI	EVA	SCP	ROE	MGN	TNO	RRT	SGR	SRD
Hindustan Lever Ltd.	0.61342	100.204	37.296	54.370	7.880	48.319	5.263	0.319	262.833
I T C Ltd.	0.38510	36.3207	7.322	31.630	8.040	14.384	5.882	0.104	339.416
Castrol India Ltd.	0.64087	19.9205	68.323	43.590	16.190	16.597	10.000	0.118	334.915
Nestle India Ltd.	0.40515	16.0925	43.378	39.040	6.500	15.035	3.333	0.113	0.000
Hitech Drilling Services India Ltd.	0.83115	14.6742	35.988	45.870	23.650	7.382	14.286	0.532	0.000
Hero Honda Motors Ltd.	0.57454	11.9121	13.246	48.490	7.820	51.163	3.846	0.340	440.471
Wipro Ltd.	0.45903	11.7943	14.421	42.970	8.820	30.375	1.389	0.243	74.413
Punjab Tractors Ltd.	0.57076	9.24007	35.863	47.710	11.380	48.455	3.704	0.271	294.661
Goodricke Group Ltd.	0.58821	8.55576	28.189	35.810	12.650	7.961	4.167	0.113	5731.667
Novartis India Ltd.	0.36882	8.27404	23.544	27.450	9.240	22.414	2.857	0.119	119.215
Oil Country Tubular Ltd.	0.27273	8.16446	-18.670	-38.420	6.610	3.749	12.500	0.133	115.992
Colgate-Palmolive (India) Ltd.	0.17402	8.06421	17.509	14.700	4.230	6.966	-20.000	0.114	27.488
Glaxo India Ltd.	0.31897	8.02248	60.842	22.600	7.690	14.859	3.030	0.016	197.400
N I I T Ltd.	0.72518	7.71733	30.069	44.490	24.040	17.618	1.852	0.402	150.739
Tata Tea Ltd.	0.51217	7.47776	16.741	30.820	14.550	17.340	7.143	0.208	181.694

FPI: Financial Performance Index
EVA: Economic Value Added
SCP: Sales/Capital Expenditure
ROE: Return on Equity
MGN: Profit Margin
TNO: Asset Turnover
RRT: Reciprocal of Return
SGR: Sales Growth Rate
SRD: Sales/Research and Development Expenditure

Table 6 reports the scores of the FPI. EVA and the seven AFRs of the top fifteen companies as per the EVA scores. We find here that none of these companies is efficient as per the FPI criterion. If one looks closely at the scores of the seven AFRs of these fifteen companies, one will find that these companies spend less on research and development and on capital expenditure. The past stock returns of these companies have also been very high. This is again not surprising since we have claimed in the beginning that our measure is different from that of EVA particularly on this ground.

Table 7: The Botom 15 Companies Ranked as per EVA

Company Name	FPI	EVA	SCP	ROE	MGN	TNO	RRT	SGR	SRD
Oswal Agro Mills Ltd.	0.35996	-22.658	4.739	0.210	0.390	2.600	9.091	0.045	11634.333
Indo Rama Synthetics (India) Ltd.	0.31802	-24.527	13.908	-40.780	-11.360	7.568	-50.000	0.608	0.000
Arvind Mills Ltd.	0.07394	-24.589	1.377	-3.460	-4.270	6.030	-4.545	0.124	0.000
Century Textiles & Inds. Ltd.	0.10739	-25.134	19.646	-10.560	-4.790	10.068	-11.111	0.096	1207.205
Tata Engineering & Locomotive Co. Ltd.	0.06187	-27.583	6.248	-2.580	-1.250	21.428	-11.111	0.026	52.847
Ambalal Sarabhai Enterprises Ltd.	0.05143	-28.143	-132.168	-45.050	-12.070	3.746	3.448	0.026	199.336
Oswal Chemicals & Fertilizers Ltd.	0.41884	-29.838	0.672	7.470	8.230	2.300	5.882	0.542	0.000
Floatglass India Ltd.	1.00000	-36.203	10.003	-109.430	-19.630	0.890	9.091	2.029	0.000
Ispat Industries Ltd.	1.00000	-57.878	1.421	1.800	1.150	3.277	50.000	0.227	32743.250
Essar Steel Ltd.	0.17367	-60.784	-3.393	-27.780	-24.280	6.046	-12.500	0.327	0.000
Essar Oil Ltd.	0.10290	-61.553	0.238	1.370	7.670	0.740	-25.000	-0.084	0.000
Gujarat Sidhee Cement Ltd.	1.00000	-64.669	52.964	196.450	-34.920	1.047	1.852	-0.042	0.000
Reliance Industries Ltd.	0.33974	-72.069	9.819	17.310	11.660	10.882	-50.000	0.231	303.834
Daewoo Motors India Ltd.	0.10674	-93.290	0.393	-5.770	-10.630	0.539	-25.000	0.214	22.520
Usha (India) Ltd.	0.19569	-96.472	55.830	1.540	1.140	3.269	1.389	0.302	568.181

FPI: Financial Performance Index
EVA: Economic Value Added
SCP: Sales/Capital Expenditure
ROE: Return on Equity
MGN: Profit Margin
TNO: Asset Turnover
RRT: Reciprocal of Return
SGR: Sales Growth Rate
SRD: Sales/Research and Development Expenditure

The findings reported in Table 7 are very similar to those reported in Table 5. As far as the bottom companies are concerned there is not much difference between the two criteria. Another interesting observation that one can see is that three of the companies, which have generated the least EVA are actually rated the most efficient as per the FPI criterion. As is seen from the above table, these companies have either reported a very high sales to R&D expenditure or a very high sales growth rate or a very low past stock returns (and hence a very high reciprocal of stock returns), which might lead them to operate on the frontier.

We find from the above four tables that there is a difference between the FPI criteria and EVA as far as the efficient companies are concerned. To gain additional insight into the difference between these two criteria, we have estimated the average scores of the seven AFRs of the top and the bottom fifteen companies as per both the criteria. Table 8 summarizes the findings.

Table 8: A comparison of average AFRs between the top and bottom fifteen companies based on FPI and EVA

Variables	Average Top 15 Companies		Average Bottom 15 Companies	
	FPI	EVA	FPI	EVA
Sales / Capital Expenditure	210.24	18.84	-2.09	5.98
ROE	27.04%	21.19%	-24.91%	-24.83%
Margin	12.14%	10.6%	-9.69%	-20.57%
Turnover	37.13 times	13.23 times	6.47 times	5.62 times
Reciprocal of Return	26.21	0.58	-10.47	-3.29
Sales Growth Rate	55.18%	18.51%	-4%	43.6%
Sales / R&D	2249.51	119.79	122.29	204.67

One can see from Table 8 that as far as the top fifteen companies are concerned, FPI clearly scores over EVA. Companies, which generate the maximum EVA, are not necessarily the ones who do well along the seven AFRs. Now we have a convincing answer as to why there is a difference between the rankings made by FPI and EVA. However, as far as the bottom companies are concerned, there is no clear difference between these two criteria. Ideally, one should expect the seven AFRs to take the lowest possible values for the least efficient companies. However, for some of the AFRs like profit margin and asset turnover, the AFRs are lower for the bottom EVA companies compared to the bottom FPI companies.

4.3. FPI and Stock Returns

One of the problems of an EVA based performance evaluation system is that it does not always encourage the management to take value maximizing decisions. If the shareholders want the management to take value-maximizing decisions, then they must adopt a performance evaluation system that properly aligns the interests of the shareholders and the management. Hence an ideal performance evaluation system should exhibit a high correlation between the performance measure and the future stock returns.

EVA measures the value created by the companies in a particular accounting year. FPI is an alternate measure of the performance of the company. Since we have accounted for the shortcomings of EVA in FPI, it is natural to expect that FPI will be a better predictor of stock returns. We regress stock returns of the year ending 1999-2000 on the FPI (and EVA) based on accounting data as at the end of April 1999. This way we ensure that we have the data required for computing FPI (and EVA) before we construct the portfolios.

Tables 8 and 9 present the summary of the regression statistics. As is seen here, there is hardly any relationship between EVA and stock returns. That is, if an investor buys shares of companies that have generated higher wealth in a particular year, they are not assured of doing well in the stock market. FPI, on the other hand, is highly correlated with stock returns. Hence our measure of corporate performance not only tells us which firm has performed better in a particular year, it also tells us which stocks to buy!

Table 9: Regression output of Return on FPI

Return =	0.83767 +	1.024553	* FPI
Standard error	(0.229381)	(0.52516)	
t-statistic	3.651876	1.950907	
p-value	0.000299	0.052	
R-squared	0.010491		
Adjusted R-squared	0.007734		

Table 10: Regression output of Return on EVA

Return =	1.23692 -	2.9E-05	*EVA
Standard error	(0.135713)	(8.9E-05)	
t-statistic	9.11418	-0.11193	
p-value	5.7E-18	0.749736	
R-squared	0.000284		
Adjusted R-squared	-0.0025		

4.4. Comparison of the Ranks

To get additional evidence on the relationship pertaining to EVA and FPI, we have conducted a chi-square independence test between EVA rank and FPI rank. This test is based on the assumption that the estimates of EVA and FPI rank computed using different methods are independently distributed. We independently sort all the stocks into five quintiles based on their EVA and FPI scores. The first four quintiles contain 72 stocks each, while the last quintile contains 73 stocks. Table 10 reports the results of the chi-square contingency table. As expected, the chi-square value of 29.25 indicates that there is a statistically significant difference between these two sets of estimates.

Table 11: Comparison of EVA and FPI Rank

		EVA Rank					Total
		1	2	3	4	5	
FPFRaRank	1	28 (14.360)	10 (14.360)	15 (14.360)	7 (14.360)	12 (14.560)	72
	2	1 (14.360)	19 (14.360)	14 (14.360)	18 (14.360)	11 (14.560)	72
	3	13 (14.360)	15 (14.360)	13 (14.360)	16 (14.360)	15 (14.560	72
	4	12 (14.360)	14 (14.360)	16 (14.360)	16 (14.360)	14 (14.560)	72
	5	9 (14.560)	14 (14.560)	14 (14.560)	15 (14.560)	21 (14.762)	73
Total		72	72	72	72	73	361

(Figures in the parentheses represent expected frequencies.)

$\chi^2 = 29.2506$ (Degrees of freedom = 16) with $p < 0.025$.

4.5. Comparison of Performance of Between Indian Companies and the Multinationals

There is a widely held hypothesis that multi national companies are more efficient than the Indian companies. They have wider access to latest technology and cheaper sources of funds. However, due to the liberalization process started by the Government of India since 1991, these two advantages are no more unique to the multinational companies. We therefore expect the Indian companies to perform at par with he multinational companies. Our results also confirm (Table*) the above. In fact we find that the stock returns generated by the Indian companies are significantly higher than that generated by the multinational companies.

Table 12: Comparison of Performance of Between Indian Companies and the Multinationals

Companies (No of companies)	Stock Return		FPI		EVA (In Rupees Crores) (1 crore = 10 million)	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Multinational (87)	63.5%	121.9%	0.365	0.223	-0.915	18.756
Indian (274)	140.3%	253.4%	0.373	0.234	-2.7	10.677
Difference (t-stat)	3.801		0.262		-0.841	

The EVA generated (destroyed) by the Indian companies is lower than that generated by the multinational companies. However, there is no significant relationship between the two.

5. Summary and Conclusion

Individual AFRs are generally used to keep track of a company's financial condition. However, when several non-aggregated individual AFRs are used at one time, there is no clear-cut rationale for using one combination of ratios over any other to obtain an overall composite score. Through an empirical study of Indian companies, this paper demonstrates how the use of DEA is made possible to help aggregate the puzzling ratios into meaningful FPI score that links with financial characteristics of a company.

We find that a model that captures the effect of capital expenditure and research and development expenditure performs better than an EVA based model. This is a very useful findings as far as the consultants are concerned. Consultants are in search of a performance evaluation measure that can address some of the problems of an EVA based measure. We hope our alternate measure will be able to fill the void. Fund managers can also use the FPI index as a stock selection criterion. All that they need to do is to select stocks that have a high FPI score, preferably closer to 1.

We have done our analysis for a very restricted sample period. Unlike in US, in India there is no database available that gives data for the cost of capital of companies. Most of the debt instruments issued by the Indian companies are not traded at all and hence it is very difficult to find out the cost of debt for an Indian company. We find out a comprehensive database on cost of capital for 500 Indian companies for the year 1998-99. Hence we had to restrict our sample period to one particular year. This study points to avenues of future research. We propose here to do this exercise for a larger sample for an extended time period to have robust results.

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