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Productivity Growth As The Predictor Of Shareholders' Wealth Maximization: An Empirical Investigation

by

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Abstract

The economic value added (EVA), orginally developed by Stern Stewart & Company, is a relatively new financial tool that is being adopted successfully by many firms. However, evidence of EVA as a predictor of shareholders' wealth is mixed. This paper empirically verifies the effect of productivity growth, *a real missing link* between EVA and a firm's financial health, on shareholders' wealth maximization. The study uses the firm-level data from the Indian food processing industry for the period 1993-94 to 2005-06 to measure and decompose the Malmquist productivity index into its different components, such as technological change, pure efficiency change and change in scale efficiency, by using the technique of data envelopment analysis (DEA). It further examines the linkage between different components of productivity change and market value added, an indicator of shareholders' wealth maximization, by using fixed effect regression models. The results reveal that the negative growth in total factor productivity (TFP) change is mainly due to technological regress on the one hand and increasing inefficiencies of the firms on the other hand. The scale efficiency change is found to be the only source of TFP change in the Indian food processing industry. As expected, there exists a positive relationship between the components of TFP change and the MVA. However, the technological change is found to be the only driving force of market value in the Indian food processing industry, indicating that the stock market does recognize the innovative activity undertaken by firms.

Keywords: economic value added, shareholders' wealth, malmquist productivity index, techological change, pure efficiency change, scale efficiency change, fixed effect regression models..

Introduction

Rapid and complex changes in the economic and business environment are posing serious challenges to today's business firms. Meeting these challenges requires effective measures for control and performance evaluation. Maximizing shareholders' wealth has become the new corporate paradigm. For a number of years now, accounting measures such as earnings, return on assets, and return on equity have been criticized and found wanting as performance indicators leading to greater shareholder wealth (Ehrbar 1998; Johnson, Natarajan, & Rappaport 1985; Rappaport, 1986; Stewart, 1991). Although maximizing shareholders' wealth has traditionally been recognized by managers and researchers as the ultimate corporate goal, it has gained a new dimension in recent years after the emergence of evaluation metric- economic value added (EVA), originally pioneered by Stern Stewart & Co., New York. In recent years, EVA has been used by companies worldwide to help them assess their financial performance. In its essence, EVA is net operating profit after taxes (NOPAT) less the dollar cost of the capital required to create that profit. Management guru Peter Drucker (1995) points out that EVA is a fundamental measure of Total Factor Productivity that reflects all the dimensions through which management may increase value. According to Ray (2001), the missing link in the EVA process is productivity, a factor which has been ignored by both the proponents and the critics of EVA. The EVA is simply a measurement tool, which points out where value is being created by firms and where it is not. In other words, EVA does not create value, it simply measures the value. In a rational market, maximizing EVA should maximize the firm's share price and hence the shareholders' wealth. The reason why the firm's financial status might improve after EVA adoption is twofold: (a) the measurement effect, and (b) change in productivity.

The performance of employees in terms of quality and/or quantity increases when they know that their performance is being measured. After all, almost everyone performs better when they know they are in the limelight, especially when they know that their livelihoods are at stake. As applied to EVA, this self-fulfilling effect means that every person in the firm knows that they are being held accountable for every dollar allotted to them. Moreover, each person also knows that they are expected to turn that dollar into something greater than a dollar – say $1.15. As might be expected, EVA thus spurs people to perform to their highest ability as quickly as possible. Not surprisingly, this "survival incentive" causes greater value to be created for the customer. However, it is difficult to show the impact of this effect on shareholders' wealth because of difficulty in its measurement.

The real missing factor at play in the EVA process is productivity, according to Ray. In the long run, productivity is the driving force behind success at every level: national, industry, firm, division, department, and even at the individual level. At the national level, countries with powerful productivity continually enjoy rising standards of living and greater productive capacities. At the corporate level, productive firms generally realize rising share prices and, in fact, improved performances in all their financial areas (profits, cash flow, stock prices, etc.). If the cost of capital is given, then obviously the only way for a reasonably efficient firm to increase its EVA is to increase its return on capital, which can be achieved through positive change in productivity. The gain in productivity can take place through technological advancement, a "catching-up" factor, or by moving the operation of the firm to the most productive scale size. In general, these factors combine to accomplish one or more of four outcomes: (a) increased output per work-hour, (b) increased quality, (c) decreased costs, and (d) decreased error/defects. Any of these four productivity outcomes alters the quality/price which is perceived/paid by the customer, thus improving the value for the customer.

Hence, linking the productivity growth with market value added could be quite useful from the policy perspective for business firms. A slowdown in productivity (which may lead to erosion in shareholders' wealth) owing to increased inefficiency indicates the need for a different policy measure than would be required to tackle a slowdown owing to lack of technological change. Policy actions intended to improve the rate of TFP change (which may lead to shareholder wealth maximization) might be badly misdirected if focused on accelerating the rate of innovation in circumstances where the cause of a lag in growth is a low rate of mastery or diffusion of best practice technology. Given the level of technology, explicit resource allocation may be required to reach the best-practice level of technical efficiency in order to improve productivity and thus shareholders' wealth maximization over time.

There are a number of value based management (VBM) frameworks. Shareholder value analysis (SVA), developed by Rappaport (1986), and economic value analysis (EVA), developed by Stern Stewart & Co., New York, are the two best-known ones. However, there exist many challengers: cash value added (CVA), developed by Ottoson and Weissenrieder (1996), and cash flow return on investment (CFROI) by Madden (1998), are two of them. A number of empirical research studies have been undertaken by academicians to explain the variations in shareholders' wealth through traditional performance measures as well as by applying the newest evalution metric, EVA.

Stewart (1991) first studied the relationship between different evaluation measures, using the market data of 618 companies. He observed that the relationship between EVA and MVA is highly correlated among U.S. companies. Lehn and Makhija (1996), in their study of 241 U.S. companies over two periods (1987-1988 and 1992-1993), observed that EVA is positively correlated with MVA and that EVA slightly outperforms other traditional performance measures, such as return on assets (ROA), return on equity (ROE), and so on.

On the predicting power of EVA in explaining the MVA or shareholders' wealth, serveral researchers (Grant, 1996; McCormack & Vytheeswaran (1998); Milunovich & Tsuei, 1996; O'Byrne, 1996; Uyemura, Kantor, & Petit, 1996) observed that EVA is better correlated with MVA than are other traditional parameters such as return on capital employed (ROCE), return on net worth (RONW), earning per share (EPS), and so on.

However, some researchers reported adverse findings too. Dodd and Chen (1996) found that ROA explained stock returns better than did EVA. Hamel (1997) was critical about the superiority of EVA. He was of the opinion that EVA reveals little about a company's share of new wealth creation. According to Kramer and Peters (2001), NOPAT, a readily available measure of financial performance, is tied more closely with MVA than with EVA. Clinton and Chenn (1998) compared EVA's ability to explain stock returns with a variety of other traditionally reported, residual-based, adjusted, and cash based measures. They found that EVA is the only measure that does not consistently reflect stock returns. Swain, Mishra, and Kumar (2002) focused on 28 top (in terms of sales in 2000-01) pharmaceutical companies in India. The study found that EVA, NOPAT, and sales assessment outperform other financial and economic measures in predicting MVA in most of the companies in the Indian pharmaceutical industry. However, in the long run, no evidence was found to support the above findings for the industry as a whole.

Most of the literature on the current issue has ignored the economic variable "productivity," which acts as the real missing link between EVA and shareholders' wealth. It is well known that business analysts observe large, persistent differences in the productivity of plants within narrowly defined industries (Baily, Campbell & Hulten, 1992; Bartelsman & Dhrymes, 1991; Dwyer, 1998; Olley & Pakes, 1997). If high relative productivity represents a true competitive advantage, then it should act as an intangible asset, and firms with highly productive manufacturing plants should have high market valuations.

Few studies have been done to link productivity with the market value of firms. In one of the studies by Dwyer (2001), it was found that firms with high productivity have higher market valuations, as measured by Tobin-q, providing the evidence of a linkage between the two. However, this study takes into consideration partial productivities such as labor and capital productivity, and an average of the above two productivity indexes. Partial factor productivity, however, can be misleading in drawing any conclusion about the performance of the input. For example, an increase in the output per unit of labor may not necessarily contribute to an increase in labor productivity because other inputs (capital, skilled workers, etc.) are used simultaneously in the production process. Swain et al. (2002) examined the relationship between MVA with economic variables such as capital productivity, labor productivity, and TFP along with other financial measures in pharmaceutical companies in India. However, they could not find any definite relationship between the two. This could possibly be because of (a) the comparatively small sample size in their study, and (b) the inclusion of too many variables in the model. Further, their measurement of TFP change was based on a traditional nonfrontier growth-accounting approach, which could not be decomposed into its different components and, thus, the detailed examination of variations in market value through TFP change could not be ascertained.

These findings reported in this paper verify the linkage between shareholders' wealth maximization and the different components of productivity change. The technique of data envelopment analysis is used to measure and decompose the Malmquist productivity index into technological change, pure efficiency change, and scale efficiency change in the Indian food processing industry during the period spanning 1993-94 to 2005-06. Further, the link between the market value of firms and the different components of productivity change are established through fixed-effect regression models to identify the dominating factor(s) of shareholders' wealth.

The rest of the paper proceeds as follows: Section 2 provides the overview of the Indian food processing industry and presents various arguments, highlighting the issue of productivity and shareholders' wealth. Section 3 deals with the theoretical background wherein the detailed computational procedures for decomposition of the Malmquist productivity index are elaborated. The data concerning the selection of inputs and outputs, and their sources are provided in section 4. Section 5 presents the results of the empirical analysis, followed by managerial implication in section 6. Finally, section 7 concludes the study with limitations and future scope.

An Overview of the Indian Food Processing Industry

The Indian agricultural sector has advanced considerably since independence. Since the advent of the "green revolution" in 1969, India has transformed itself from a country of shortages to a land of surpluses. With the rapid growth of the economy, a shift is also being seen in the consumption pattern, from cereals to a more varied and nutritious diet of fruit and vegetables, milk, fish, and meat and poultry products. This has resulted in the development of a burgeoning industry, namely the food processing industry. The food processing sector in the country, with its vast potential, has emerged as one of the major drivers of economic growth. It has huge potential for upliftment of the agricultural economy, the creation of large-scale processed food manufacturing and food-chain facilities, and the resultant generation of employment and export earnings. Food processing industries provide throughput between farm and industry, accelerating agricultural development by the creation of backward linkages, such as supply of credit, inputs, and other production enhancement services, and forward linkages, such as processing and marketing (Shah, 1998). These add value to the farmers' produce and create employment opportunities, thereby improving the economic condition of the farmers. In addition, processing activities generate more demand on the farm sector for such outputs, which are suitable for processing. Besides increasing farm income, these industries also create, with the concomitant capital investments, technical and managerial requirements. Food processing covers a spectrum of products from the subsector comprising agriculture, horticulture, plantation, animal husbandry, and fisheries.

India is estimated to be the third largest producer of raw food products, after China and the United States, and the largest producer of fruits and vegetables in the world. However, unfortunately, the percentage of raw food processed into value-added products up the food chain is one of the lowest in the world. Only 12% of agricultural raw materials and less than 10% of the annual fruit and vegetable production of over 40 million tonnes and around 30 million tonnes are processed. The percentage processed is as high as 70% in some developed countries (The Hindu Survey of Indian Industry, 1993).

The structure of the Indian food processing industry reflects the fact that food production is mainly constrained due to the lack of productivity-augmenting technologies as the major quantity of food products are being produced in the unorganized sector, where resource utilization is very limited. The organized food processing units also face various kinds of challenges that have emerged due to the opening up of the economy in the recent decade. To meet the emerging challenges, there is an urgent need to improve efficiency in production process through either maximizing the output or minimizing the cost, which, in turn, will lead to maximization of shareholders' wealth.

Though India's agricultural production base is reasonably strong, wastage of agricultural produce is sizeable. Processing of fruits and vegetables is as low as 2%, around 35% in milk, 21% in meat, and 6% in poultry products. These are quite low by international standards, as processing of agriculture produce is around 40% in China, 30% in Thailand, 70% in Brazil, 78% in the Philippines, and 80% in Malaysia (KPMG & FICCI, 2007). The wastage of raw materials might result in technical inefficiency of firms, and thus, it may further depress the productivity growth in this sector and, in turn, may lead to erosion in shareholder wealth.

Theoretical Background

The different approaches to productivity measurement can be divided broadly into two groups, namely frontier and nonfrontier. Each one can further be subdivided into parametric and nonparametric methods. The traditional nonfrontier approaches to productivity measurement are based on the assumption that the observed production in each period is equivalent to the efficient production, that is, the boundary of the technology is assumed to pass through the observed points. Thus, it ignores the distinction between two main sources of productivity growth, that is, technological change and technical efficiency change. Among the frontier approaches, the parametric (econometric) approach assumes an explicit functional form for the underlying production technology and is thus subject to specification errors. In addition, here the single optimized regression equation is assumed to apply to each decision-making unit (DMU). In contrast, the data envelopment analysis, originally pioneered by Charnes, Cooper, and Rhodes (1978), does not require any underlying functional form specification, but it enables one to obtain a maximal performance with the sole requirement that each DMU lies on or below the external frontier. Instead of trying to fit a regression plane, it floats piecewise on the linear/Cobb-Douglas (log-linear) surface to rest on the top of the observations.

Reference Technology

A sample of ***J*** DMUs from an industry producing a vector of ***M*** outputs (y) from a vector of ***N*** inputs (x) will be considered. Let **B** denote the ***J*** x ***M*** matrix of observed outputs and **A** denote the ***J*** x ***N*** matrix of observed inputs. Individual elements of ***M*** denoted by y^j_m measure the quantity of m^{th} output produced by the j^{th} DMU, while the individual elements of N, denoted by X^j_n, measure the employment level of n^{th} input by the j^{th} DMU, at a particular period of time. A production technology transforming input vector x to output vector y can be represented by the graph of technology,

$$GR(x,y) = \left((x,y) \mid x \geq \sum_{j=1}^{J} \lambda_j x^j, y \leq \sum_{j=1}^{J} \lambda_j y^j, \lambda_j \geq 0 \right) \quad (1)$$

which exhibits constant returns to scale (CRS) and strong disposability of inputs and outputs (Färe, Grosskopf, Norris, & Zhang, 1994). Following Afriat (1972), the assumption of CRS can be relaxed and one may allow for variable returns to scale by putting the restriction in (1): $\sum_{j=1}^{J} \lambda_j = 1$, where λ_j is an intensity variable indicating at what intensity a particular activity (firm) may be employed in production.

A Malmquist Output-based Productivity Index

Following Shepherd (1970) and Färe (1988), the output distance function in time period t is defined as

$$D_o^t(x^t, y^t) = \inf \left\{ \theta / (x^t, y^t / \theta) \in GR^t \right\} \quad (2)$$

It is to be noted that $D_o^t(x^t, y^t) \leq 1$ if and only if $(x^t, y^t) \in GR^t$. This function is reciprocal to Farrell's (1957) output-oriented measures of technical efficiency, that is, the reciprocal of the maximum proportional expansion of the output vector y^t, given the input vector x^t.

To define a Malmquist productivity index, the distance functions required with respect to two different time periods are as follow:

$$D_o^t(x^{t+1}, y^{t+1}) = \inf\{\theta/(x^{t+1}, y^{t+1}/\theta) \in GR^t\} \quad (3)$$

$$D_o^{t+1}(x^t, y^t) = \inf\{\theta/(x^t, y^t/\theta) \in GR^{t+1}\} \quad (4)$$

The first distance function measures the maximum proportional change in outputs required to make (x^{t+1}, y^{t+1}) feasible in relation to the technology at time period t. Similarly, the second mixed-period distance function measures the maximum proportional change in outputs required to make (x^t, y^t) feasible in relation to the technology at time period $t + 1$. In both these mixed-period cases, the value of the distance function may exceed unity if the observation being evaluated is not feasible in the other period.

Caves, Laurits, Christensen, & Diewert (1982) define an output-based Malmquist productivity index relative to single technology for time t and $t + 1$ as

$$M_0^t = \frac{D_c^t(x^{t+1}, y^{t+1})}{D_c^t(x^t, y^t)} \quad (5)$$

$$M_0^{t+1} = \frac{D_c^{t+1}(x^{t+1}, y^{t+1})}{D_c^{t+1}(x^t, y^t)} \quad (6)$$

Following Ray and Desli (1997), the productivity index in (5) and (6) can be rewritten as

$$M_0^t = \frac{D_v^t(x^{t+1}, y^{t+1})}{D_v^t(x^t, y^t)} \times \frac{D_c^t(x^{t+1}, y^{t+1})/D_v^t(x^{t+1}, y^{t+1})}{D_c^t(x^t, y^t)/D_v^t(x^t, y^t)} = \frac{D_v^t(x^{t+1}, y^{t+1})}{D_v^t(x^t, y^t)} \times \frac{SE^t(x^{t+1}, y^{t+1})}{SE^t(x^t, y^t)} \quad (7)$$

where subscripts c and v refer to constant returns to scale (CRS) and variable returns to scale (VRS) technology. SE^t (x^t, y^t) and SE^t (x^{t+1}, y^{t+1}) represent the scale efficiency with respect to technology t evaluated at two different levels of inputs.

Similarly,

$$M_0^{t+1} = \frac{D_v^{t+1}(x^{t+1}, y^{t+1})}{D_v^{t+1}(x^t, y^t)} \times \frac{SE^{t+1}(x^{t+1}, y^{t+1})}{SE^{t+1}(x^t, y^t)} \quad (8)$$

By taking the geometric mean of (7) and (8), one gets

$$M_0 = \left[\frac{D_v^t(x^{t+1}, y^{t+1})}{D_v^t(x^t, y^t)} \times \frac{D_v^{t+1}(x^{t+1}, y^{t+1})}{D_v^{t+1}(x^t, y^t)}\right]^{\frac{1}{2}} \left[\frac{SE^t(x^{t+1}, y^{t+1})}{SE^t(x^t, y^t)} \times \frac{SE^{t+1}(x^{t+1}, y^{t+1})}{SE^t(x^t, y^t)}\right]^{\frac{1}{2}} \quad (9)$$

The first component of (9) can further decomposed as

$$\left[\frac{D_v^t(x^t, y^t)}{D_v^{t+1}(x^t, y^t)} \frac{D_v^t(x^{t+1}, y^{t+1})}{D_v^{t+1}(x^{t+1}, y^{t+1})}\right]^{\frac{1}{2}} \times \left[\frac{D_v^{t+1}(x^{t+1}, y^{t+1})}{D_v^t(x^t, y^t)}\right] \quad (10)$$

where the first component of (10) is the geometric mean of two ratios, which measures the shift in the technology calculated at x^t and x^{t+1}. The second component measures the change in relative efficiency between the years t and $t + 1$. The second component of (9) involves both CRS and VRS distance functions at both the time periods and measures the change in scale efficiency.

Calculation of Distance Function: Linear Programming Models

In order to calculate the productivity index of a firm j', one needs to solve the following linear programming (LP) problems:

$D_c^t(x^t, y^t)$, $D_c^{t+1}(x^{t+1}, y^{t+1})$, $D_c^t(x^{t+1}, y^{t+1})$ and $D_c^{t+1}(x^t, y^t)$.

The output distance function $D_c^t(x^t, y^t)$ is calculated by using the following LP problem:

$$\left[D_c^t\left(x^{j',t}, y^{j',t}\right)\right]^{-1} = Max\,\theta^{j'} \quad (A)$$

$$s.t.\ \sum_{j=1}^{J} \lambda_j x_n^{j,t} \le x_n^{j',t},\ n = 1,2,3,\ldots,N$$

$$\sum_{j=1}^{J} \lambda_j y_n^{j,t} \ge y_n^{j',t},\ m = 1,2,3,\ldots,M$$

$$\lambda_j > 0,\ j = 1,2,3,\ldots,J$$

The output distance function is calculated by solving the LP problem; given above is the reciprocal of the output-oriented Farrell's measure of technical efficiency, calculated relative to technology satisfying the constant returns to scale. The mixed-period distance function $D_c^t(x^{t+1}, y^{t+1})$ is solved by using the following LP problem:

$$\left[D_c^t\left(x^{j',t+1}, y^{j',t+1}\right)\right]^{-1} = Max\,\theta^{j'} \quad (B)$$

$$s.t.\ \sum_{j=1}^{J} \lambda_j x_n^{j,t} \le x_n^{j',t+1},\ n = 1,2,3,\ldots,N$$

$$\sum_{j=1}^{J} \lambda_j y_n^{j,t} \ge y_n^{j',t+1},\ m = 1,2,3,\ldots,M$$

$$\lambda_j > 0,\ j = 1,2,3,\ldots,J$$

Note that in (A), ($x^{j',t}$, $y^{j',t}$)$\in GR^t$ and therefore $D_c^t(x^{j',t}, y^{j',t}) \le 1$. However, in (B), ($x^{j',t+1}$, $y^{j',t+1}$) need not belong to GR^t, and so it may take a value greater than 1. The above four distance functions can be estimated under VRS technology by putting the restriction $\sum_{j=1}^{J} \lambda_j = 1$.

The Data

The basic data for this study have been collected from the electronic database PROWESS, provided by the Centre for Monitoring Indian Economy (CMIE), Mumbai. Company-wise information on output and inputs was collected for the period 1992-93 to 2005-06. A single output (gross value added) and two inputs (labor and capital) are considered. As the physical data on output and inputs are not available, unit wise, these have been taken in value terms (in terms of Rs. Crore). In order to convert the money value into real terms, the data have been deflated with the price index (base year being 1998-99). The gross value added (GVA), a measure of output, is deflated with the wholesale price index of food and food products. The *total wages and salaries* has been taken as the proxy for the input labor. It has been deflated with respect to the consumer price index (CPI) for industrial workers. The economic conditions of a section of people are more affected by the consumer price index than that of wholesale price index (WPI). In CPI, the basket of goods and services represents the actual consumption pattern of a typical family from a specific group for which it is being constructed.

The input capital is measured by assessing the gross fixed asset, which includes movable and immovable assets as well as capital stocks in progress, that is, assets that are in the process of being installed. These are the fixed assets that are used for producing goods and services and are shown as gross of depreciated value. The gross fixed asset is a stock concept, and the problem of nonhomogeneity is resolved once this stock is measured in terms of monetary units. It has been deflated with the WPI of machinery, machine tools, and parts. All the relevant data to calculate the market value added have been taken for the period spanning 1992-93 to 2001-02 from CMIE.

Results and Discussion

Efficiency of the Indian Food Processing Industry

Since the basic components of the Malmquist index are related to measurement of technical efficiency, the distribution of firms according to the efficiency scores has been reflected in Table 1. Value of unity implies that the firm is on the frontier/technically efficient and value less than unity implies that the firm is below the frontier/ technically inefficient in the associated year. As can be observed from Table 1, out of 29 firms, 11 to 19 firms are technically inefficient. The efficiency scores in the food processing industry vary widely over the said time period across various types of food processing units. However, the overall efficiency of the industry as a whole does not vary much across the years, as is evident from the very low variations in dispersion across the years (SD varies from 0.209 in 1994 to 0.264 in 2003). The average efficiency score varies from 0.783 in year 1999-00 to 0.876 in the year 1993-94. As can be seen from Figure 1, the trend in technical efficiency is a declining one in the Indian food industry throughout, except during the years 1993-94, 1997-98, 2000-01, and 2003-04. Ali (2005) also found a declining trend in efficiency of the Indian food processing industry during the period 1980 to 1990.

Table 1
Frequency Distribution of Technical Efficiency of Indian Food Processing Units

	1993[1]	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*
< 0.3	0	1	1	2	1	0	2	1	0	1	2	0	0	0
0.3 – 0.4	1	1	0	0	3	1	0	1	1	1	2	1	1	1
0.4 – 0.5	3	1	3	1	1	0	3	3	3	3	2	3	3	3
0.5 – 0.6	2	0	0	3	1	3	0	4	2	0	3	1	1	1
0.6 – 0.7	2	3	4	1	1	4	3	0	2	2	0	2	3	4
0.7 – 0.8	2	1	0	2	5	1	2	4	2	4	4	5	4	3
0.8 – 0.9	2	2	2	4	1	4	5	3	1	1	1	0	1	1
0.9 – 1.0	1	3	1	1	1	6	1	1	4	1	3	2	1	1
1	16	17	18	15	15	10	13	12	14	16	12	15	15	15
Total	29	29	29	29	29	29	29	29	29	29	29	29	29	29
Mean Eff.	0.830	0.878	0.855	0.834	0.807	0.845	0.807	0.783	0.837	0.826	0.784	0.835	0.830	0.825
SD	0.226	0.209	0.229	0.235	0.252	0.194	0.230	0.236	0.213	0.241	0.263	0.212	0.217	0.221

(1) Year 1993 indicates the financial year 1992-93.

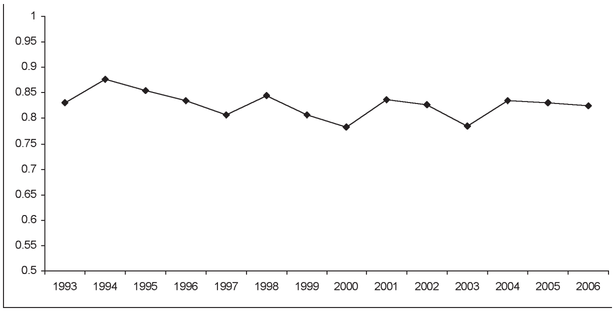

Figure 1. Trend in Technical Efficiency in Indian Food Industry

The declining trend in efficiency, particularly in this sector, is the result of low capacity utilization caused by nonavailability of quality raw materials, lack of right management techniques, wastage, lack of demand, and other relevant problems. Nearly 20% of Indian food grains and 40% of horticultural produce go to waste every year due to lack of adequate post-harvest facilities like silos, cold storage, and transportation. The country's cold storages have the capacity of only 8.7 million tonnes, whereas the total production of fruits and vegetables is over 100 million tonnes. On top of this, most of the cold storage suffers the vagaries of poor power supply, and road transport operators work with extremely poor road networks, particularly in the rural area. In the fruit and vegetable chain, there are as many as six intermediaries between the farmer and the consumer. This leads to a high incidence of wastage and loss across the value chain as well as unstable price mark-up at every stage.

Technological Change, Pure Technical Efficiency Change, Scale Efficiency Change and Change in Total Factor Productivity in the Indian Food Processing Industry

In this section, the Malmquist productivity index as well as its components–technological change, pure technical efficiency change, and scale efficiency change for each firm for the obtained sample, in line with variable returns to scale technology are reported. Since this is an index based on discrete time, each firm will have an index for every pair of years. This entails calculating the component distance function, using the linear programming models (A) and (B). Instead of presenting the disaggregated results for each firm and year, a summary description of the average performance of all the firms together for all the consecutive time periods is given. The value of the Malmquist index and any of its components less than 1 implies deterioration in performance, whereas a value greater than 1 implies improvement in the relevant performance. The natural logarithms of the indexes and their components have been taken, which allows the results to be interpreted in percent changes. The average annual percent changes in TFP and its different components–technological change, pure technical efficiency change, and scale efficiency change are reported in Table 2, and their trends are shown in Figures 2 to 5.

Table 2

Average Annual Change in TFP and its Components in Indian Food Industry

Sub-periods	TECHCH	PEFFCH	SEFFCH	TFPCH
1993-1994[1]	-10.759	5.921	8.526	3.689
1994-1995	-5.763	-3.459	-2.737	-11.959
1995-1996	4.306	-3.252	0.100	1.154
1996-1997	-1.613	-4.395	7.881	1.873
1997-1998	-7.472	8.434	-2.943	-1.981
1998-1999	-2.122	-6.828	5.827	-3.123
1999-2000	-6.614	-3.046	-0.501	-10.161
2000-2001	-8.338	8.250	-0.300	-0.388
2001-2002	-4.186	-3.356	-6.345	-8.851
2002-2003	-3.874	-6.828	6.485	-4.217
2003-2004	-1.207	5.449	0.499	4.740
2004-2005	0.797	-0.300	1.094	1.590
2005-2006	2.859	-0.501	2.274	4.631
Mean	*-3.904*	*-0.284*	*1.885*	*-2.303*
SD	*4.280*	*5.250*	*4.330*	*5.410*

(1) The year 1993-1994 indicates the sub-period 1992-93 to 1993-94.

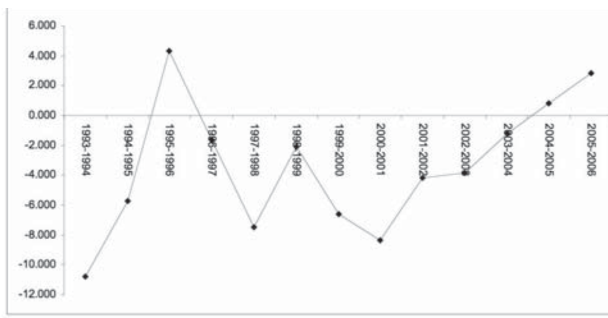

Figure 2. Trend of Total Factor Productivity Change in Indian Food processing industry

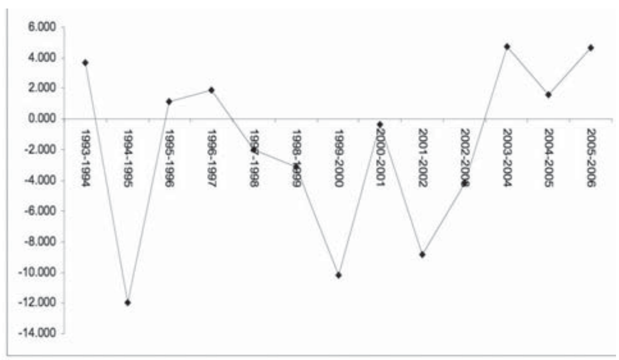

Figure 3. Trend of Technological Change in Indian Food Processing Industry

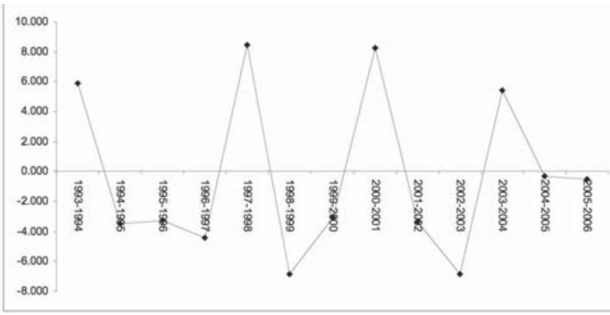

Figure 4. Trend of Pure Efficiency Change in Indian Food Processing Industry

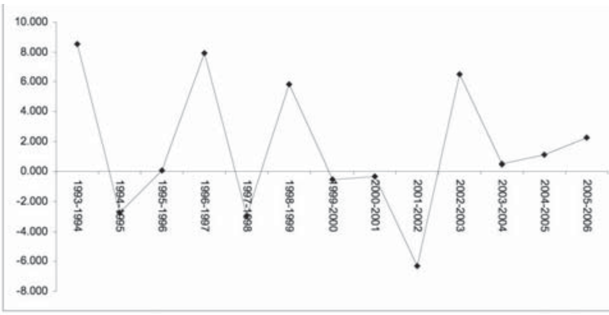

Figure 5. Trend of Scale Efficiency Change in Indian Food Processing Industry

The results show wide variations in TFP change across the years, as is evident from very high standard deviation shown in the last row of Table 2. On average, the TFP change is found to be negative in most of the subperiods, except during 1993-1994, 1995-1996, 1996-1997, and 2003-2004 till 2005-2006. The trend in TFP change is a declining one during the period 1996-1997 to 1999-2000. However, it shows a rising trend since 2001-2002 onwards, except during the subperiod 2004-2005. On average, the annual TFP change in the Indian food industry is found to be negative, that is, -2.303% during the entire period of study. The negative growth in TFP is mainly because of either technological regress or loss in pure technical efficiency or both. The only factor that contributes positively to TFP change is the scale efficiency change. The scale efficiency change contributes positively throughout the period, except during 1994-1995, 1997-1998, and 1999-2000 to 2001-2002. On average, the gain in productivity through scale change is 1.885% during the entire period of study. This implies that most of the firms move towards the most productive scale size over the years.

A loss is shown in pure technical efficiency in the Indian food industry during most of the subperiods, except during 1993-1994, 1997-1998, 2000-2001, and 2003-2004. On average, the loss in efficiency over the years in the Indian food industry is 0.284%. The technological regress is reflected in most of the periods, except during 1995-1996, 2004-2005, and 2005-2006. On average, the technological change contributes negatively towards TFP change by -3.90%. However, there is the indication of an increasing trend in technological change since 2001-2002 onwards. As pointed out by Ray (1997), the regressive shift in the production frontier may be the result of aggravating structural bottlenecks. Notwithstanding advancement in technical knowledge and improvements in skills, the maximum quantity of output producible from any given input bundle depends crucially on the available infrastructures. Chronic and frequent shortage of power, congested transport networks, industrial disputes, and prolonged political chaos disrupting day-to-day civilian life cause significant inward shift in the production frontier. In a study by Ali (2005), it was found that the overall TFP change in the Indian food processing industry declined from 1.06 during 1980-1990 to 1.03 during 1990-2001. His study shows positive changes in TFP. Further, the findings also differ in terms of contribution of different components towards TFP growth in the Indian food industry. This might possibly be because of differences in a) the units of analysis, b) period of study, and c) measurement of data. The findings of this research seem to be in agreement with the study by Kumar and Basu (2008), in terms of sources of TFP change in the Indian food processing industry. However, the findings differ in terms of percentage contribution of different components to TFP change, possibly because of differences in sample size and the sampling units.

Under the mistaken assumption that the food processing industry is a low-technology, low-investment activity, the government of India chooses to reserve the production of processed food products for the small-scale sector. As a result, small units with limited vision and resources account for three-fourths of the industry. The food chain in India is regulated by a number of ministries and departments with overlapping and unstable controls that confuses the entrepreneurs. In addition to that, the food legislation in the country has been anachronistic, overly complex, and often contradictory. At last count, the food sector was covered by not less than 20 central, state, and local rules, as well as sources of amendments. What is worse is that much of the legislation is prescriptive instead of being flexible. As a result, the technological breakthroughs that allow replacements of different blends or better alternatives are disallowed.

India's taxes on food and processing equipments are comparatively higher than in other nations. Excise and sales tariffs, accounting for 8-40% of retail prices, reduce marketability and inhibit investment. Cold storage and freezing equipment are essential to developing the value food chain. The very high rate of duties (around 30% to 40%) on such equipment and the high excise tariff on branded food products which are not specified elsewhere is not conducive to the technological enhancement of the food processing industry (Parpia, 1974).

India lacks the appropriate technology and enough market information to improve the poor harvesting processing of fruits and vegetables. Not enough money has been invested in processing machinery, grading and packaging, and cold storage freeze-drying systems. The capacity of the present installations is too small to be economical.

Linkages Between Components of the Productivity Index and Shareholders' Wealth Maximization

After analyzing the productivity change in the Indian food processing industry, the linkages between different components of TFP change and the changes in MVA will now be established. The objective is to test whether MVA is partially explained by the components of TFP change.

MVA is a cumulative measure of corporate performance that looks at how much a company's stock has added to (or taken out of) investors' pocketbooks over its life and compares it with the capital of those same investors put into the firm. Although the calculation of MVA uses the book value of capital, which is subject to inflationary distortions, it provides an excellent measure of a company's ability to create wealth. MVA of a company is defined as the difference between the market value and the economic capital of the firm.

MVA = Market Value of the Company - Economic Capital[1]

Certain studies (such as Banerjee, 2000) have used a simplified method of calculating MVA, as defined below:

MVA = (market value of equity + market value of debt) – (book value of equity + book value of debt).

In the Indian context, a vibrant debt market is yet to emerge, where the private corporate debt papers are traded frequently. If the reasonable assumption is made that the market and book values of debt are the same, the MVA of a company can be simplified as MVA = market value of equity – book value of equity[2], where the market value of equity is the stock price multiplied by the number of shares outstanding. Taking market price at the end of the financial year for the purpose of market capitalization may lead to bias. Hence, the average of the weekly closing price (from the Bombay Stock Exchange) of the equity shares for the entire year has been considered.

In order to determine the relationship between the components of productivity growth and market value added, the panel data for 1992-93 to 2002-03 have been used. Given that the productivity index indices refer to pairs of years, the resultant sample has a panel of 29 firms and 9 time periods. The availability of panel data allows the effect of unobserved heterogeneity to be controlled, that is, the effect of unobserved variables that may affect the dependent variable but which do not vary across units (time effect) or over time (individual effects). The panel data regression model can be expressed as:

$$MVACH_{it} = \alpha_i + \delta_t + \beta_1 TECHCH_{it} + \beta_2 PEFFCH_{it} + \beta_3 SEFFCH_{it} + u_{it,} \qquad (11)$$

where MVACH is the dependent variable, the components of TFP change are the independent variables, and u is the random error term. Subscripts *i* and *t* refer to the individual firm and the time period respectively. The coefficient α_i represents the individual effects that capture the time-invariant effect of the unobserved characteristics of each individual on the dependent variable (unobserved heterogeneity). Similarly, the coefficient δ_t represents time effects that capture the effect of period *t*, which is common across individual firms.

Individual and time effects can be considered as fixed parameters or random variables. The appropriate model depends on the specific setting of the analysis. When the specific value of the firm effect is of interest, then the fixed-effect model is more appropriate[3]. Unlike in a fixed-effect model, consistency in a random-effect model rests on the assumption that there is no correlation between the effects and the explanatory variables. The explantory variables in the model used are the three components of the TFP change. These components are expected to have a positive impact on market value added. Table 3 shows the results of

Table 3
Components of TFP Change as Drivers of Shareholders' Wealth Maximization

	Model I		Model II		Model III	
	Firm Effect		Time Effect		Firm and time effect	
	Coefficients	t-value	Coefficients	t-value	Coefficients	t-value
Intercept	-7.338**	(-2.067)	-6.407**	(-2.344)	-6.932**	(-2.016)
TECHCH	7.484*	(3.526)	8.411*	(3.970)	8.457*	(3.893)
PEFFCH	0.515	(0.389)	0.107	(0.080)	0.274	(0.202)
SEFFCH	0.204	(0.811)	0.095	(0.397)	0.105	(0.413)
R^2	0.256		0.198		0.402	
F-test	1.407**		2.356*		1.631**	
DW	—		1.953		1.985	
N	261		261		261	

Note. * and ** indicate that the coefficients are statistically significant at 99% and 95% level of confidence.

three models–showing the firm effect (Model I), time effect (Model II), and both firm as well as time effect (Model III). The coefficients of dummies have not been reported because too many dummy variables were used in the model. Moreover, the focus of interest for this study is mainly on the coefficients of explanatory variables rather than the intercept and coefficients of time or firm dummies.

The results show a postive relationship between MVA and all the components of TFP change, as expected. However, pure efficiency change or scale efficient change does not show any significant impact on MVA change in any of the models. A possible explanation for this result may be that changes in scale efficiency are discounted in the stock price before the scale efficiency improvements are actually achieved. Such may be the case with most announcements of mergers, where the (positive or negative) expected effects are rapidly discounted by the market. Alternatively, it could be due to an inadequate treatment of merger processes in the sample used, due to lack of information. Technological change has a statistically significant impact on a firm's market value, irrespective of whether the time effects are excluded or included in the model. It indicates that the stock market does recognize innovative activity undertaken by firms.

In the study of Kumar and Basu (2008), it was observed that research and development and import liberalization have significant impact on technological change in the Indian food processing industry. There is a need to upgrade the technology available to the Indian manufacturers by enlisting foreign collaboration where required, to back up understanding and use of design. The Central Food Technology Research Institute should be actively involved in research into food processing machinery. Encouragement to food processing industries would *ipso facto* increase demand for the latest food processing machinery. Incentives and other facilities to Indian machinery manufacturers would, therefore, be required to enable them to enlist new foreign collaborations for food processing machinery as well as for high-speed packaging machinery.

Further, the import liberalization will provide to industrial firms greater and cheaper access to imported capital goods and intermediate goods (embodying advanced technology), which will enable the firms to improve their productivity performance. This, in turn, will increase the market value of the firms. The increased competitive pressure on industrial units in a liberalized import regime will force them to be more efficient in the use of resources, which can be achieved through better organization of production, improved managerial efficiency, more effective utilization of labour, and better capacity utilization.

Managerial Implication

A large difference in productivity change can be observed across the firms and/or years within a narrowly defined industry. The components of productivity change are positively associated with change in market value, indicating that the stock market places higher value on firms with higher productivity. Among all the components of productivity change, the technological change strongly reflects the movement in market value of the firms in the Indian food processing industry. Thus, technological progress could play a vital role in improving the TFP change and, in turn, maximizing the shareholders' wealth in the Indian food processing industry. It is necessary to encourage imports along with R&D to ensure considerable technological progress in the Indian food industry. However, the technological possibilities depend on the mode of organization and various economic and institutional factors. Therefore, bold institutional changes should be made simultaneously in order to reduce inefficiency substantially. A suitable policy framework is essential to encourage investment in the upstream chain: agriculture and procurement, which will give farmers access to appropriate technology and inputs to raise yields. Hence, it helps to develop the necessary cold storage and transport infrastructure, ensuring that the output is scientifically stored and transported to the markets and consumers in good time. This will reduce both wastage as well as intermediaries between the farmer and the consumer and will thus also induce technological progress as well as minimize the efficiency loss in the Indian food industry.

Conclusion

The productivity growth in the Indian food industry is depressed by negative technological change as well as loss in pure technical efficiency. Most of the firms have contributed to productivity growth positively through their movements to the most productive scale size. This empirical study provides the evidence of movement of market value with technological change, indicating that the stock market does recognize innovative activity undertaken by firms. A firm with technological change through innovation of product and/or process could lead to a positive shift in productivity as well as boost MVA and therefore shareholders' value in the Indian food industry. However, the findings of the study cannot be generalized. The study can, however, be extended further to validate the linkages of components of productivity growth with market value of the firms in other industries/ countries.

References

Afrait, S. N. (1972). Efficiency estimation of production functions. *International Economic Review, 13*(3), 568-598.

Ali, J. (2005). Analysis of total factor productivity change in Indian food processing industry: A nonparametric approach.

(Paper N° 5068). *Proceedings of the 11th International Conference on Productivity and Quality Research, organized by the Indian Institute of Technology, Delhi (India) in association with the International Society of Productivity and Quality Research,* USA.

Baily, M. N., Campbell, D. & Hulten, C. (1992). Productivity dynamics in manufacturing plants. *Brookings Papers: Microeconomics,* 187-267.

Banerjee, A. (2000). Linkage between economic value added and market value: An analysis. *Vikalpa, 25*(3), 23-36.

Bartelsman, E. J., & Dhrymes, P. (1991). Productivity Dynamics: US Manufacturing Plants, 1972-1986. (N° 584) *Discussion Paper Series*. New York: Columbia Universty, Deparment of Economics.

Caves, D. W., Laurits, R., Christensen, W., & Diewert W. E. (1982). The economic theory of index numbers and the measurement of input, output, and productivity. *Econometrica, 50*(6), 1393-1414.

Charnes, A., Cooper, W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research, 2*(6), 429-444.

Clinton, B.D., & Chen, S. (1998). Do new performance measures measure up? *Management Accounting, 80*(4), 38-44.

Dodd, J. L., & Chen, S. (1996, July-September). EVA: A New Panacea? *Business and Economic Review, 42,* 26-28.

Drucker, P. F. (1995). *Managing in the time of great change*. New York: Truman Talley Books/Plume.

Dwyer, D. W. (1998). Technology locks, creative destruction and nonconvergence in productivity levels. *Review of Economic Dynamics, 1*(2), 430-473.

Dwyer, D. W. (2001). *Plant-level productivity and the market value of a firm* (Working Paper 01-03). Center for Economics Studies, Census Bureau, USA.

Ehrbar, A. L. (1998). *EVA – The Real Key to Creating Wealth*. New York: John Wiley.

Färe, R. (1988). *Fundamentals of production theory.* Berlin, Germany: Springer-Verlag.

Färe, R., Grosskopf, S., Norris, M., & Zhang Z. (1994). Productivity growth, technical progress, and efficiency change in industrial countries. *American Economic Review, 84*(1), 66-83.

Farrell, M. J. (1957). The measurement of productivity efficiency. *Journal of Royal Statistical Society, 120*(3), 253-281.

Grant, J. L. (1996, Fall). Foundations of EVA for investment managers. *The Journal of Portfolio Management, 23,* 41-48.

Greene, W. H. (1993). *Econometric Analysis*. New York: Macmillan.

Hamel, G. (1997, June 23). Killer strategies that make shareholders rich. *Fortune,* 70-88.

Johnson, W.B., Natarajan, A., & Rappaport, A. (1985). Shareholder returns and corporate excellence. *Journal of Business Strategy, 6*(2), 52–62.

KPMG and FICCI. (2007). Processed Food and Agribusiness: Opportunities for Investment in India. A Knowledge Paper. Retrieved on October 21, 2008 from http://www.in.kpmg.com/TL_Files/Pictures//Processed_Food_Final.pdf

Kramer, J., & Peters, J. (2001). An inter-industry analysis of economic value added as a proxy for market value added. *Journal of Applied Finance, 11*(1), 41-49.

Kumar, M., & Basu, P. (2008). Perspective of productivity growth in the Indian food processing industry. *International Journal of Productivity and Performance Management, 57*(7), 503-522.

Lehn, K., & Makhija, A. K. (1996). EVA and MVA as performance measures and signals for strategic change. *Strategy and Leadership, 24,* 34-38.

Madden, B. J. (1998). CFROI valuation model. *Journal of Investing, 7,* 31-44.

McCormack, J. L., & Vytheeswaran, J. (1998, Fall). How to use EVA in the oil and gas industry. *Journal of Applied Corporate Finance, 11*(3), 109-127.

Milunovich, S., & Tsuei, A. (1996). EVA in the computer industry. *Journal of Applied Corporate Finance, 9*(3), 104-115.

O'Byrne, S. F. (1996). EVA and market value. *Journal of Applied Corporate Finance, 9*(1), 116-125.

Olley, S. G., & Pakes, A. (1997). The dynamics of Productivity in the Telecommunications Equipment Industry. *Econometrica, 64*(6), 1263-1297.

Ottonson, E., & Weissenrieder, F. (1996). *Cash value added – A new method for measuring financial performance*. (Working Paper 1996:1) Gothenburg, Sweden: Gothenburg University.

Parpia, H. A. B. (1974). Problems of technology transfer in food and agricultural industries in developing countries. *Productivity, 14*(4), 375-386.

Rappaport, A. (1986). *Creating Shareholder Value*. New York: The Free Press.

Ray, R. (2001). Economic value added: Theory, evidence, a missing link. *Review of Business, 22*(1/2), 66-71.

Ray, S. C. (1997). Regional variation in productivity growth in Indian manufacturing: A non-parametric analysis. *Journal of Quantitative Economics, 13*(1), 73-94.

Ray, S. C., & Desli, E. (1997). Productivity growth, technical progress, and efficiency changes in industrialized countries: Comment. *American Economic Review, 87*(5), 1033-39.

Shah, N. (1998). Opportunities and challenges in agro-based industries: Food processing. *Journal of Rural Development, 17*(3), 565-572.

Shephard, R. W. (1970). *Theory of Cost and Production Function*. Princeton, NJ: Princeton University Press.

Stewart, G. B. III (1991). *The Quest for Value*. New York: Harper-Collins.

The Hindu Survey of Indian Industry (1993). *Food processing: waiting for the big leap. A special correspondent*. Author: 397-99.

Swain, R., Mishra, C., & Kumar, M. (2002). EVA & MVA: A Study of the Indian pharmaceutical industry. In N. Swain & C. Mishra (Eds.), *Economic value added: Concepts and cases*. Hyderabad, India: ICFAI Press.

Uyemura, D.G., Kantor, C. C., & Petit, J. M. (1996). EVA for bank value creation, risk management, and profitability measurement. *Journal of Applied Corporate Finance, 9*(2), 94-111.

Footnotes

1. Economic capital = net fixed Assets + investments + current assets – noninterest bearing current liabilities + (miscellaneous expenditure not written off) + intangible assets + cumulative nonrecurring losses + capitalized expenditure on R&D) – (revaluation reserve + cumulative nonrecurring gains).
2. Book value of equity = paid-up capital + reserves and surplus.
3. See Greene (1993; pp. 479-480) for a more detailed discussion about the differences between the fixed and random effects models.

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Appendix

List Of Food Processing Units

DMU	*Name of Food Processing Units*
1	A D F Foods Ltd.
2	A F T Industries Ltd.
3	Agro Tech Foods Ltd.
4	B & A Ltd.
5	Bannari Amman Sugars Ltd.
6	Britannia Industries Ltd.
7	Dhampur Sugar Mills Ltd.
8	Dharani Sugars & Chemicals Ltd.
9	Flex Foods Ltd.
10	Ganesh Benzoplast Ltd.
11	Glaxosmithkline Consumer Healthcare Ltd.
12	Goodricke Group Ltd.
13	Gujarat Ambuja Exports Ltd.
14	Harrisons Malayalam Ltd.
15	Jay Shree Tea & Inds. Ltd.
16	Kerala Chemicals & Proteins Ltd.
17	Ledo Tea Co. Ltd.
18	Lotus Chocolate Co. Ltd.
19	Madhusudan Industries Ltd.
20	Milkfood Ltd.
21	Nestle India Ltd.
22	Rajshree Sugars & Chemicals Ltd.
23	Rasoi Ltd.
24	Ruchi Soya Inds. Ltd.
25	Simbhaoli Sugar Mills Ltd.
26	Tata Tea Ltd.
27	Venky'S (India) Ltd.
28	Warren Tea Ltd.
29	Williamson Tea Assam Ltd.