Jurnal Keuangan dan Perbankan, 22(3):518–531, 2018
http://jurnal.unmer.ac.id/index.php/jkdp

Felisitas Defung (Indonesia)

Determinants of Bank Efficiency during Financial Restructuring Period: Indonesian Case

Article history:
Received: 2018-04-20
Revised: 2018-06-07
Accepted: 2018-07-22

Felisitas Defung

Department of Management, Faculty of Economics and Business, Mulawarman University
Jl. Tanah Grogot No.1 Kampus Unmul Gunung Kelua Samarinda, 75119, Indonesia

Corresponding Author:
Felisitas Defung:
Tel./Fax.+62 541 738916
E-mail: felisitas.defung@feb.unmul.ac.id

Abstract

The banking sector in Indonesia had been through many challenges aftermath the 1997 Asian financial crisis. The restructuring programs aimed to strengthen and improve the performance of the banking system. Empirical researches around the world, however, present various result with regard to the effect of the policy on bank efficiency. We investigated the determinants of the relative efficiency of the Indonesian banking industry. Using panel data of 101 Indonesian commercial banks, this study employs a non-parametric frontier method, Data Envelopment Analysis (DEA), to measure the efficiency score. In the second stage, the Tobit regression model used to analyze the factors that potentially determine the variation of efficiency score. The finding indicated the bank was technically inefficient particularly during financial restructuring. The improvement was evidence toward the end of the period. Bank size, macroeconomic factors, and three bank groups were strongly associated with bank efficiency level. There was no strong evidence that merger, which typically the form of restructuring policy output, positively associated with bank efficiency.

Keywords: Bank Size; Bootstrap; Efficiency; Data Envelopment Analysis, Macroeconomic

JEL Classification: G21, G28, G34, C14

Citation: Defung, F. (2018). Determinants of Bank Efficiency during Financial Restructuring Period: Indonesian Case. *Jurnal Keuangan dan Perbankan, 22*(3), 518-531. https://doi.org/10.26905/jkdp.v22i3.2094

Abstrak

Sektor perbankan di Indonesia telah melalui banyak tantangan setelah mengalami krisis ekonomi yang melanda Asia 1997. Program restrukturisasi umumnya bertujuan memperkuat dan memperbaiki kinerja system perbankan. Namun demikian Hasil penelitian empiris menunjukkan hasil yang tidak searah dan berbeda-beda. Kami meneliti faktor-faktor apa saja yang memengaruhi efisiensi relatif di industri perbankan Indonesia. Dengan menggunakan 101 bank umum, studi ini menggunakan metode non-parametrik, Data Envelopment Analisis (DEA)*, untuk mengukur skor efisiensi bank. Selanjutnya, pada tahap kedua, model regresi Tobit digunakan untuk menganalisis faktor yang memengaruhi variasi di dalam skor efisiensi. Hasil penelitian menunjukkan bahwa bank di Indonesia berada pada level yang tidak efisien, terutama selama periode restrukturisasi. Namun demikian level efisiensi ditemukan semakin membaik ke arah akhir periode analisis. Ukuran bank, faktor makroekonomi, dan tiga kelompok bank memiliki pengaruh yang kuat terhadap level efisiensi bank. Tidak ditemukan pengaruh yang positif signifikan akan pengaruh merger, yang umumnya merupakan salah satu output restrukturisasi, terhadap level efisiensi.*

Kata kunci: *Ukuran Bank, Bootstrap, Efisiensi, Data Envelopment Analysis, Ekonomi Makro*

ISSN: **2443-2687** (Online)
ISSN: **1410-8089** (Print)

The Asian financial crisis (AFC) in 1997 led to the Indonesian banking sector facing huge changes after alterations to government regulations. Banking, currency, and debt crises were also issues faced by the Indonesian economy. After financial crises, regulators aim to restructure the banks and arrange the industry so it can be stronger and more resilient. Sato (2005) states that, in the case of Indonesia, the restructuring program were part of the requirements set by the IMF when assisting Indonesia.

In the 2000s, regulatory reforms were introduced, which involve revisions of two Indonesian banking regulations; the Central Bank Act (UU Bank Indonesia No. 23/1999) and the Banking Act (*UU Perbankan* No.10/1998). The results of these regulatory changes include restructuring and privatization. As a consequence, the number of banks decreased significantly from 151 in 2000 to 120 in 2011. Other implications were also involved in establishment several financial-related organizations such as the establishment of the Financial Service Authority (FSA) in 2011 and the Indonesian Deposit Insurance Corporation (IDIC) in 2004.

The essence of these events was to push the industry in a proper direction such as integrated supervision system which is independent of the central bank; an accredited deposit guarantee scheme, so forth. The introduction of the IDIC in September 2004 was to be a replacement for the AFC's blanket guarantee system. Different from the blanket guarantee system, which covers full deposits for domestic banks only, the IDIC system ensures every bank, including joint venture and foreign banks. Yet, this insurance system is only for limited amounts. In this situation, banks can adjust their operations to perform efficiently to gain or retain the larger depositors' confidence.

As the typical financial structure in emerging economies, Indonesia financial sector is back-boned by the banking industry. After being hit by the severe economic crisis in 1997, the industry has slowly transformed to a relatively more resilient system. However, according to IMF (2010), the share of the Indonesian financial sector to GDP is relatively small (less than 60 percent), compared other Asian countries such as Thailand, Malaysia, Korea, and China.

Officially, the banking sector in Indonesian banking is divided into commercial banks and rural banks. The differentiation between the two is the scope and scale of business operation where the first cover most banking business in larger (mostly urban) area, while the latter operates in a rural area with a limited coverage area. Each group is further divided into conventional bank practice and syariah bank (also known as Islamic bank). Table 1 details the assets and the number of banks during the pe-

Table 1. Indonesia Banking Sector's Profile

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total Assets (Millions IDR):												
Conventional Commercial Banks	1,038,134	1,097,199	1,108,633	1,206,939	1,259,554	1,452,716	1,672,699	1,959,215	2,276,521	2,486,092	2,929,667	3,535,902
Sharia Comercial Banks	1,721	2,500	3,571	6,579	12,527	17,111	21,151	27,286	34,036	48,014	79,186	116,930
Rural Banks	4,731	6,474	9,080	12,635	16,707	20,393	23,045	27,741	32,533	37,554	45,742	55,799
Sharia Rural Banks	-	-	-	-	-	585	896	1,215	1,693	2,123	2,739	3,520
Total	1,044,586	1,106,173	1,121,284	1,226,153	1,288,788	1,490,805	1,717,791	2,015,457	2,344,783	2,573,783	3,057,334	3,712,151
Total Banks :												
Conventional Commercial Banks	149	143	139	136	130	128	127	127	119	115	111	109
Sharia Comercial Banks	2	2	2	2	3	3	3	3	5	6	11	11
Rural Banks	4,731	2,355	2,141	2,141	2,158	2,009	1,880	1,817	1,772	1,733	1,706	1,669
Sharia Rural Banks	-	-	-	-	-	92	105	114	131	139	150	155
Total	4,882	2,500	2,282	2,279	2,291	2,232	2,115	2,061	2,027	1,993	1,978	1,944

Source: Indonesian Banking Statistics, Bank Indonesia, various editions

riod of 2010-2011. For decades, the commercial bank has been the main locomotive of the development of the Indonesian banking sector. On average, the portion of the commercial bank's asset to the total assets of banks is above 90 percent (Indonesian Banking Statistic, Bank Indonesia 2000–2011).

Table 1 show that the number of the bank is developing in the opposite direction with the total asset, particularly for a commercial bank. The commercial banks are officially divided into six groups, namely state-owned banks, foreign exchange commercial banks, non-foreign exchange commercial banks, regional development banks, joint venture banks, and foreign-owned banks.

The number of the bank is slowly, but consistently, decreasing. The reduction mainly was because of mergers and acquisitions (other cases were due to liquidation) which mostly occurred during the restructuring period. Table 2 exhibits some of the notable mergers during the post-crisis period.

Table 2. Mergers during Restructuring Period

Year	Number of Banks Merger	The output of Merger (Bank)
1999	8	3
2000	8	1
2001	9	4
2002	5	1
2003	2	1
2004	3	1
2005	2	1
2006	2	1
2007	4	2
2008	7	3
2009	2	1
2010	2	1
2011	2	1

Source: Defung (2014)

This paper tries to examine what determines the Indonesian banks' technical efficiency during the restructuring period. As the financial market and institution are facing a highly competitive environment in the globalization era, then perform efficiently, lower the cost, improve the services, and innovate new products and improve the technology used are critical for banks to gain their business potential. Theory suggests that competitive environment logically leads to efficient allocation of resources in providing financial services, such as intermediating fund from depositors to borrowers; improve other financial services and others.

Accordingly, as the availability of loan and other financial services to business and households increases, it stimulates economic growth which in turn improves the income and well-being of the people. To achieve that goal, restructuring has been one of the favorable policies in the banking industry in many countries, including Indonesia. This study is motivated by the increasing awareness of customers, the internal management of the bank, policy makers and investors to comprehend the banking performance as the result of a change in regulation in Indonesia. This paper may help those aforementioned related parties to respond to the effect the change in policy to bank efficiency, particularly policymakers or regulators in formulating measured policy.

As restructuring mostly aims to improve banking performance such which include efficiency, however, the studies in most Indonesian banking efficiency provide dissimilar results. For instance, bank size is found to be positively related to Indonesian bank efficiency. However, they are not always statistically significant (Hadad et al., 2010; Zhang & Matthews, 2012), other variables include ownership and internal bank factors.

Common wisdom about the intention of change in regulation is to improve market completion. However, empirical studies assessing the effect of financial reforms on bank efficiency produce various findings. Research by Koutsomanoli-Filippaki, Margaritis, & Staikouras (2009), Hsiao, Chang, & Cianci (2010), and Zhao, Casu, & Ferrari (2010) find deregulation have a positive impact on bank efficiency in Taiwan, Central and Eastern European Countries, and India, respectively. On the

contrary, some studies such as Fu & Heffernan (2009) suggest that bank efficiency tend to decline after financial reform in Japanese banks and Korean banks, respectively. There was no meaningful impact of bank deregulation on bank efficiency also emerge in some studies (Havrylchyk, 2006).

Research on what factors affect bank efficiency using a two-stage DEA method has been commonly used by researchers. Variables that included in the investigation model in international literature can be grouped in four categories, macroeconomic factors, market concentration or market share, internal bank variables, and ownership structure (Sufian & Habibullah, 2010; Gardener, Molyneux, & Nguyen-Linh, 2011; Castellanos, Del Angel, & Garza-García, 2013). The effect the variable included present different result. For instance, inflation tends to be negatively affected bank efficiency as of Delis, Molyneux, & Pasiouras (2011) and Barth et al. (2013), but the result seems to the opposite with the finding of Hermes & Nhung (2010).

The research on bank efficiency in developing countries has been vastly growing, yet there are only a small number of studies on Indonesian case. Particularly, studies that employed a frontier method examine the bank efficiency and productivity. Among others, studies on Indonesian banks that have been published scholarly and presents a significant contribution include Sufian (2009), Hadad et al. (2010), Margono, Sharma, & Melvin (2010), Hadad et al. (2012), Zhang & Matthews (2012), and Defung, Salim, & Bloch (2016). These studies cover a various period horizon using either parametric or non-parametric frontier approach. Although there are the significant findings, the Indonesian banking industry has never been comprehensively examined, especially following the crisis or during the restructuring period.

The use of the frontier method in those studies focuses mostly on a specific group of banks such as private national banks, state banks, and only large banks. The period of restructuring is very crucial to be analysed as it sets as the starting point to improve the performance of the industry. Besides, the conventional efficiency frontier's method has been criticized as statistically unreliable due to the absence of inference. Therefore, this study tries to fill the void in the literature to examine what factors that mostly affect the efficiency measure of Indonesian bank by using bootstrap DEA method.

The non-parametric data envelopment analysis (DEA) method is used in this research, complemented by the application of Simar & Wilson's (1998) bootstrapping procedure. Through the bootstrap procedure, the statistical inference of efficiency result can be obtained; it provides bias-corrected estimates and confidence intervals of the original DEA efficiency score. Furthermore, the determinants of the efficiency score in Indonesian banks will be analyzed using Tobit regression at the second stage.

Table 3. Summary of Sample Banks

Groups	Number of Banks in 2011	Sample Bank in This Study	% of The Sample Bank
State-owned bank	4	4	100
Private national bank*)	66	53	80.3
Regional development bank	26	25	96.2
Joint venture bank	14	11	78.6
Foreign bank	10	8	80.0
Total	**120**	**101**	**84.2**

METHODS

The data set is the annual bank financial report covering the period from 1993-2011 which is published by the Indonesian Central Bank (Bank Indonesia). The observation includes 101 Indonesian commercial banks which represent more than 80 percent of the total Indonesian commercial banks assets.

Based on the number of existing banks until 2011, there are 19 banks have to be excluded due to incomplete data and/or being closed down before 2011. Table 3 detail of the sample bank per-group

The measure of efficiency and productivity might be meaningless if input and output measures used are not specified carefully. Inefficiency studies, the set of input and output variables is critical to affecting the results (Das & Ghosh, 2009). The literature reveals that intermediation and production methodologies are the most frequent methods used to specify inputs and outputs in productivity and efficiency research (Berger & Humphrey 1997). This production approach assumes banks to be production centers where the deposit is treated as an output. In intermediation approach, the bank is considered as medium to intermediate funds from the depositor to the borrower, where the deposit is regarded as an input, together with other input variables (Sealey Jr & Lindley, 1977).

There is no agreement on which approach works best. Therefore this research uses an intermediation approach, focusing on the banks' role in intermediating funds from surplus to deficit units. Table 4 shows the details of the input and output variables used in this study.

Table 4. Variables for DEA

Outputs	Inputs
Total Loan (y_1)	Total Deposits (x_1)
Other Earning Assets (y_2)	Fixed Assets (x_2)

Table 5. Second Stage's Variables

Variable		Exp. sign	Description
Dependent variable			
Bank efficiency	TE		Technical efficiency of the bank
Independent variable			
Economic growth	GDP	+	Indonesian GDP growth
Inflation	Infl	-	Consumer price (annual %)
Broad money	Bmoney	+/-	Sum of the currency sum outside of the bank (% of GDP)
Concentration ratio	HHI	-	Measured by the Herfindahl Index (HHI), the sum of squared shares of bank loans to total loans.
Size	Size	+	The natural log of the bank's assets
Risk management	NPL	-	Measured by the % of the bad loan over the total loans
Profitability	ROA	+	Return on assets measured by the % annual profit before taxes over average assets
Capital strength	CAR	+/-	Capital adequacy ratio measured by the % bank's capital over risk-weighted assets.
Bank restructuring	Dmerger	+	1 if a merged bank, 0 otherwise
Listing bank	dlisting	+	1 if a listing bank, 0 otherwise
Foreign exchange operation	dforex	+	1 if a foreign exchange bank, 0 otherwise
State bank	d_state	+/-	1 if state bank, 0 otherwise
Private bank	d_private	+/-	1 if domestic private bank, 0 otherwise
Joint venture bank	d_jvb	+/-	1 if joint venture bank, 0 otherwise
Foreign bank	d_purefb	+/-	1 if foreign bank, 0 otherwise

Table 6. Descriptive Statistics of the Outputs and Inputs

	Total Loans	Other Earning Assets	Total Deposits	Fixed Assets
Mean	47,898.83	27,410.02	74,765.25	2,179.09
Max	973,979.27	625,001.56	2,461,022.61	54,090.65
Min	4.78	39.29	14.51	3.64
SD	126,638.28	72,941.01	218,286.08	6,111.27

Source: Author's calculation based on bank financial reports published by Bank Indonesia

To investigate the impact of other factors that possibly affect the efficiency measure, some of the explanatory variables are chosen to provide explanations as to Indonesian banking efficiency differences. This procedure will be performed in the second stage. Table 4 presents the selected explanatory variables which are included in the research. The second stage variables are chosen to represent economic conditions, bank characteristics, market concentration, restructuring policies, bank status, bank group, and ownership status.

A brief of data summary of the variables is presented in Table 6, which presents descriptive statistic for the inputs and outputs over the research period. As can be seen from the table, the total deposit is the dominant input whereas the total loan is the largest output part on average.

First, the non-parametric DEA approach with variables return to scale (VRS) assumption is employed to calculate Indonesian banks' technical efficiency. Following Banker, Charnes, & Cooper (1984), the technical efficiency is estimated using the following model:

$$\begin{aligned} &\text{Min}_{\theta,\lambda}\ \theta, \\ &\text{Subject to}\ -y_i + Y\lambda \geq 0, \\ &\qquad\qquad \theta x_i - X\lambda \geq 0, \\ &\qquad\qquad I1'\lambda = 1, \\ &\lambda \geq 0 \quad (1) \end{aligned}$$

Where θ is a scalar value between 0 and 1 and representing the efficiency score for the i^{th} bank; λ is an I x 1 vector of constants; I1 is an I x1 vector of ones; y is the output vector for the i^{th} Decision-Making Unit (DMU); X is the matrix of input of the others DMUs; and Y is the matrix of output of others DMUs which range from i = 1…n; x is a vector of input of the i^{th} DMU. The VRS assumption is chosen because, like others DMU, there is a possibility a bank may not operate at optimal scale. As mentioned by Coelli et al. (2005), some external aspects, e.g., the constraint on finance and imperfect competition may affect operation.

The main critic regarding the original DEA results is the absence of statistical inference which indicates the estimated efficiency scores are inaccurate. Following Simar & Wilson (1998), this study addresses the limitation of statistical verification by employing the DEA bootstrapping procedure, which can be summarised as follows: (1) calculate the DEA efficiency score θ_i for each bank i = 1,…, n, by solving the linear programming models previously; (2) using kernel density estimation, generate a random sample of size n from $\widehat{\theta_i}$ i = 1, … , n, given $\theta^*_{1b},\ldots,\theta^*_{Lb}$; (3) calculate a pseudo-dataset (x^*_{ib},y_i), i = 1,…, n, to construct the reference bootstrap technology; (4) for the pseudo-data, calculate the bootstrap estimate of efficiency $\hat{\theta}^*_{ib}$ of $\hat{\theta}_i$ for each i = 1,…, by solving the bootstrapped input as explained in the previous chapter; and (5) repeat all of the steps B times (in this study, B = 1,000) to generate a set of estimates $\{\hat{\theta}^*_{ib}, b = 1, \ldots, B\}$.

Simar & Wilson (1998) suggest an improved calculation which improves for bias without using a noisy bias estimate. If the distribution of $(\hat{\theta}^*_{ib} - \hat{\theta}_i)$ is known, then it would be possible to approximate a_a and b_a such that $\Pr(-b_\alpha \leq \hat{\theta}_i - \theta \leq -a_\alpha) = 1 - \alpha$. This term can, therefore, be approximated by estimating the values a^*_a and b^*_a given by$(-b^*_\alpha \leq \theta^*_{ib} - \theta_i$

$\leq -a_{\alpha}^{*}) = 1 - \alpha$. Following placing $-\hat{b}_{\alpha}^{*}$, $-\hat{a}_{\alpha}^{*}$ to the endpoint of the array, the estimated percentage confidence interval is $\hat{\theta}_i + \hat{a}_{\alpha}^{*} \leq \theta \leq \hat{\theta} + \hat{b}_{\alpha}^{*}$.

Since some of the external factors were unable to be accommodated directly in DEA; hence, following Coelli et al. (2005), those variables are analyzed in the second stage toward the efficiency scores. Additionally, the second-stage method has been commonly used in DEA approach research, such as Tecles & Tabak (2010) and Barth et al. (2013). As the efficiency scores are ranged from 0 to 1, this research used the Tobit regression method which permits limited-range dependent variables. The standard Tobit model is as follows: $y_i^* = \beta' z_i + \varepsilon_i; y_i = y_i^*, if\ y_i^* \geq 0, and\ y_i = 0,$ otherwise (2)

Where $\varepsilon_i \approx N(0, \sigma^2)$, z_i is the vectors of independent variable and β is the coefficients, whereas y_i and y_i^* are the observed DEA efficiency score and the vector a latent variable. To accommodate the above explanatory factors, Equation (2) can be extended as follows:

$$TE_{it} = \alpha + \beta_1 size_{it} + \beta_2 CAR_{it} + \beta_3 NPL_{it} + \beta_4 ROA_{it} + \beta_5 HHI_t + \beta_6 GDP_t + \beta_7 inlf_t + \beta_8 BMoney_t + \beta_9 Dforex_{it} + \beta_{10} Dlisting_{it} + \beta_{11} Dmerger_{it} + \beta_{12} D\_state_i + \beta_{13} D\_PureFB_i + \beta_{14} D\_private_i + \beta_{15} D\_JVB_i + \varepsilon_i \quad (3)$$

Where TE is the technical efficiency (DEA) of the bank, and i represents bank at time t for annual observation.

RESULTS

The Efficiency of the Indonesian Bank

The banking industry's annual technical efficiency scores from 1993-2011 are presented in Table 7. We decided to calculate the score since 1993 to capture the variation of the efficiency before the AFC 1997. The original result is column 2, followed by followed by bias-corrected estimates and bias in columns 3 and 4, respectively. The other two columns give the lower and upper bounds of the estimated efficiency for the 95 percent confidence interval.

Table 7. The Average Efficiency Estimates of Indonesian Bank

Year	Estimated Efficiency	Bias-corrected Mean	Bias	Lower Bound	Upper Bound
1993	0.4759	0.4189	0.0569	0.3349	0.4801
1994	0.4827	0.3947	0.0880	0.2906	0.4880
1995	0.5611	0.4902	0.0709	0.3979	0.5648
1996	0.5369	0.4911	0.0457	0.4302	0.5404
1997	0.4880	0.4181	0.0699	0.3331	0.4916
1998	0.7136	0.6847	0.0289	0.6381	0.7157
1999	0.6393	0.6048	0.0345	0.5485	0.6418
2000	0.5858	0.5420	0.0437	0.4547	0.5876
2001	0.5583	0.4958	0.0625	0.3903	0.5618
2002	0.6075	0.5597	0.0478	0.4716	0.6093
2003	0.6133	0.5646	0.0487	0.4798	0.6154
2004	0.6668	0.6218	0.0450	0.5441	0.6688
2005	0.6822	0.6389	0.0433	0.5645	0.6839
2006	0.6934	0.6516	0.0419	0.5780	0.6949
2007	0.6981	0.6597	0.0384	0.5929	0.6994
2008	0.5785	0.5202	0.0583	0.4327	0.5814
2009	0.5268	0.4705	0.0563	0.3795	0.5299
2010	0.5851	0.5327	0.0523	0.4509	0.5878
2011	0.5956	0.5471	0.0486	0.4676	0.5980
Mean	**0.5942**	**0.5425**	**0.0517**	**0.4621**	**0.5969**

In total, the Indonesian banking industry was not efficient in the analysis period. The overall mean efficiency estimate is 59.42 percent for the whole period, with the highest level occurred in 1998 at 71 percent. This leaves room for the Indonesian banking industry to reduce input use by an average of 40.58 percent, without a decreasing the amount of output. The results show a substantial asymmetry among banks regarding technical efficiency. Pre-crisis improvements in efficiency coincide with deregulation implementation in the 1990s by the Indonesian government. Deregulation increased competition among banks, which led to improved performance in the banking sector.

Estimated efficiency trends are shown in Figure 1; it is vividly showing that although the bank is inefficient throughout the period, it shows efficiency improvement towards the end of the period. In addition, this pattern highlights the possible impact of several economic turmoils occurred in 1997 and 2008. The restructuring policies taken at the beginning did not show the maximum efficiency of bank function intermediation.

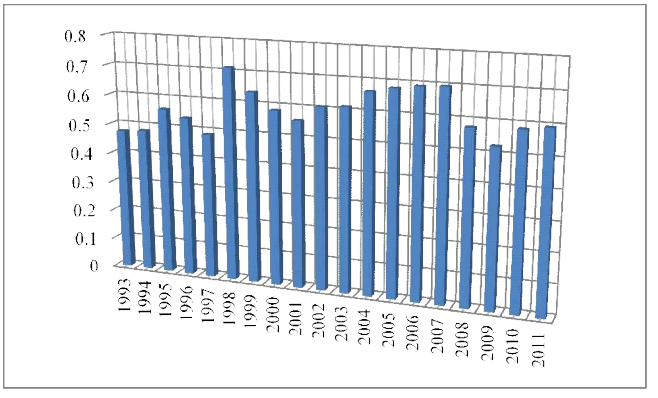

Figure 1. Annual Means of Estimated Efficiency for All Banks

During the initial period, the average efficiency starts at the lowest level of 47.59 percent. However, in total, it slightly increases over the period. In some period, there are notable ups and downs. Basing on the low score in the early 1990s, financial liberalization in the late 1980s does not seem to affect bank efficiency in 1993 and 1994. The efficiency rebounded to a relatively constant and stable score from 2002-2007, although it is still far from a fully efficient standard. These patterns are like the pattern identified by Zhang & Matthews (2012) who found cost efficiency in the Indonesian banking industry was low in the initial period (1992-1993) in the asset creation model but is higher in their income flow model.

Figure 1 displays fluctuations of average technical efficiency during 1993-2011. Overall, the trend of Indonesian bank efficiency is improving toward the end of the period. There is three majors' downturn occurred in 1997-1999, 2000-2002, and 2008-2009. These downturns possibly related the three economics turmoil or events which caused average efficiency to decline: the AFC in 1997, the restructuring process aftermath the AFC and the global financial crisis. The 1997-1998 period is known as the AFC. The result shows after a decline in 1997; the efficiency increased sharply throughout 1998. This condition might be explained since there was no proper deposit insurance in place at that time; the depositors lost their confidence which resulted in a massive withdrawal from the bank. Deposit volumes would then significantly decline while on the output side; there is no change in the amount of on bank balance sheets.

The second downturn (2000-2002) is the initial period of financial restructuring, which includes mergers, privatization, and acquisitions. This can be explained as banks need to consolidate their operation to meet some business requirements, such as capital adequacy ratio, assets management, and so forth, which tightened following the crisis. The final fluctuation (2008-2009) is during the global financial crisis, which spread to the Indonesian banking industry. Before that period, during the 2003-2004, the efficiency shows an improvement in efficiency. Therefore, results present a question regarding source those variations.

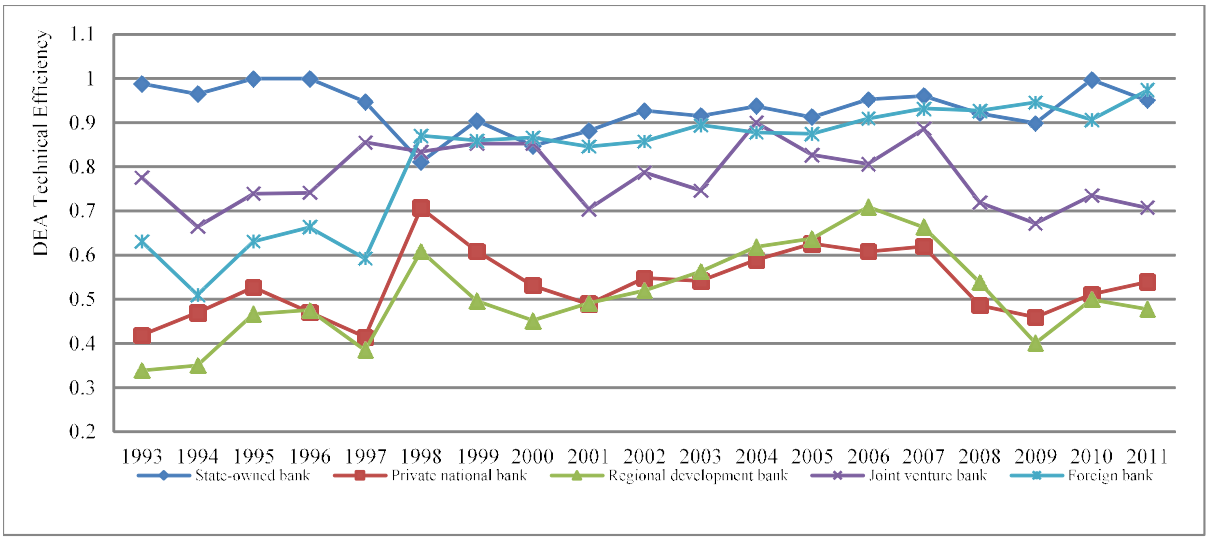

Figure 2. Technical Efficiency by Group of Bank
Source: Author's calculation based on DEA results

Table 8. The Number of Efficient Banks

Year	State-Owned Bank	Private National Bank	Regional Development Bank	Joint Venture Bank	Foreign Bank	Total
1993	3	3	2	3	2	27
1994	3	1	2	2	0	25
1995	4	4	1	1	2	31
1996	4	5	4	4	1	36
1997	2	3	2	3	2	26
1998	2	10	2	6	5	42
1999	3	8	1	6	3	33
2000	3	7	1	7	5	38
2001	3	3	0	4	5	29
2002	3	6	1	5	5	34
2003	3	5	1	4	5	27
2004	2	4	3	7	5	29
2005	3	3	1	3	4	27
2006	3	5	3	3	5	35
2007	2	5	3	4	6	37
2008	2	2	3	2	5	29
2009	1	4	0	3	7	32
2010	3	4	0	2	5	30
2011	3	4	0	3	8	39

Efficiency estimate shows that the original efficiency estimates are in the confidence interval range. However, they are upwardly biased compared with bias-corrected efficiency scores. This is due to sampling variation with caused the sensitivity of efficiency estimate. Results are similar to those of Simar & Wilson (1998) but are contrasted with those obtained by Tortosa-Ausina et al. (2008). The

biases vary across the period. The bias is less than 0.05 in 1996, 1998-2000, 2002-2007, and 2011, but in the remaining years, the bias is above 0.05, with 1994 showing the largest bias.

Further, the efficiency measures are classified into five groups of banks by averaging the score annually. The result is shown in Figure 2, and the amount of efficient banks per-group is presented in Table 8. As can be seen in the figure, that banks owned by the state government are the more efficient group followed by a foreign bank, whereas the least efficient is regional development bank and private national bank.

The Determinants of Efficiency

Using equation (3), the determinant of efficiency is estimated with results shown in Table 9. Two periods of estimation results are provided to capture the effect of an explanatory factor on efficiency during financial restructuring (2000–2011), and to observe the effect on the full period (1993–2011).

The estimations are over the whole Indonesian banking industry and include four dummy group of banks. Every model has good explanatory power, and the Wald chi^2 are all statistically significant at 1 percent. It indicates that the regression model is robust and reliable to explain the determinant of efficiency.

Some variables have significant roles, in explaining their existent on efficiency. However, the magnitude of their influence is not consistent. Banks' status, which is listed bank and foreign exchange operation (forex), do not have a significant effect at both periods.

Table 9. The Determinants of Bank Efficiency

Variable	2000–2011		1993–2011	
	Coef	SE	Coef	SE
Size	0.050 ***	0.008	0.039 ***	0.007
CAR	0.004	0.004	-	
NPL	-0.003	0.059	-	
ROA	0.090	0.080	-	
HHI	0.394 **	0.169	-0.273 ***	0.043
GDP	0.061 ***	0.008	0.005 *	0.003
Infl	0.009 ***	0.001	0.006 ***	0.001
BMoney	0.007 ***	0.002	0.003 **	0.001
Dforex	-0.038	0.024	0.004	0.020
Dlisting	-0.010	0.021	0.017	0.019
Dmerger	-0.068 **	0.029	-0.030	0.027
D_state	0.166 ***	0.083	0.177 ***	0.075
D_PureFB	0.224 ***	0.059	0.173 ***	0.053
D_Private	0.033	0.037	0.022	0.033
D_JVB	0.208 ***	0.050	0.202 ***	0.045
Intercept	-1.036 ***	0.176	0.087	0.069
/sigma_u	0.0965 ***	0.011	0.0875 ***	0.010
/sigma_e	0.0958 ***	0.003	0.1208 ***	0.003
rho	0.3486	0.041	0.2382	0.036
Log-likelihood	546.00		515.52	
Wald chi^2	244.99 ***		349.06 ***	
Observation	1212		1919	

Note: SE stands for a standard error, while ***, **, and * indicate the 1 %, the 5% and the 10% level of significance, respectively.

Due to unavailability of data before 2000, the internal bank characteristic variables (Size CAR, NPL, and ROA) are only included in the shorter period. The inclusion of these variables is to test whether a bank's capital strength, the presence of bad loan inherits from the crisis and ability to earn profit have determined the efficiency. As can be seen in Table 9, the only size has a meaningful effect.

DISCUSSION

There are some variables that show consistent results across the periods, such as size, macroeconomic variables, and the group of a foreign bank, a state bank and JVB. Those variables are shown to be positively significant to the level of bank efficiency. The size of the bank displays a positive effect on the banking industry efficiency under both regression results. This means larger banks can be more efficient than smaller banks, confirmed other research such as Zhang & Matthews (2012), Hadad et al. (2010), and Hadad et al. (2012), but it is contrary to those of Ye, Xu, & Fang (2012) and Jha, Hui, & Sun (2013) who find a negative relationship. In Indonesia, as typically exist in many countries; large banks tend to be advanced in diversifying their product, technology, and number branches which outweigh any negative effects.

The market concentration (HHI) assesses the effects of bank market power on the efficiency. The finding presents an ambiguous impact over the two periods which is not meaningful due to the lack of significant coefficients. HHI has a negative coefficient from 1993–2011 but is positive for 2000–2011. This negative correlation suggests a highly concentrated market reduces bank efficiency, supporting the hypothesis. This concurs with Ye, Xu, & Fang (2012) and Barth et al. (2013).

All macroeconomic variables demonstrate their important role in bank efficiency. The positive and statistically significant of variable GDP strongly implies that the bigger the economic growth, the better bank efficiency. To some extent, this finding is the opposite to the result of Sufian (2009) in Malaysian banks. The 1990s-economic growth volatility does not appear to negatively impact on technical efficiency from 1993-2011. The coefficients of inflation coefficients are in a contrary of commonly expected. Given the strongly statistically significant relationship to bank efficiency, it is tended to advise that the higher the inflation, the more favorable to banking efficiency. This is conflicted with the common results of bank efficiency studies by Delis, Molyneux, & Pasiouras (2011), Barth et al. (2013), and Castellanos, Del Angel, & Garza-García (2013). However, this result is in line with Hermes & Nhung (2010) although the magnitude is statistically insignificant.

Furthermore, this finding supports the claim of Grigorian & Manole (2006). They claim that inefficiencies do not always relate to high inflation since the inflation can be represented in the form of non-price behavior. Finally, broad money results indicate that higher efficiency is strongly related to the higher currency outside banks.

As mentioned earlier, the status of the bank as being a listed bank (in Indonesian Stock Exchange) and/or a foreign exchange bank is not meaningful to efficiency. This finding does not support Hadad et al. (2012), who states listed banks are more efficient than average in the industry. However, the results confirm the findings of Havrylchyk (2006) in Polish banking. The results are surprising as listed and foreign exchange banks in Indonesia are large and are the best performers in many studies.

About the restructuring itself (merger), the magnitude of the effect is negative under both periods, although it is even stronger in a shorter period. This variable is important to be observed as the focus of this study which is to the factors that affect the efficiency. As can be seen from the regression results, the restructuring variable (merger) tends to affect negatively on banking efficiency. This result is in line with earlier research by Halkos &

Tzeremes (2013). Both papers present the result that a merged bank does not mean efficiency gains. This seems to contradict to the result of a size which suggests bigger is better. The possible explanation might be the longer time horizon required by a merged bank to perform efficiently following the integration and transition process.

Observing the different group of banks and their possible impact on bank efficiency, foreign, either pure foreign ownership or joint venture bank, and state banks appear to be consistently significant throughout the period. The result strongly implies those three group of banks have a positive effect on Indonesian banking sector efficiency. This supports the findings in many studies related to developing countries, particularly that foreign banks perform better compare to its domestic counterparts by Gardener, Molyneux, & Nguyen-Linh (2011). Nonetheless, there is a need to be cautious with comparisons. The 'foreign bank' here is defined as a bank branch which is 100% foreign-owned, while most research includes partially-owned foreign banks. In that case, it is similar to joint venture banks (JVBs) of this study.

Among the bank group, the JVB itself even has a stronger positive coefficient compare to others. Other research has found differently, such as Lensink, Meesters, & Naaborg (2008). State banks are more efficient, having positive and statistically significant coefficients, meaning private national banks are consistent with Das & Ghosh (2009) in their Indian bank studies and Staub, Souza, & Tabak (2010) for Brazilian banks.

The result of private national banks, which is the biggest group in term of some banks, is contrary to others. There is no evidence that this group has a powerful influence on efficiency. It shows the positive effect, but the coefficients are statistically insignificant over the periods. These results place private banks as the least efficient in the industry. Due to their large number of bank, therefore, their performance is simply the reflection of the industry as a whole. Based on that result, the policy in forcing the bank to merge should be marinated consistently.

CONCLUSION AND SUGGESTIONS

Conclusions

The results show that the Indonesian banking sector is not totally efficient. The technical efficiency mean was found to be 59.4 percent, indicating that inputs can be reduced by 40.6 percent on average relative to the current best practices. The overall trend is improving toward the end, although fluctuations have occurred. This contrasting movement may be attributed to improvements in bank management regarding the core function of banking resulting from the presence of proper prudential supervision. The regression of some variables is convincing. Macroeconomics factors, bank size and foreign presence in bank ownership is the most influential variable that affects technical efficiency. The policy of merger during the restructuring period is in the opposite direction than what expected. From those findings, it can be concluded that Indonesian bank efficiency during the restructuring period is not necessarily influenced by the restructuring policy, but by various factors. Disparities exist in direction, level of significance and magnitude of the variables can be observed in the model, showing that each variable depends on the periods and which model is used.

Suggestions

Some suggestions can be assumed from the results. Firstly, based on the variable of size, therefore a consistent and simultaneous policy regarding mergers on the private and small bank is needed to promote efficiency in the industry. Although in the short run the result indicates otherwise. Secondly, a stable macroeconomic cycle must be maintained, and reforms sped up to promote bank efficiency. Results imply there are some policy implica-

tions that possibly can be drawn to improve the future result, such to implement policy toward stronger and resilient banks.

Due to some limitation of this study, we encourage future research to include some alternative variables to represent restructuring such as acquisitions, ownership structure and using stochastic frontier. Additionally, a comparative result of determinant efficiency pre-restructuring and after restructuring would be very good for future study.

REFERENCES

Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science 30*(9), 1078-1092. https://doi.org/10.1287/mnsc.30.9.1078

Barth, J. R., Lin, C., Ma, Y., Seade, J., & Song, F. M. (2013). Do bank regulation, supervision, and monitoring enhance or impede bank efficiency? *Journal of Banking & Finance, 37*(8), 2879-2892. https://doi.org/10.1016/j.jbankfin.2013.04.030

Berger, A. N., & Humphrey, D. B. (1997). Efficiency of financial institutions: International survey and directions for future research. *European Journal of Operational Research, 98*(2), 175-212. https://doi.org/10.1016/S0377-2217(96)00342-6

Castellanos, S. G., Del Angel, G. A., & Garza-García, J. G. (2013). *Competition and Efficiency in the Mexican Banking Sector (Theory and Empirical Evidence)*. E-Books in Business, Economics, Finance & Management. https://doi.org/10.1057/9781137518415

Coelli, T. J., Rao, D. S. P., O'Donnell, C. J., & Battese, G. E. (2005). *An Introduction to Efficiency and Productivity Analysis*. Second Edition. New York: Springer.

Defung, F. (2014). Impact of banking deregulation on bank efficiency and productivity growth: Evidence from Indonesia. *Thesis*. School of Economics and Finance Curtin University.

Defung, F., Salim, R., & Bloch, H. (2016). Has regulatory reform had any impact on bank efficiency in Indonesia? A two-stage analysis. *Applied Economics*, *48*(52), 5060–5074. https://doi.org/10.1080/00036846.2016.1170934

Das, A., & Ghosh, S. (2009). Financial deregulation and profit efficiency: A nonparametric analysis of Indian banks. *Journal of Economics and Business*, *61*(6), 509-528. https://doi.org/10.1016/j.jeconbus.2009.07.003

Delis, M. D., Molyneux, P., & Pasiouras, F. (2011). Regulations and productivity growth in banking: Evidence from transition economies. *Journal of Money, Credit, & Banking*, *43*(4), 735-764. https://doi.org/10.1111/j.1538-4616.2011.00393.x

Fu, X., & Heffernan, S. (2009). The effects of reform on China's bank structure and performance. *Journal of Banking and Finance*, *33(1)*, 39–52. https://doi.org/10.1016/j.jbankfin.2006.11.023

Gardener, E., Molyneux, P., & Nguyen-Linh, H. (2011). Determinants of efficiency in South East Asian Banking. *Service Industries Journal*, *31*(16), 2693-2719. https://doi.org/10.1080/02642069.2010.512659

Grigorian, D., & Manole, V. (2006). Determinants of commercial bank performance in transition: An application of data envelopment analysis. *Comparative Economic Studies*, *48*(3), 497-522. Retrieved from: http://www.palgrave-journals.com/ces/journal/v48/n3/pdf/8100129a.pdf

Hadad, M. D., Hall, M. J. B., Kenjegalieva, K. A., Santoso, W., & Simper, R. (2010). Banking efficiency and stock market performance: An analysis of listed Indonesian banks. *Review of Quantitative Finance and Accounting*, *37*(1), 1-20. https://doi.org/10.1007/s11156-010-0192-1

Hadad, M. D., Hall, M. J. B., Kenjegalieva, K. A., Santoso, W., & Simper, R. (2012). A new approach to dealing with negative numbers in efficiency analysis: An application to the Indonesian banking sector. *Expert Systems with Applications*, *39*(9), 8212-8219. https://doi.org/10.1016/j.eswa.2012.01.145

Halkos, G. E., & Tzeremes, N. G. (2013). Estimating the degree of operating efficiency gains from a potential bank merger and acquisition: A DEA bootstrapped approach. *Journal of Banking &*

Finance, *37*(5), 1658-1668. https://doi.org/10.1016/j.jbankfin.2012.12.009

Havrylchyk, O. (2006). Efficiency of the polish banking industry: Foreign versus domestic banks. *Journal of Banking & Finance*, *30*(7), 1975-1996. https://doi.org/10.1016/j.jbankfin.2005.07.009

Hermes, N., & Nhung, V. T. H. (2010). The impact of financial liberalization on bank efficiency: Evidence from Latin America and Asia. *Applied Economics, 42*(26), 3351-3365. https://doi.org/10.1080/00036840802112448

Hsiao, H., Chang, H., Cianci, A. M., & Huang, L. (2010). First financial restructuring and operating efficiency: Evidence from Taiwanese commercial banks. *Journal of Banking & Finance*, *34*(7), 1461-1471. https://doi.org/10.1016/j.jbankfin.2010.01.013

Jha, S., Hui, X., & Sun, B. (2013). Commercial banking efficiency in Nepal: Application of DEA and Tobit model. *Information Technology Journal*, *12*(2), 306-314. https://doi.org/10.3923/itj.2013.306.314

Koutsomanoli-Filippaki, A., Margaritis, D., & Staikouras, C. (2009). Efficiency and productivity growth in the banking industry of Central and Eastern Europe. *Journal of Banking and Finance*, *33*(3), 557–567. https://doi.org/10.1016/j.jbankfin.2008.09.009

Lensink, R., Meesters, A., & Naaborg, I. (2008). Bank efficiency and foreign ownership: Do good institutions matter? *Journal of Banking & Finance*, *32*(5), 834-844. https://doi.org/10.1016/j.jbankfin.2007.06.001

Margono, H., Sharma, S. C., & Melvin, P. D. (2010). Cost efficiency, economies of scale, technological progress and productivity in Indonesian Banks. *Journal of Asian Economics*, *21*(1), 53-65. https://doi.org/10.1016/j.asieco.2009.06.001

Sato, Y. (2005). Bank restructuring and financial institution reform in Indonesia. *The Developing Economies*, *43*(1), 91-120. https://doi.org/10.1111/j.1746-1049.2005.tb00254.x

Sealey Jr, C. W., & Lindley, J. T. (1977). Inputs, outputs, and a theory of production and cost at depository financial institutions. *Journal of Finance*, *32*(4), 1251-1266. https://doi.org/10.2307/2326527

Simar, L., & Wilson, P. W. (1998). Sensitivity analysis of efficiency scores: How to bootstrap in nonparametric frontier models. *Management Science*, *44*(1), 49-61. Retrieved from: http://www.jstor.org/stable/2634426

Sufian, F. (2009). Determinants of bank efficiency during an unstable macroeconomic environment: Empirical evidence from Malaysia. *Research in International Business and Finance, 23*(1), 54–77. https://doi.org/10.1016/j.ribaf.2008.07.002

Sufian, F., & Habibullah, M. S. (2010). Bank-specific, industry-specific, and macroeconomic determinants of bank efficiency: Empirical evidence from the Thai banking sector. *Margin J. Appl. Econ. Res*, *4*(4), 427–461. https://doi.org/10.1177/097380101000400403

Staub, R. B., Souza, G. S., & Tabak, B. M. (2010). Evolution of bank efficiency in Brazil: A DEA approach. *European Journal of Operational Research, 202*(1), 204–213. https://doi.org/10.1016/j.ejor.2009.04.025

Tecles, P. L., & Tabak B. M. (2010). Determinants of bank efficiency: The case of Brazil. *European Journal of Operational Research*, *207*(3), 1587-1598. https://doi.org/10.1016/j.ejor.2010.06.007

Tortosa-Ausina, E., Grifell-Tatjé, E., Armero, C., & Conesa, D. (2008). Sensitivity analysis of efficiency and Malmquist productivity indices: An application to Spanish savings banks. *European Journal of Operational Research*, *184*(3), 1062-1084. https://doi.org/10.1016/j.ejor.2006.11.035

Ye, Q., Xu, Z., & Fang, D. (2012). Market structure, performance, and efficiency of the Chinese banking sector. *Economic Change & Restructuring*, *45*(4), 337-358. https://doi.org/10.1007/s10644-012-9123-6

Zhang, T., & Matthews, K. (2012). Efficiency convergence properties of Indonesian banks 1992–2007. *Applied Financial Economics*, *22*(17), 1465-1478. https://doi.org/10.1080/09603107.2012.663468

Zhao, T., Casu, B., & Ferrari, A. (2010). The impact of regulatory reforms on cost structure, ownership, and competition in Indian banking. *Journal of Banking and Finance*, *34*(1), 246–254. https://doi.org/10.1016/j.jbankfin.2009.07.022