

Efficiency Analysis of the Indonesian Financial Institution Subsector: A Dea Approach

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This paper applies Data Envelopment Analysis in measuring and analyzing the relative efficiency of 11 Indonesian financial companies listed in Indonesia stock Exchange (IDX). DEA measures the efficiency of decision making units (DMUs) by doing linear program for each one as a comparison to other units. Accordingly the DMUs that lie on frontier curve are efficient. Whereas the DMU that is not lie on the curve is considered inefficient. This paper shows that only three companies are fully efficient (100%) in both CCR and BCC scores. This indicates that those companies are operating in the most productive scale size. In addition to identifying best-practice companies and those that are out-of-line with the best practice companies, DEA also points to the specific changes that must be made in the less productive companies in order for them to catch up with their best-practice peer group. The findings of this study should help the managers in financial institution to put more efforts into efficiency improvement.

Key words: CRS-input, data envelopment analysis, decision making unit, efficiency, financial institution, VRS-input

INTRODUCTION

Non-bank financial institutions (NBFIs) such as insurance firms, pension funds, mutual funds, leasing and venture capital companies have a key role to play in Indonesia future development. NBFIs in Indonesia are much smaller than those in several other large developing countries and in many countries of the East Asia region (World Bank, 2006). In Indonesia, multi finance companies as non-bank financial institutions can conduct leasing, factoring and consumer and credit card finance. This sector provides financing for small and medium enterprises. This sector is small, but growing strongly in Indonesia, driven largely by consumer finance.

Presidential Decree no.61 of 1988 and the following minister of finance decrees set out the definition of each business under the multi finance industry (Decree no.1169/KMK.01/1991 for leasing and Decree no.1251/KMK.13/1988 for factoring). The leasing business offers both financial leases and operating leases. Leasing can only finance capital goods, which are defined as tangible fixed assets that have economic life of more than one year and are being used directly and indirectly to produce, enhance, or smooth the production and distribution of goods and services. Factoring is the purchase, sale and management of debts and short term claims of a company arising from domestic or overseas trade transactions. Factoring includes both financing and non-financing services. Non-financing services

include credit investigation, sales ledger administration, control of credit and collection of debts, and credit risk management.

Consumer finance is the activity of financing goods for consumers where in repayment via periodic payments. The credit card business allows consumers to purchase goods and services with the use of credit cards as a means of payment. Unlike leasing and factoring, which are used by individuals to purchase consumer goods and services, most consumer financing is used to purchase new and used cars or motorbikes. Recently, consumer financing has been made available for purchasing electronic appliances and furniture.

Based on data from Bank Indonesia (BI), financing services were valued at Rp. 107.7 trillion in 2007 up 15.7 percent from Rp 93.1 trillion in the previous year. Consumer finance with a value of Rp 67.6 trillion accounted for the largest portion of 62.8 percent, followed by leasing, accounting for 33.9 percent or Rp 36.5 trillion of the total value. Development of multi-finance follows the fast growth of the consumption sector of the country economy. The expansion of the multi-finance industry is reflected by its assets. Total asset of multi-finance industry was recorded at Rp.127.26 trillion by the end of 2007, up 17.5 percent from Rp.108.34 trillion in the previous year. Consumer finance and leasing still dominated the industry until 2007. In the period of 2003-2007, the number of multi-finance companies in Indonesia declined by

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3.4 percent annually. Based on official data of Bank Indonesia (BI), there were 239 companies in 2004, but the number declined in 2007. In 2006, there were 24 multi-finance companies suspended by the finance ministry for failure to submit audited financial report for 2004. The decline in number was also caused by other factors such as merger among some of the companies, change in line of business or bankruptcy (Indonesian Commercial Newsletter, 2008b).

In Indonesia stock exchange (IDX) the multi finance companies listed as financial institution under finance industry. This institution is undergoing turmoil due to the global financial crisis. In Q4/2008 (Bank Indonesia, 2009), the global financial turbulence began to bear down on the Indonesian economy. The crisis has hit the country mainly in the financial and export sectors. The impact on the financial sector began to bite since early in 2008 marked with rupiah fall, shrinking composite price index as a result of withdrawals of foreign investment from share and bond markets resulting in tight liquidity, high inflation and higher business risks and larger cost of money (Indonesian Commercial Newsletter, 2008a). In fact, several leading firms in the industry are reporting significant decline in their net incomes due to losses, resulting in steep drops in their stock prices.

Objective Of The Study. The objective of this paper is to find out the relative efficiency of the eleven (11) financial companies listed in Indonesia Stock Exchange (IDX), comparing said companies with each other for the year 2008. This paper aims to determine the usefulness of data envelopment analysis (DEA) for the efficiency analysis. By measuring efficiency, it is possible to evaluate the performance of the financial company by comparing it with counterparts along standards of best practices. **Significance Of The Study.** The importance of this paper comes from its smooth and simplified presentation of data envelopment analysis system with the procedures and conditions of using it to measure the efficiency through the application on listed Indonesian financial institution in 2008. This makes it easy to other researcher to understand and apply this approach to measure the efficiency of other decision making units. This paper can help investors understand how each financial company performs and it may also assist them to do the right investment decisions by knowing how these companies may perform in terms of efficiency and productivity in the long run. To the general public, this study is essential for giving

insights about the status of the Indonesian financial institution. For sample financial companies, this study may assist them to evaluate and analyze their own performance relative to their competitors in the industry. The results of this study may help them identify their strengths and weaknesses alongside competition. Likewise, this study may also serve as a guide in their formulation or revision of policies and strategies to gain competitive advantage. Hence overall, this paper can serve as a benchmark for future performance management researches, especially in the financial industry

Scope and Limitation. The study is limited to the eleven (11) Indonesian financial companies listed in Indonesia stock exchange for 2008. This study addresses the question: Which company is more efficient in converting inputs into outputs. Three (3) inputs and one output variable were used and entered into the DEA model for efficiency analysis. The data were extracted mainly from the audited financial statements published by Indonesia stock exchange (IDX).

Review Of Related Literature. Data envelopment analysis (DEA) usually investigates efficiency change at both firm and country levels. This approach has been applied by many studies. In the manufacturing industry, related studies include Tan (2006), Hashimoto and Hamed (2008), Liu and Wang (2008), Helvoigt and Adams (2008). Xue et al. (2008) measured the productivity of the construction industry in China using DEA-based malmquist productivity indices. In hotel industry, Jones and Siag (2009) examined the factors that influence productivity in hotel. Topuz and Isik (2009) evaluated the structural changes, market growth and productivity gain of the US real estate investment trusts in the 1990.

A number of research projects have been conducted to explore the use of DEA in financial and banking industry. Khalaf Al-Delaimi and Battall Al-Ani (2006), using DEA to measure cost efficiency with an application on Islamic banking. This study shows that most Islamic banking institutions which are the sample of the study are efficient and the rest is on the way of improving their efficiencies. Mostafa (2007) used DEA method to evaluate the relative efficiency of Arab banks and the results indicate that the performance of several banks is sub-optimal, suggesting the potential for significant improvements. Separate benchmarks were derived for possible reductions in resource used, and significant savings are possible on this account. Lin and Huang (2009) used DEA in studying the

optimal size of the financial services industry in Taiwan and the results suggest a great potential for restructuring of the financial services industry in Taiwan. Saad and El-Moussawi (2009) evaluated the productive efficiency of Lebanese commercial banks. The empirical results show that the process of restructuring the Lebanese banking sector has been accompanied by an improvement of the cost efficiency of Lebanese banks. Ahmed and Farooq (2009) used the output-oriented model of DEA to put much weight on the

DATA SAMPLE AND METHODOLOGY

This study used financial statement data available for 2008 from Indonesia Stock Exchange (IDX). Three input variables and one output variable used to evaluate all eleven companies from the financial institution. The eleven companies with the scope of activities of leasing, consumer financing and factoring that include in this study are: PT. Adira Dinamika Multi Finance Tbk, PT. BFI Finance Indonesia Tbk, PT. Buana Finance Tbk, PT. Clipan finance Indonesia Tbk, PT. Danasupra Erapacific Tbk, PT. Duta Kirana Finance Tbk, PT. Indo Citra Finance Tbk, PT. Mandala Multifinance Tbk, PT. Trust Finance Indonesia Tbk, PT. Verena Oto Finance Tbk, and PT. Wahana Ottomitra Multiartha Tbk.

The three input variables are total equity, total operating expenses, and total salaries and benefits. The output variable is total revenues. In this study, the comparative evaluation among the companies is an important consideration. Therefore, the envelopment model for analysis is selected. In addition, the outputs are an outcome of managerial goals. Therefore, input-based formulation is recommended for this study. Furthermore, to investigate the affect of scale of operations, if any among the 11 companies, constant return to scale and variable returns to scale DEA models are considered.

Data envelopment analysis is a powerful technique for measuring performance because of its objectivity and ability to handle multiple inputs and outputs that can be measured in different units. The DEA approach does not require specification of any functional relationship between inputs and outputs or a priori specification of weights of inputs and outputs. DEA provides gross efficiency scores based on the effect of controllable and uncontrollable factors. DEA uses a number of variables to determine how good a firm is. Each firm is

expansion of output quantity out of given amount of inputs. Overall conclusion of the study is that financial sector reforms are successful in improving the efficiency of the domestic commercial banks role as intermediations in Pakistan. Ravichandran et al. (2009) applied DEA for analyzing the efficiency of market based bank mergers in India. Empirical research was carried out on seven Indian banks and found that merger and acquisition has greater impact on banking efficiency.

evaluated against either an existing firm or a hypothetical firm with an identical set of inputs or outputs that is constructed as a combination of performing and nonperforming companies.

Data envelopment analysis (DEA) is a nonparametric method in operations research and economics for the estimation of production frontiers. It is used to empirically measure productive efficiency of decision making units (or DMUs). DEA identifies a "frontier" on which the relative performance of all utilities in the sample can be compared: DEA benchmarks firms only against the best producers. It can be characterized as an extreme point method that assumes that if a firm can produce a certain level of output utilizing specific input levels, another firm of equal scale should be capable of doing the same. The most efficient producers can form a composite producer, allowing the computation of an efficient solution for every level of input or output.

In the DEA methodology, formally developed by Charnes, Cooper and Rhodes (1978), building on the ideas of Farrell (1957), efficiency is defined as a weighted sum of outputs to a weighted sum of inputs, where the weights structure is calculated by means of mathematical programming and constant returns to scale (CRS) are assumed. Banker, Charnes and Cooper (1984) developed a model with variable returns to scale (VRS). The main developments of DEA in the 1970s and 1980s are documented by Seiford & Thrall (1990).

The comparisons of the (input-oriented) CCR and BCC scores are considered in this study. The CCR model assumes the constant returns to scale (CRS) production possibility set, i.e., it is postulated that the radial expansion and reduction of all observed DMUs and their nonnegative combinations are possible and hence the CCR score is called global technical efficiency. On the other hand, the BCC model assumes the convex combinations of the observed DMUs as the production possibility set and the BCC score is called local pure technical efficiency. If a DMU is fully efficient (100%) in both the CCR and BCC

scores, it is operating in the most productive scale size. An input-oriented model was adopted in this study. Efficiency scores range from 0 to 1; whereby, a score of 1 represents 100 percent efficiency. The CCR score is called the (global) technical efficiency (TE), since it takes no account of scale effect. On the other hand, the BCC expresses the (local) pure technical efficiency (PTE) under variable returns-to-scale circumstances. (Cooper, Seiford & Tone, 2004). This paper utilized the input-oriented CCR and input-oriented BCC. The input-oriented CCR model attempts to minimize inputs while producing at least the given output levels:

$$\begin{aligned} & (DPL_o) \min \theta \\ \text{Subject to } & \theta x_o - x\lambda \geq 0 \quad YX \geq y_o \quad \lambda \end{aligned} \quad (1)$$

where θ is efficiency score, λ is the reference set the input-oriented BCC model evaluates the efficiency of DMU_o ($o = 1, \dots, n$) by solving the following (envelopment form) linear program: (BCC_o) min θ_B Subject to $\theta_B x_o - X\lambda \geq 0$; $Y\lambda$

$\geq y_o$; $e\lambda = I$; $\lambda \geq 0$; where θ_B is a scalar

If a DMU has the full BCC efficiency but a low CCR score, then it is operating locally efficiently but not globally efficiently due to the scale size of the DMU. Thus, it is needed to characterize the scale efficiency of a DMU by the ratio of the two scores. The scale efficiency is defined by:

$$SE = \frac{\theta^* CCR}{\theta^* BCC} \quad (2)$$

Table 1 shows the list of eleven sample financial companies with the financial data for the fiscal year of 2008 included in this study, considering three (3) input variables and one (1) output variable. The variables were then subjected to the DEA method under the constant returns to scale (CRS) and variable return to scale (VRS) assumption for the eleven (11) pooled data or decision making units (DMUs).

Table 1. Actual Financial Data for 2008 of the Financial Institution

DMU No.	DMU	Total Equity	Input Operating Expenses	Salaries & Benefits	Output Total Revenues
1	PT. Adira Dinamika Multi Finance Tbk	1,950,003	1,959,381	654,911	3,378,703
2	PT. BFI Finance Indonesia Tbk	1,357,496	559,701	148,052	889,940
3	PT. Buana Finance Tbk	866,658	199,707	41,398	275,128
4	PT. Clipan Finance Indonesia Tbk	1,174,763	165,295	33,290	323,342
5	PT. Danasupra Erapacific Tbk	41,615	5,529	3,347	2,926
6	PT. Duta Kirana Finance Tbk	8,040	7,957	1,330	397
7	PT. Indo Citra Finance Tbk	10,809	1,707	481	677
8	PT. Mandala Multifinance Tbk	396,438	497,722	127,482	644,137
9	PT. Trust Finance Indonesia Tbk	201,916	29,931	7,099	47,336
10	PT. Verena Oto Finance Tbk	118,677	128,038	25,105	145,630
11	PT. Wahana Ottomitra Multiartha Tbk	275,716	1,299,484	176,355	1,377,564

Note: All figures are in Rp. Millions

Empirical Results. Using the DEA – CRS input assumption, Table 2 presents that only three (3) companies achieved efficiency scores of 1.00. These companies are PT. Adira Dinamika Multi Finance Tbk, PT. Clipan Finance Indonesia Tbk and PT. Wahana Ottomitra Multiartha Tbk. In other words, these best practice DMUs generate revenues and provide services requiring fewer resources than do their peers. The other eight (8) DMUs: 2, 3, 5, 6, 7, 8, 9 and 10 obtained efficiency scores below 1.00. This indicates that they can make substantial improvements in terms of increasing productivity. Table 2 includes peer groups (or reference sets) in addition to the efficiency scores obtained from DEA analysis. The reference groups for PT. BFI Finance Indonesia Tbk, PT. Buana Finance Tbk, PT. Duta Kirana Finance Tbk, PT. Mandala Multifinance Tbk and PT. Verena Oto Finance Tbk are DMU 1,

DMU 4 and DMU 11. PT. Danasupra Erapacific Tbk's reference is DMU 4. The reference groups for PT. Indo Citra Finance Tbk and PT. Trust Finance Indonesia Tbk are DMU 1 and DMU 4. It could be argued that the DEA results ranking the DMUs in terms of their operational efficiency. The efficiency score of 0.958229 applied to DMU 2 (PT. BFI Finance Indonesia Tbk)'s input will bring this DMU onto the efficient frontier. The efficiency score of 0.041228 applied to DMU 11 (PT. Duta Kirana Finance Tbk)'s input will bring this DMU onto the efficient frontier while leaving its output at its present value. As concluded by Khalaf Al-Delaimi and Battall Al-Ani (2006) that DMUs lie on frontier curve are efficient in choosing the optimal mixture of inputs to achieve the aimed level of outputs whereas the DMUs that isn't lie on the curve are considered inefficient.

Table 2. Efficiency Summary DEA Efficiency Scores & Rankings – CRS Input

DMU No.	Bank (DMU Name)	Efficiency Score	DEA Rankings	Reference Set
1	PT. Adira Dinamika Multi Finance Tbk	1.000000	1	1
2	PT. BFI Finance Indonesia Tbk	0.958229	4	1, 4, 11
3	PT. Buana Finance Tbk	0.818221	7	1, 4, 11
4	PT. Clipan Finance Indonesia Tbk	1.000000	1	4
5	PT. Danasupra Erapacific Tbk	0.270536	9	4
6	PT. Duta Kirana Finance Tbk	0.041228	11	1, 4, 11
7	PT. Indo Citra Finance Tbk	0.205838	10	1, 4
8	PT. Mandala Multifinance Tbk	0.884973	5	1, 4, 11
9	PT. Trust Finance Indonesia Tbk	0.814176	8	1, 4
10	PT. Verena Oto Finance Tbk	0.88123	6	1, 4, 11
11	PT. Wahana Ottomitra Multiartha Tbk	1.000000	1	11

Using the DEA – VRS input assumption, Table 3 shows that there are five (5) DMUs efficient and are in the reference set of the other DMUs. They are PT. Adira Dinamika Multi finance Tbk, PT. Clipan finance Indonesia Tbk, PT. Duta Kirana Finance Tbk, PT. Indo Citra Finance Tbk and PT. Wahana Ottomitra Multiartha Tbk. In other words, these best practice DMUs generate revenues and provide services requiring fewer resources than do their peers. The other six (6) DMUs obtained efficiency

scores below 1.00. This indicates that they can make substantial improvements in terms of increasing productivity. Table 4 includes peer groups (or reference sets) in addition to the efficiency scores obtained from DEA analysis. Here we note that the reference groups for DMU 5, the least efficient (efficiency score of 0.514961) are DMU 4 and DMU 7 with efficiency scores of 1.00.

Table 3. Efficiency Summary DEA Efficiency Scores & Rankings – VRS Input

DMU No.	Bank (DMU Name)	Efficiency Score	DEA Rankings	Reference Set
1	PT. Adira Dinamika Multi Finance Tbk	1.000000	1	1
2	PT. BFI Finance Indonesia Tbk	0.968498	6	1, 4, 11
3	PT. Buana Finance Tbk	0.821571	10	1, 4, 7, 11
4	PT. Clipan Finance Indonesia Tbk	1.000000	1	4
5	PT. Danasupra Erapacific Tbk	0.514961	11	4, 7
6	PT. Duta Kirana Finance Tbk	1.000000	1	6
7	PT. Indo Citra Finance Tbk	1.000000	1	7
8	PT. Mandala Multifinance Tbk	0.887793	8	1, 4, 7, 11
9	PT. Trust Finance Indonesia Tbk	0.852892	9	1, 4, 7
10	PT. Verena Oto Finance Tbk	0.896994	7	1, 4, 7, 11
11	PT. Wahana Ottomitra Multiartha Tbk	1.000000	1	11

Table 4 shows the efficiency summary of financial institution for year 2008 using input-oriented DEA. Results suggest that PT. Adira Dinamika Multi Finance Tbk, PT. Clipan Finance Indonesia Tbk and PT. Wahana Ottomitra Multiartha Tbk registered constant returns to scale and posted a constant performance over the 2008 period. These three companies were operating under efficiency since the value (1.00) of its TECRS is equal to TEVRS. They were operating in the most productive scale size. PT. Trust Finance Indonesia Tbk (DMU 9) has a low BCC score and relatively high scale efficiency among the group, meaning that the overall inefficiency (0.814176) in TECRS is caused by inefficient operations (0.852892) rather than the scale inefficiency (0.954606). PT. Duta Kirana Finance

Tbk and PT. Indo Citra Finance Tbk have the full TEVRS efficiency but a low TECRS score, meaning that they are operating locally efficiently but not globally efficiently due to the scale size. They have low scale efficiency (0.041228 and 0.205838). This can be interpreted to mean that the global inefficiency of these companies under TECRS score is mainly attributed to disadvantageous economic conditions. This result is consistent with the findings of Saad and El-Moussawi (2009) that show that internal factors and the economic environment seem to contribute significantly to the evolution of the efficiency scores.

Table 4 Efficiency Summary Input Oriented DEA 2008

DMU No.	Bank (DMU Name)	Technical Efficiency (TECRS)	Pure Technical Efficiency (TEVRS)	Scale Efficiency (SE)
1	PT. Adira Dinamika Multi Finance Tbk	1.000000	1.000000	1
2	PT. BFI Finance Indonesia Tbk	0.958229	0.968498	0.989397
3	PT. Buana Finance Tbk	0.818221	0.821571	0.995922
4	PT. Clipan Finance Indonesia Tbk	1.000000	1.000000	1
5	PT. Danasupra Erapacific Tbk	0.270536	0.514961	0.525352
6	PT. Duta Kirana Finance Tbk	0.041228	1.000000	0.041228
7	PT. Indo Citra Finance Tbk	0.205838	1.000000	0.205838
8	PT. Mandala Multifinance Tbk	0.884973	0.887793	0.996824
9	PT. Trust Finance Indonesia Tbk	0.814176	0.852892	0.954606
10	PT. Verena Oto Finance Tbk	0.88123	0.896994	0.982426
11	PT. Wahana Ottomitra Multiartha Tbk	1.000000	1.000000	1

CONCLUSION

DEA methods were utilized to generate different efficiency measures. The analysis of efficiency of listed Indonesian financial institution was undertaken for the year 2008. DEA in this study serves as a helpful tool to measure the efficiency of the eleven (11) financial companies. Based on the results of the study, PT. Adira Dinamika Multi Finance Tbk, PT. Clipan Finance Indonesia Tbk and PT. Wahana Ottomitra Multiartha Tbk posted a constant performance over the 2008 test period, even when the companies were confronted by the great competitive pressures due to the global financial crisis. These companies found to be efficient with a CCR model and also found to be efficient with the corresponding BCC model and constant returns-to-scale prevail at these DMUs.

The findings provide evidence of substantial variations in the efficiency of the financial companies. There is a considerable variability among firms in terms of technical and scale efficiency. Management and decision makers should be able to clearly pinpoint the root causes of efficiencies and be able to surpass best performers. It is important to consider that keeping pace with the industry is significant factor in every aspect of operations. Industry players should be able to carefully study how they could

improve their equipment and organization while minimizing input resources.

Although the use of the DEA method in the measurement and assessment of efficiency is not without limitations, many have embraced DEA as a useful tool and are already seeing the benefits as proved by the existing research literature. The empirical findings in this study can contribute significantly to the empirical studies that used DEA method for an industry analysis. Once more,

DEA is proven to be a powerful technique which measures the relative efficiency of a set of decision-making units and was originally designed to study the relative efficiencies of different firms or managerial units.

REFERENCES

- Ahmed, U. and Farooq, S. (2009). Efficiency dynamics and financial reforms: Case study of Pakistani banks. *International Research Journal of Finance and Economics*, **25**, 172-182.
- Banker, R. D., Charnes, R. F. and Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science*, **30**, 1078-1092.
- Bank Indonesia (2009). *2008 Economic Report on Indonesia*. Directorate of Economic Research and Monetary Policy, 30 April 2009.
- Charnes, A., Cooper, W. and Rhodes, E. (1978). Measuring the efficiency of decision-making units. *European Journal of Operational Research*, **2**, 429-444.
- Cooper, W.W., Seiford, L.M., & Tone, K. (2004). *Data envelopment analysis: A comprehensive text with models, applications, references and DEA-Solver software*. Boston, MA: Kluwer Academic Publishers.
- Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society*, **120**, 253-281.
- Hashimoto, A. and Hameda, S. (2008). Measuring the change in R & D efficiency of the Japanese pharmaceutical industry. *Research Policy*, **37**, 1829-1836.

- Helvoigt, T. L. and Adams, D. M. (2008). Data envelopment analysis of technical efficiency and productivity growth in the US Pacific Northwest sawmill industry. *Can J. For. Res.*, **38**, 2553-2565.
- Indonesian Commercial Newsletter (2008a). *Indonesia Economic Outlook 2009*, Monthly Report, December 2008.
- Indonesian Commercial Newsletter (2008b). *Market Intelligence Report on Multi Finance Industry in Indonesia*, Monthly Report, March 2008.
- Jones, P. and Siag, A. (2009). A re-examination of the factors that influence productivity in hotels: A study of the house keeping function. *Tourism and Hospitality Research*, **9(3)**, 224-239.
- Khalaf Al-Delaimi, K. S. and Battall Al-Ani, A. H. (2006). Using data envelopment analysis to measure cost efficiency with an application on Islamic banking. *Scientific Journal of Administrative Development*, **4**, I.A.D., 134-156.
- Lin, L. and Huang, C. Y. (2009). Optimal size of the financial services industry in Taiwan: A new DEA-option-based merger simulation approach. *The Service Industries Journal*, **29(4)**, 523-537.
- Liu, F. H. F. and Wang, P. H. (2008). DEA malmquist productivity measure: Taiwanese semiconductor companies. *International Journal of Production Economics*, **112**, 367-379.
- Mostafa, M. (2007). Benchmarking top Arab banks' efficiency through efficient frontier analysis. *Industrial Management & Data Systems*, **107(6)**, 802-823.
- Ravichandran, K., Abdullah Alkhathlan, K., Mat-Nor, F. and Mohd-Said, R. (2009). Performance of market based mergers in Indian banking institutions: An empirical study using DEA analysis. *Review of Business Research*, **9(5)**, 136-144.
- Saad, W. and El-Moussawi, C. (2009). Evaluating the productive efficiency of Lebanese commercial banks: Parametric and non-parametric approaches. *International management Review*, **5(1)**, 5-19.
- Seiford, L. M. and Thrall, R. M. (1990). Recent Development in DEA: The mathematical programming approach to frontier analysis. *Journal of Econometrics*, **46**, 7-38.
- Tan, G. K. R. (2006). Efficiency estimates for Singapore manufacturing: New evidence from the malmquist index. *Applied Economics*, **13**, 715-721.
- Topuz, J. C. and Isik, I. (2009). Structural changes, market growth and productivity gains of the US real estate investment trusts in the 1990s. *J Econ FinPan*, **33**, 288-315.
- World Bank (2006). *Unlocking Indonesia's Domestic Financial Resources: The role of non-bank financial institutions*. Document of the World Bank December 2006.
- Xue, X. L., Shen, Q. P., Wang, Y. W. and Lue, J. F. (2008). Measuring the productivity of the construction industry in China by using DEA-based malmquist productivity indices. *Journal of Construction Engineering and Management*, ASCE, January 2008, 64-71.