

Use of Merger and Acquisition Approach to Improve the Productivity of Taiwanese Laptop Manufacturers: An Empirical Study

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Abstract—This study examines the efficiency of 12 Taiwanese laptop manufacturers in 2002. This work demonstrates the feasibility of adopting Data Envelopment Analysis (DEA) to identify individual manufacturing firms that are less efficient than other ones. Efficiency is measured in terms of output variables relative to input variables. For those efficient laptop manufacturers lacking of productivity, they can use DEA Approach as an assistant tool to choose candidates for merger or acquisition. The researcher has developed a general framework for combining Merger & Acquisition (M&A) Approach with DEA Approach. Empirical results indicate that superior insights can be obtained by analyzing simultaneously operation and profitability, then the useful information for merger or acquisition activity can be obtained from analyzing hypothetical Decision Making Units' (DMUs) efficiency. The researcher believe that such computations hold the potential of becoming a useful tool assisting resource analyst and mergers in their routine evaluation of the performance of corporations and industries.

Keywords—Merger & Acquisition Approach; Laptop Manufacturers; Data Envelopment Analysis (DEA)

I. INTRODUCTION

It is a big challenge for Taiwanese laptop manufacturers to maintain their high growth and position as a leader in laptop industry. Since Taiwan's laptop industry is an exporting industry, it is highly dependent on the performance of global computer manufacturers. According to current cooperation between Taiwanese and world manufacturers, as well as predictions for the global laptop market, Taiwan's laptop industry will continue to grow. The reliance of large foreign manufacturers on Taiwanese laptop manufacturers requires professionalism, efficiency and technological advancement of the Taiwanese laptop manufacturers [1].

Before 2000, most of information technology products were produced in Taiwan. However the trend changed and China got most of market share by low labor costs in recent years. But yet Taiwan has more than half of the world laptop market share [2]. It is very important for Taiwanese manufacturers to increase or at minimum to maintain this

market share. Taiwanese manufacturers have already lost the competitive advantage of low labor costs. Therefore they should try to build competitive advantage in other areas.

Base on continue improvement and professionalism in technology and skill, Taiwan can built the competitive advantage and achieve efficiency in production [3]. Taiwanese laptop manufacturer managers are not exception from this rule. They, too, can improve efficiency by constant evaluation and investigation of their performance. This study provides the means and ways of evaluation and improvement of Taiwanese laptop manufacturers.

The objectives of this study are to develop a comprehensive framework and a model for evaluating the efficiency of Taiwanese laptop manufacturers. The results of this study will provide the managers of Taiwanese laptop manufacturers with instruments for productivity improvement without losing efficiency. Merger & Acquisition (M&A) Approach will provide the application and recommendations of the study.

II. LITERATURE REVIEW

This part show what prior research has been done in efficiency measure and productivity improvement, and to provide the theoretical foundation for the study.

A. Data Envelopment Analysis Approach

Data Envelopment Analysis (DEA) is a new technique used to measure efficiency of a company. DEA technique supplements the traditional approaches and provides a more comprehensive insight into how well an organization is performing. DEA is a powerful tool that can be utilized to analyst and improve the performance of a company [4]. DEA Approach is coming into general use as a tool to measure efficiency of different organization, and it is a good tool for performance measurement.

DEA Approach is a linear programming model developed by Charnes, Cooper and Rhodes [5] that measures efficiency, or productivity, of each member of a set of comparable producing units. Charnes, Cooper and Rhodes extended

Farrell's idea [6] and processed a model that generalizes the single-input and single-output ratio measure of efficiency of a single Decision Making Unit (DMU) in a multiple-inputs and multiple-output setting. The efficiency of a DMU is computed using the measure of efficiency as Equation 1.

$$Efficiency = \frac{\sum weight \times output}{\sum weight \times input} \quad (1)$$

Under DEA Approach, there is no particular structure superimposed on the data in identifying the efficient units [7]. Instead, a best-practice structure is empirically constructed by putting inputs and outputs through linear programming. The significance of this feature of DEA is that it can become a valuable tool in performance measuring. It also means that units with different configurations of inputs and outputs can be recognized as efficient in implementation of the production process. DEA determines the inefficiency in a particular unit by comparing it to efficient units of similar configuration. The contrasts the operation of parametric techniques where a particular measure of inefficiency is associated with statistical averages that may or may not be applicable to that unit's composition.

B. Merger & Acquisition Approach

Merger and acquisition are two commonly ways to pursue growth and profit. An acquisition occurs when a large organization purchases a smaller firm, or vice versa. A merger occurs when two organization of about equal size unite to form one enterprise. Among mergers and acquisition in recent years, same-industry combinations have predominated. A general market consolidation is occurring in many industries, especially computer industry. Analysts agree that the M&A Approach trend that first become apparent in computer industry in the late 1990s shows no signs of slowing, primarily because of the benefits it has created and continues to create for the companies involved and for shareholders, such as HP and Compaq [8].

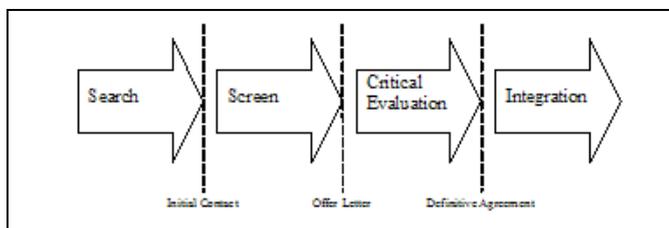


Figure 1. Robison's strategic acquisition process.

M&A Approach is driven by plenty of motives. One of the most popular is efficiency theory [8]. For example, the argument of cost savings often advanced in support of firm mergers includes excess capacity. Other motivations for mergers are scale economies arising from technological change, and excess capital looking for investment opportunities. Firms can provide improved capacity utilization and gain economies of scale by M&A Approach. Robinson [9] breaks down merger

and acquisition activity into four distinct process steps: search, screen, critical evaluation and integration (Figure 1).

An acquisition should meet a strategic need within the acquirer's organization and ultimately, should increase shareholder value. Evaluating acquisition candidates, therefore, requires a thorough understanding of the acquirer's underlying business strategy. Only with such an understanding can synergies created by a potential acquisition be adequately identified, understood, and quantified. Evaluating a candidate as a stand-alone entity is somewhat routine. But the nuances involved in any created synergies can be subtle and not easily quantified. To justify the acquisition, candidate evaluation requires more than finding an opportunity where the target's economic performance outweighs the buyer's cost of capital [9].

Using DEA Approach, Seiford and Zhu [10] examined the potential effect of acquisitions on profitability and marketability of top 55 US commercial banks. They put hypothetical DMUs into DEA calculation to see whether these banks gained deficiency after merged and acquired. Chapin and Schmidt [11] used DEA to measure efficiency for US rail firms since deregulation, and assess whether mergers have improved efficiency. As the researcher shall see, DEA has been implied in merged and acquired field to evaluate efficiency gains.

III. RESEARCH DESIGN

This study begins with providing a conceptual foundation for DEA Approach, followed by a methodology section in which the formulation of the DEA assessment model and data collection procedures presented. Then the findings and analysis of the results based on a comparative efficiency rating will be discussed. Furthermore, the productivity improvement methods and recommendations of the study will be presented.

The research questions addressed in this study are: (1) How much does efficiency differ among Taiwanese laptop manufacturers? (2) How to improve Taiwanese laptop manufacturers' productivity or profitable without losing efficiency?

The data sources in the study, including company information, Return on Investment and financial reports (or annual report) of each company were adapted from the Market Observation Post System (<http://newmops.tse.com.tw>) which is built by Taiwan Stock Exchange Corporation (TSEC).

There are total of 12 laptop finished goods manufacturers that are listed on the TSEC. They are FIC(2319), Compal(2324), Elitegroup(2331), Acer(2353), Inventec(2356), Asustek(2357), Clevo(2362), Twinhead(2364), Arima(2381), QCI(2382), MTC(3005) and Wistron(3231) [12]. These 12 Taiwanese laptop manufacturers are all DMUs in this study.

A. Performance Measuring: Data Envelopment Analysis Approach

Base on Lai's study [13], the performance measuring model in this study includes 3 output variables and 3 input variables (See Figure 2), and some of them follow the simple rule of

Brunner, Hancock and McLaughlin [14]. Operating Revenue, Non-Operating Revenue and Assets are output variables, and Operating Expenses, Non-Operating Expenses and Operating Costs are input variables.

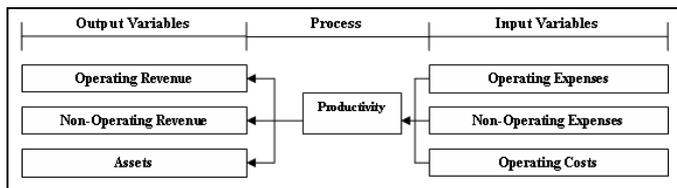


Figure 2. The DEA model of Taiwanese laptop manufacturers.

This study applies the output-oriented DEA model to reveal the extent to which inputs can be augmented while maintaining the same level of outputs. The model fits the current situation of Taiwanese laptop manufacturers: when outputs are fixed, companies should reduce inputs if they want to improve their efficiency. The study uses a DEA model to establish a foundation for measuring the efficiency of Taiwanese laptop manufacturers.

DEA is a linear technique that generates a comparative ratio of weighted outputs to inputs for each DMU. The relative efficiency score is generally reported as a number between 0% ~ 100%. A unit with a score less than 100% is regarded as inefficient relative to other units in the sample. DEA can be conducted using standard linear programming software. The researcher used DEA-Solver 11 for the DEA calculation in this study.

B. Productivity Improvement: Merger & Acquisition Approach

After understanding where the companies stand relative to their competitors, the researcher discussed how these efficient companies can improve their productivity by M&A Approach. M&A Approach is a convenient tool to become more competitive quickly in a highly competitive industry such as laptop industry.

Most observers agree that mergers are driven by a complex pattern of motives, and that no single approach can render a full account. Companies can get productivity by means of M&A Approach. DEA Approach is a powerful tool for choosing candidate of merged and acquired (See Figure 1). Thus this study makes a simulative situation to explain this approach.

IV. RESULTS

In this study, the researcher analyzes the efficiency of 12 Taiwanese laptop manufacturers in 2002. For those efficient laptop manufacturers lacking of productivity, they can use DEA Approach as an assistant tool to choose candidates for M&A Approach.

DEA measures efficiency of DMUs and provides a basis for comparing the efficiency of each unit versus the other units. This study applies a DEA model to publicly traded Taiwanese laptop manufacturers to find the degree of efficiency or inefficiency of each manufacturer within the industry.

Table I. The Efficiency Scores of 12 Taiwanese Laptop Manufacturers

Code	Symbol of Company	Efficiency Score (%)	Return on Investment (%)
2319	FIC	32.71	-7.26
2324	Compal	100.00	8.76
2331	Elitegroup	87.76	10.35
2353	Acer	100.00	9.64
2356	Inventec	100.00	7.94
2357	Asustek	78.02	12.87
2362	Clevo	40.13	2.20
2364	Twinhead	25.98	-8.57
2381	Arima	100.00	1.51
2382	QCI	81.40	10.93
3005	MTC	47.43	9.78
3231	Wistron	58.57	5.33
	Average	71.00	5.29

The efficiency scores of these 12 Taiwanese laptop manufacturers can be calculated by applying the DEA model as Figure 2. Table I reports the efficiency scores of these 12 Taiwanese laptop manufacturers with code numbers. The DEA yields an average efficiency of 71.00%, with a range of 100.00%~25.98%. The following four firms were found to be efficient: Compal, Acer, Inventec and Arima. The following eight firms were found to be inefficient: Twinhead, FIC, Clevo, MTC, Wistron, Asustek, QCI and Elitegroup.

Most observers agree that mergers are driven by a complex pattern of motives, and that no single approach can render a full account. In this section the researcher focuses on efficiency theory: companies can get efficiency and productivity by means of M&A Approach [8]. DEA Approach is a good tool for step one and step three in Robison’s strategic acquisition process (See Figure 1). So, DEA Approach is a helpful tool in choosing and critical evaluation candidate in the process of M&A Approach. Besides, the study focuses on accounting courses, and they are generally useful to consider when identifying source of value for M&A Approach [15].

In Table I, Arima (2381) is the only one efficient firm that Return on Investment is under the industrial average. It is a professional laptop manufacturer. It is good performance in productivity and earns excellent goodwill in the past decade. It is difficult for Arima to get more profit by improve efficiency, but it is lacking of productivity always. Their growth of productivity can’t catch up growth of customers’ demands. Besides, to penetrate laptop market quickly Arima also needs more productivity to feed consumer’s demand. It was too late to build new factories and machines. M&A Approach is one way to improve productivity. However, the merging company needs to ensure its efficiency could be improved or maintained the original level after merger or acquisition.

Table II. The Efficiency Score of Each Candidate

Unit	Hypothetical Company (Hypothetical DMU)	Efficiency Score (%)	Return on Investment (%)
U00	2381	100.00	1.51
U01	2381+2319	75.11	-2.77
U02	2381+2362	100.00	1.65
U03	2381+2364	87.28	-0.45
U04	2381+3005	100.00	3.10
U05	2381+3231	100.00	3.48
U06	2381+2319+2362	78.38	-2.18
U07	2381+2319+2364	73.28	-3.41
U08	2381+2319+3005	81.45	1.40
U09	2381+2319+3231	67.66	0.09
U10	2381+2362+2364	90.34	0.01
U11	2381+2362+3005	100.00	2.94
U12	2381+2362+3231	95.97	3.33
U13	2381+2364+3005	92.65	1.20
U14	2381+2364+3231	92.37	2.22
U15	2381+3005+3231	100.00	*4.13
U16	2381+2319+2362+2364	76.38	-2.81
U17	2381+2319+2362+3005	83.36	1.02
U18	2381+2319+2362+3231	69.81	0.26
U19	2381+2319+2364+3005	79.43	-2.11
U20	2381+2319+2364+3231	67.06	-0.55
U21	2381+2319+3005+3231	72.44	0.80
U22	2381+2362+2364+3005	93.88	1.35
U23	2381+2362+2364+3231	89.97	2.22
U24	2381+2362+3005+3231	97.29	3.93
U25	2381+2364+3005+3231	93.56	2.93
U26	2381+2319+2362+2364+3005	81.35	-1.69
U27	2381+2419+2362+2364+3231	69.21	-0.35
U28	2381+2319+2362+3005+3231	74.01	0.90
U29	2381+2319+2364+3005+3231	71.64	0.15
U30	2381+2362+2364+3005+3231	91.34	2.86
U31	2381+2319+2362+2364+3005+3231	83.74	0.98

After application with DEA with all companies in Taiwanese laptop industry, according to Table I, the researcher picks up five candidates to be merged for Arima: FIC (2319), Clevo (2362), Twinhead (2364), MTC (3055) and Wistron (3231). The Efficiency Score and Return on Investment of these five companies are all under the industrial average. They may be willing to agree the merger or acquisition deal.

After pick up these five companies, 31 hypothetical merger companies are created to represent the result of merger or acquisition (See Table II). Additively is assumed in merger or acquisition, the input and output levels in the new company.

Table II report some parts of outcomes. The U00 Company is the original Arima, and the others are Arima merger or acquisition with other companies. The data of new company is the summary of sub-companies.

In Table II, most hypothetical DMU's efficiency scores are less than 1. The efficiency scores of U02, U04, U05, U11 and U15 are equal to 100%. They are good solution for the M&A strategy of Arima. After considering the maxima of Return on Investment, the researcher may suggest that Arima choose MTC (3005) and Wistron (3231) to merge or acquire for improve productivity (See U15 in Table II).

From the case shown above, the researcher can know DEA indeed provides a new way to evaluate merger or acquisition candidate.

V. DISCUSSION

The object of this study was to provide an alternative method to improve the productivity of laptop manufacturers in Taiwan. A detail review of the literature relevant to commonly used performance indicators and various studies measuring efficiency in the laptop industry was used as the starting point.

This study analyzes the efficiency of the 12 Taiwanese laptop manufacturers in 2002. The study has indicated how use DEA Approach to identify individual manufacturing companies that are less efficient that other comparable units in terms of output factors relative to input factors. The study results obtained show that out of 12 laptop manufacturers 4 were found to be relatively efficient.

The researcher adopted M&A Approaches to improve these efficient companies' productivity. This study show that how to evaluate merger or acquisition candidates by means of DEA. The discussions provided rich and detail information on how the DEA results were accepted by companies in the context of

deciding candidates for merger or acquisition. Needless to say, DEA provided new insights to senior managers on evaluating merger or acquisition candidates which are not available from other methods for assessment. The researcher may suggest that Arima choose MTC and Wistron to merge or acquire for improve productivity.

The researcher has developed a general framework for combining M&A Approach with DEA Approach. Empirical results indicate that superior insights can be obtained by analyzing simultaneously operation and profitability, then the useful information for merger or acquisition activity can be obtained from analyzing hypothetical DMUs' efficiency. For those units lacking of productivity, companies can use DEA Approach as an assistant tool to choose candidates for M&A Approach. The researcher believe that such computations hold the potential of becoming a useful tool assisting resource analyst and mergers in their routine evaluation of the performance of corporations and industries.

REFERENCES

- [1] Trappey, C. V., *The Taiwan Electronics Market*. Taipei, Taiwan: Hwa-Tai Publishing, 2003.
- [2] Chang, H. C., Lin, C. H., & Kao, S. C., "Exploring Significant Core Resources for the Performance for the Performance of High Technology Industries in Taiwan," *International Journal of Management*, vol. 20(2), pp. 138-142, 2003.
- [3] Porter, M. E., "The competitive advantage of Taiwan," Harvard University, Institute for Strategy and Competitiveness. Retrieved December 31, 2014, from <http://www.isc.hbs.edu/econ-natlcomp.htm>, 2001.
- [4] Norton, R., "Which Offices or Stores Really Perform Best? A New Tool Tells," *Fortune*, vol. 130(9), pp. 38, 1994.
- [5] Charnes, A., Cooper, W. W., & Rhodes, E., "Measuring the Efficiency of Decision Making Units," *European Journal of Operational Research*, vol. 2(6), pp. 391-465, 1978.
- [6] Farrell, M. J., "The Measurement of Productive Efficiency," *Journal of the Royal Statistical Society*, vol. 123(3), pp. 253-290, 1957.
- [7] Mester, L. J., "A Study of Bank Efficiency Taking into Account Risk-Preferences," *Journal of Banking & Finance*, vol. 20(6), pp. 1021-1045, 1996.
- [8] Trautwein, F., "Merger Motives and Merger Prescriptions," *Strategic Management Journal*, vol. 11(4), pp. 283-295, 1990.
- [9] Robinson, B. R., "Strategic Acquisitions: A Guide to Growing and Enhancing the Value of Your Business," Burr Ridge, IL: Irwin Professional Publishing, 1995.
- [10] Seiford, L. M., Zhu, J., "Profitability and Marketability of the Top 55 U.S. Commercial Banks," *Management Science*, vol. 45(9), pp. 1270-1288, 1999.
- [11] Chapin, A., Schmidt, S. "Do Mergers Improve Efficiency? Evidence From Deregulated Rail Freight," *Journal of Transport Economics and Policy*, vol. 33(2), pp. 147-162. 1999.
- [12] Taiwan Securities and Futures Commission. Market Observation Post System of Taiwan Stock Exchange Corporation, Retrieved January 31, 2014, from <http://newmops.tse.com.tw>, 2004.
- [13] Lai, Yi-Horng, *Efficiency of Taiwanese Laptop Manufacturers*. Doctoral dissertation, Lynn University – Boca Raton, Florida, 2004.
- [14] Brunner, A. D., Hancock, D., & McLaughlin, M. M., "Recent Developments Affecting the Profitability and Practices of Commercial Banks," *Federal Reserve Bulletin*, vol. 78(7), pp. 459-483, 1992.
- [15] Viscio, A. J., Harbison, J. R., Asin, A., & Vitaro, R. P., "Post-Merger Integration: What Makes Mergers Work?" *Strategy & Business*, vol. 17, 26-33, 1999.