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Efficiency Assessment of Selected Indonesian Food and Beverage Manufacturing Industry

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Efficient use of resources to generate outputs in food and beverage manufacturing industry is critical. This research evaluates the revenue, net income, fixed assets and operating expenses of five Indonesian food and beverage manufacturing companies. It presents a study which demonstrates how managers can identify the best performers in the industry and how to conduct an improvement analysis using data envelopment analysis (DEA) approach. Data on five food and beverage manufacturing companies collected from Jakarta Stock Exchange were used to identify inefficient companies and determine which efficient companies to benchmark in order to improve their efficiency. Findings show that the efficient companies have reached the input and output target. The emphasis of this paper is on the application.

Keywords: Benchmarking, DEA-CRS, Efficiency Assessment, Food and Beverage

BACKGROUND OF THE STUDY

Indonesia, the world's fourth most populous nation, offers significant market potential for the local food and beverage processing sector asides from the export market. Processed food sales in 2002 grew approximately 15% reaching IDR 61,000 billion (US$6.67 billion). The food-processing sector is expected to grow positively over the next five years, on the assumption that external factors and economic conditions continue to improve. Growth is expected to be about 8% per year. (Gandakusuma, 2003)

Convenience processed food products are affordable only for higher income groups. The urban middle class, comprising 20 percent of the population, are the main consumers of processed food. Yet, post crisis, processed food industries are facing changing consumer profiles. There are a growing number of more sophisticated, critical and educated consumers. Consumers are increasingly familiar with fortified food, i.e. products with added vitamins and minerals in milk, biscuits and ice cream. These sophisticated consumers gained knowledge not only from living, studying, and working abroad but also from the media, which plays an important role in educating the consumers. However, the majority of consumers remain price-conscious. When product offerings are similar, price is the determining factor.

Rising input costs are the big factor in food and beverage processing. Many of these business variables are beyond an organization's control, such as the rising cost of energy and materials, global competition, and the introduction of new regulatory mandates. These factors directly impact the cost of goods sold, influence the final price, and continually put financial performance in jeopardy.

The way that a company responds to these factors can impact long-term customer satisfaction and loyalty and more importantly, the business profitability. For many, it is difficult to pass direct costs on to retailers because strong retailers and retailer concentrations push back on price increases.

This research evaluates the revenue, net income, fixed assets and operating expenses for the efficiency assessment of selected Indonesian food and beverage manufacturing companies listed in Jakarta Stock Exchange over the period 2003-2005, using DEA (data envelopment analysis) approach. Factors that affect the efficiency performance of these companies during this period are critical for sustenance or improvement on their operations.

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Objectives Of The Study. This study seeks to measure relative efficiency and performance of selected five Indonesian food and beverage manufacturing companies listed in Jakarta Stock Exchange, specifically: To present the different companies in terms of the revenue, net income, fixed assets and operating expenses; To identify which among these companies are efficient and less efficient; To benchmark the efficient company against the non-efficient companies.

Scope and Limitations of the Study. The study is limited to the selected five Indonesian food and beverage manufacturing companies listed in Jakarta Stock Exchange. The study covers a limited period from 2003-2005.

Significance of the Study. The study focuses on measuring the efficiency of different companies in the same industry. It examines two inputs and two outputs that affect the performance of these companies. Likewise, it presents the empirical works on efficiency of these companies and contributes to the theoretical assumption of efficiency using the DEA techniques. The study can also be used as a reference point for the efficient level of Decision Making Units (DMUs) both for investors and management. Furthermore, this can help players in the industry to be globally competitive.

Review Of Related Literature Lovell (1993) provides an excellent introduction to frontier functions and measures the efficiencies of firms relative to theses estimated frontiers. The two principal methods used are data envelopment analysis and stochastic frontiers which involve mathematical programming and econometric methods. Fare, Grosskopf, Lovell (1985, 1994) developed the efficiency concepts.

Some additional models to the basic DEA model include: the stochastic DEA model proposed by Land, Lovell and Thore (1993) and Olesen and Petersen (1995); the additive model proposed by Charnes, Cooper, Golany, Seiford and Stutz (1985); the DEA models in which restrictions are placed upon the shadow prices in Dyson and Thanassoulis (1988) and Wong and Beasley (1990).

RESEARCH DESIGN AND METHODOLOGY

Data Envelopment Analysis (DEA) involves the use of linear programming methods to construct a non-parametric piece-wise surface (or frontier) over the data. Efficiency measures are then calculated relative to this surface. Comprehensive reviews of the methodology are presented by Seiford and Thrall (1990), Lovell (1993), Ali and Seiford (1993).

Charnes, Cooper and Rhodes (1978) proposed a model which had an input orientation and assumed constant returns to scale (CRS). The input oriented model under the constant returns to scale (CRS) assumption was utilized to evaluate the relative efficiencies of the food and beverage manufacturing companies in this study. Assume there are data on K inputs and M outputs for each of N firms. The i-th firms there are presented by the column vectors x_ and y_ respectively. The KxN input matrix, A and the MxN output matrix, Y, represent the data for all N firms.

An intuitive way to introduce DEA is via the ratio form. For each firm, to obtain a measure of the ratio of all outputs over the inputs, i.e. u'y,/v'x_, where u is an Mx1 vector of output weights and v is a Kx1 vector of input weights. The optimal weights are obtained by solving the mathematical programming problem:

Subject to:

$$Max_{u,v}\left(u'y_i/v^i x_i\right),\ \ u^i y_i/-v^i x_i < 1,2\ldots N, u,v \geq 0. \quad (1)$$

This involves finding values for u and v, such that the efficiency measure for the i-th firm is maximized, subject to the constraints that all efficiency measures must be less than or equal to one. One problem with this particular ratio formulation is that it has an infinite number of solutions. To avoid this, one can impose the constraint $v'x_i = 1$, which

Subject to:

$$Max_{\mu,v}(\mu' y_i)\ \ v^i x_i = l,\ \ \mu' y_j - v' x_j \geq o\, j - 1,2,\ldots,N,$$
$$\mu,v \geq o, \quad (2)$$

The change of notation from u and v to μ and v is used to stress that this is a different linear programming problem. The form in the above equation is known as the multiplier, form of the DEA linear programming problem. Using the duality in linear programming, one can derive an equivalent envelopment form of this problem:

Subject to:

$$Min_{\theta\lambda}\theta \ -y_i + Y\lambda \geq o, \ \theta x_i X\lambda \geq \lambda \geq 0, \qquad (3)$$

Where θ is a scalar and λ is a Nx1 vector of constants. This envelopment form involves fewer constraints than the multiplier form (K+M, N+1), and hence is generally the preferred form to solve. The value of θ obtained will be the efficiency score for the i-th firm It will satisfy: θ≥1, with a value of 1 indicating a point on the frontier and hence a technically efficient firm. The linear programming problem must be solved N times, once for each firm in the sample. A value of θ is then obtained for each firm.

The DEA problem in the above equation has a nice intuitive interpretation. Essentially, the problem takes the i-th firm and then seeks to radially contract the input vector, x_i, as much as possible, while still remaining within the feasible input set. The inner-boundary of this set is a piece-wise linear isoquant, determined by the observed data points (i.e. all the firms in the sample). The radial contraction of the input vector, $x_{i,}$ produces a projected point, (Xλ, Yλ) on the surface of this technology. This projected point is a linear combination of these observed data points. The constraints in the said equation ensure that this projected point cannot lie outside the feasible set.

Through the DEA Constant Returns of Scale (CRS) two inputs namely fixed assets and operating expenses were used. Two outputs which are revenue and net income were also used to analyze the data to evaluate the efficiency of Indonesian food and beverage industry. The data were taken from Jakarta Stock Exchange. The empirical analysis covered a total of 15 observations which is 3 years x 5 food and beverage manufacturing companies.

The following table shows the list of food and beverage manufacturing companies as sample firms included in this study.

Indonesian Food & Beverage Companies

No	Company	Product Line	Head Office Address
1	Davomas Abadi Tbk	Cocoa butter & cocoa powder	Jl. Pangeran Jayakarta 117 Blok B/35-39, Jakarta
2	Delta Djakarta Tbk	Beer	Jl. Inspeksi Tarum Barat, Desa Setiadharma, Kec. Tambun, Bekasi Timur
3	Mayora Indah Tbk	Biscuit, candy, wafer, chocolate, health food, coffee	Jl. Tomang Raya No.21-23, Jakarta
4	Multi Bintang Tbk	Beer	Jl. Daan Mogot Km 19, Tangerang
5	Siantar Top Tbk	Macaroni spaghetti vermicelli noodles, Pasta	Jl. Tambak Sawah No. 21-23, Waru, Sidoarjo 61256

RESULTS AND DISCUSSION

Summary of Inputs Target and Actual (In Million Rupiah)

DMU No.	Period	DMU Name	Fixed Assets		Operating Expenses	
			Target	Actual	Target	Actual
1	**2003**	**Davomas Abadi, Tbk**	**677,223**	**677,223**	**8,281**	**8,281**
2	2003	Mayora Indah Tbk	513,917	600,992	127,336	148,911
3	2003	Delta Djakarta Tbk	119,477	142,936	75,791	90,672
4	**2003**	**Multi Bintang Tbk**	**245,422**	**245,422**	**166,789**	**166,789**
5	2003	Siantar Top Tbk	255,848	268,915	73,546	77,302
6	**2004**	**Davomas Abadi, Tbk**	**1,194,061**	**1,194,061**	**8,592**	**8,592**

DMU No.	Period	DMU Name	Fixed Assets		Operating Expenses	
			Target	Actual	Target	Actual
7	2004	Mayora Indah Tbk	522,558	610,503	181,347`	211,867
8	2004	Delta Djakarta Tbk	113,590	131,377	90,698	104,901
9	2004	Multi Bintang Tbk	250,755	277,696	185,365	205,280
10	**2004**	**Siantar Top Tbk**	**250,677**	**250,677**	**73,471**	**73,471**
11	2005	Davomas Abadi, Tbk	884,244	1,109,255	11,625	14,583
12	2005	Mayora Indah Tbk	587,269	732,053	227,358	283,411
13	**2005**	**Delta Djakarta Tbk**	**129,736**	**129,736**	**133,874**	**133,874**
14	2005	Multi Bintang Tbk	279,030	340,460	203,572	248,389
15	2005	Siantar Top Tbk	231,512	240,075	64,942	67,344

The summary of input target and actual shows that among 15 DMUs (Decision Making Units) used in the study, five DMUs have met their efficiency in using the fixed assets and operating expenses, while the other 10 DMUs have to reduce their fixed assets and operating expenses to the target. For 2005, Davomas Abadi Tbk has to lessen its fixed assets and operating expenses by 20.28%, Mayora Indah Tbk has to reduce its fixed assets and operating expenses by 19.78 percent, Multi Bintang Tbk by 18.04 percent and Siantar Top Tbk by 3.57%.

Summary of Output Target and Actual (In Million Rupiah)

DMU No.	Period	DMU Name	Revenue		Net Income	
			Target	Actual	Target	Actual
1	**2003**	**Davomas Abadi, Tbk**	**854,967**	**854,967**	**92,016**	**92,016**
2	**2003**	**Mayora Indah Tbk**	**1,103,893**	**1,103,893**	**83,955**	**83,955**
3	**2003**	**Delta Djakarta Tbk**	**302,646**	**302,646**	**38,149**	**38,149**
4	**2003**	**Multi Bintang Tbk**	**562,852**	**562,852**	**90,222**	**90,222**
5	**2003**	**Siantar Top Tbk**	**701,077**	**701,077**	**31,182**	**31,182**
6	**2004**	**Davomas Abadi, Tbk**	**1,032,178**	**1,032,178**	**98,958**	**98,958**
7	**2004**	**Mayora Indah Tbk**	**1,378,127**	**1,378,127**	**85,105**	**85,105**
8	**2004**	**Delta Djakarta Tbk**	**353,481**	**353,481**	**38,695**	**38,695**
9	**2004**	**Multi Bintang Tbk**	**710,911**	**710,911**	**85,297**	**85,297**
10	**2004**	**Siantar Top Tbk**	**712,558**	**712,558**	**28,599**	**28,599**
11	2005	Davomas Abadi, Tbk	**1,120,893**	**1,120,893**	120,081	90,069
12	2005	Mayora Indah Tbk	**1,706,184**	**1,706,184**	90,975	45,730
13	**2005**	**Delta Djakarta Tbk**	**432,729**	**432,729**	**56,405**	**56,405**
14	**2005**	**Multi Bintang Tbk**	**852,613**	**852,613**	**87,014**	**87,014**
15	2005	Siantar Top Tbk	**641,698**	**641,698**	26,638	10,637

The summary of output target and actual shows that among the 15 DMUs used in the study, all 15 DMUs have met their efficiency revenue output targets and only three DMUs (2005-Davomas Abadi Tbk, 2005-Mayora Indah Tbk, and 2005-Siantar Top Tbk) had not achieved their efficiency net income output target.

Summary of Efficiency Performance and Benchmarking food and beverage manufacturing companies against the non-efficient

DMU No.	Period	DMU Name	Input Oriented	Benchmark Results	
			CRS Efficiency	Weight of input & output of benchmark DMU	Benchmark DMU
1	**2003**	**Davomas Abadi Tbk**	**1**	**1**	**1**
2	2003	Mayora Indah Tbk	0.855114	0.291, 0.338, 0.933	1, 4, 10
3	2003	Delta Djakarta Tbk	0.835879	0.324, 0.105, 0.105	4, 10, 13
4	**2003**	**Multi Bintang Tbk**	**1**	**1**	**4**
5	2003	Siantar Top Tbk	0.951407	0.021, 0.027, 0.937	1, 4, 10
6	**2004**	**Davomas Abadi Tbk**	**1**	**1**	**6**
7	2004	Mayora Indah Tbk	0.855947	0.05, 0.398, 1.56	1, 4, 10
8	2004	Delta Djakarta Tbk	0.864608	0.039, 0.125, 0.56	4, 10, 13
9	2004	Multi Bintang Tbk	0.902985	0.386, 0.216, 0.785	4, 10, 13
10	**2004**	**Siantar Top Tbk**	**1**	**1**	**10**
11	2005	Davomas Abadi Tbk	0.797151	1.301, 0.012	1, 10
12	2005	Mayora Indah Tbk	0.802221	2.044, 0.576	10, 13
13	**2005**	**Delta Djakarta Tbk**	**1**	**1**	**13**
14	2005	Multi Bintang Tbk	0.819569	0.11, 0.404, 1.162	4, 10, 13
15	2005	Siantar Top Tbk	0.964331	0.015, 0.882	1, 10

Summary of efficiency performance and benchmarking food and beverage manufacturing companies against the non-efficient table shows that DMUs that having efficiency scores of unity, specifically are, DMUs 1, 4, 6, 10 and 13 were identified as the benchmarking companies. The remaining non-efficient DMUs were compared to the best performing DMUs. For instance, DMU 2 (2003-Mayora Indah Tbk) should use DMU 1 (2003-Davomas Abadi Tbk), DMU 4(2003-Multi Bintang Tbk), DMU 10 (2004-Siantar Top Tbk). The table also exhibits the weights of inputs and outputs of the benchmark DMUs that should be adopted by the non-efficient DMUs to achieve the efficient frontier.

CONCLUSIONS

The major findings are as follows: in terms of efficiency assessment of the selected Indonesian food and beverage manufacturing industry, the five (5) companies have different efficiency ranking all over the observation period. Davomas Abadi Tbk has reached efficiency level during the first two (2) years of the observation period (2003 to 2005). Multi Bintang Tbk operates at efficient level in 2003, Siantar Top Tbk operates at efficient level in 2004 while Delta Djakarta Tbk operates at efficient level in 2005. Findings show that the amount from the input-oriented CRS model target of the said efficient food and beverage manufacturing companies are competent in terms of both input variables: fixed assets and operating expenses as well as on the output variables: revenue and net income. The same companies have reached the input and output target.The remaining food and beverage manufacturing companies who have not reached both input and output target are: 2005-Davomas Abadi Tbk, 2005-Mayora Indah Tbk, 2005-Siantar Top Tbk show an overall inefficiency on input target of fixed

assets and operating expenses as well as on output target of net income.

The information resulting from DEA analysis is valuable to management in that a given food and beverage manufacturing company should be able to make productivity improvements and/or cost reductions. The inefficient companies can learn from and emulate their efficient peers regarding what needs to be done to improve.

Recommendations. Periodic study should be conducted by the Indonesian food and beverage manufacturing companies on the efficiency and performance. Instead of using traditional techniques such as ratio analysis and observation, the management of the food and beverage manufacturing companies studied here recommended to use DEA to identify areas where improvement could be made in the performance.

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