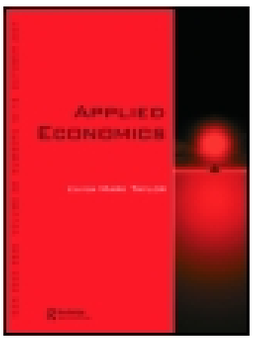

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Has regulatory reform had any impact on bank efficiency in Indonesia? A two-stage analysis

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ABSTRACT

More than a decade following the severe economic crisis 1997, Indonesia has undergone major regulatory changes in its banking industry. This article examines the impact of these regulatory changes on the relative technical efficiency (TE) of the Indonesian banking industry employing data envelopment analysis (DEA) and censored Tobit regression model. Additionally, the bootstrap approach of Simar and Wilson is employed to provide statistical properties to the DEA efficiency score. The findings show that the industry on average is inefficient over the period of analysis. Also, state-owned and foreign-owned banks are found to be more efficient than any other group of banks. Finally, the impact of regulatory reforms is generally positive and statistically significant.

KEYWORDS

Bank efficiency; bootstrap; data envelopment analysis; Indonesia

JEL CLASSIFICATION

G21; G28; G34; C14

I. Introduction

There is an ongoing debate whether regulatory changes have a constructive impact on bank efficiency. Technically, regulatory reform is aimed to improve market competition by decreasing barriers to compete, reducing subsidies to protected sectors and improving the contracting environment, so that deposits and credits can be intermediated effectively (Berger and Humphrey 1997). However, empirical research provides mixed evidence.

Since the Asian financial crisis (AFC) in 1997, the Indonesian banking sector has undergone substantial transformation following changes in government regulations. The actions taken by regulators following the financial crisis have generally been directed at building the industry towards a stronger and more resilient system. In the case of Indonesia, the reform programme was not only needed but also it was required by the terms of the International Monetary Fund (IMF) assistance that Indonesia received (Sato 2005).

The regulatory reforms launched after the crisis include the revision of two main regulations in Indonesian banking sector; the Banking Act (*UU Perbankan No. 10/1998*) and the Central Bank Act (*UU Bank Indonesia No. 23/1999*). Subsequently, there has been restructuring, privatization and establishment of several financial-related institutions through the enactment of Islamic Bank Act in 2008; the establishment of The Indonesian Deposit Insurance Corporation (IDIC) in 2004; and, lately, the establishment of the Financial Service Authority (FSA) in 2011. The reforms have conveyed the industry towards international best-practice standards, including more independence of the central bank, a proper deposit guarantee scheme and an integrated supervision system.

Despite the extensive and growing number of research studies regarding bank efficiency in developing countries, studies on Indonesia have been few. Scholarly studies on Indonesian banks include Margono, Sharma and Melvin (2010) Hadad et al. (2011), Hadad et al. (2012) and Zhang and Matthews (2012). These studies examine bank efficiency and productivity growth of the Indonesian bank sector using various frontier approaches. So far, studies on Indonesian banks have never comprehensively examined the whole industry with a longer period of data. The most recent study only covers the data up to 2007, so there is a lack of recent empirical studies that

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analyse the efficiency of Indonesian banking sector after the most recent regulatory changes. We use annual data for 101 commercial banks over the period from 1993 to 2011 to analyse the efficiency of Indonesian banking.

In terms of methodology, this study represents the first attempt employing bootstrap data envelopment analysis (DEA) in the Indonesian case. The non-parametric DEA method is utilized along with the application of the bootstrapping procedure developed by Simar and Wilson (1998). With the bootstrap method, bias-corrected estimates and confidence intervals provide statistical reliability measures for the DEA efficiency score.

Even with bootstrapping, the DEA methodology has drawbacks. For example, the method does not exclude the effect of random noise or measurement errors, so the best practice among sample firms may be overstated or understated. Further, the results are only comparable to the best practice among firms in the sample, which might not be at the efficiency frontier. Finally, important inputs such as categorical inputs and environmental factors may not be incorporated.

In addition to measuring bank efficiency, this study employs a second-stage analysis based on probit regressions to investigate what determines the variation in Indonesian banks' efficiency. Here, the emphasis is on the impact of regulatory changes, but the influences of bank size, ownership structure, bank type, mergers industry concentration and macroeconomic conditions are also examined.

The reminder of this article is structured as follows: Section II provides a brief history and background of the Indonesian banking sector. Section III reviews related studies, while Section IV presents the data and variables. Section V discusses the empirical results and Section VI concludes the article.

II. A brief of the Indonesian banking industry

The financial sector in Indonesia, like most emerging economies, is dominated by the banking industry. Compared to peer countries such as China, Korea, Malaysia and Thailand, the share of financial sector assets to GDP is relatively small (below 60%) (IMF, 2010). Historically, the commercial bank is the engine of the industry, far in the lead above rural banks. The share of commercial banks to the total assets in the banking industry is above 90% on average during the last decade.[1] The commercial banks are officially divided into six groups, namely (including their assets share in 2011): state-owned banks (36%); foreign exchange commercial banks (40.1%); non-foreign exchange commercial banks (2.9%); regional development banks (8.3%); joint venture banks (5%) and foreign-owned banks (7.3%).

Table 1 presents the structure of Indonesian commercial banks during the last 12 years. The table reveals that there has been a constant decrease in the number of banks from 239 in 1996 to 151 in 2000, then to 120 banks in 2011. These numbers include two Islamic commercial banks in 2000 and 11 in 2011. The reduction is mainly due to post-crisis liquidations and mergers, which commenced in 1999. Even though the development of Islamic commercial banks is noticeable following the release of Act No 21 of 2008, the conventional commercial banks still dominate the industry with more than 95% of total assets on average during the last decade. Furthermore, the structure of the banking system is also changed due to an increasing foreign presence in the banking industry from 4.5% in 2000 to 45.8% in 2009. The sale of government shares to both

Table 1. Summary of Indonesian banking industry profile.

Descriptions	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Mergers*	7 (1)	9 (4)	5 (1)	2 (1)	3 (1)	2 (1)	2 (1)	4 (2)	7 (3)	2 (1)	2 (1)	2 (1)
Number of banks	151	145	141	138	133	131	130	130	124	121	122	120
Total assets (IDR tn)	1,039.9	1,099.7	1,112.2	1,213.5	1,272.1	1,469.8	1,693.9	1,986.5	2,310.6	2,534.1	3,008.9	3,652.8

* Number outside the parentheses is total banks closed through merger; number in parentheses is the number of merged banks.
Source: Indonesian Bank Directory, Bank Indonesia various issues, Indonesia Bank Statistic, Bank Indonesia various issues, IMF (2004) and bank Supervision report, Bank Indonesia various issues

[1]Calculated from Indonesian banking statistic, Bank Indonesia (2000–2011).

Table 2. List of selected regulations and reforms after the AFC.

Year	Event(s)
1998	– Blanket guarantee scheme introduced to guarantee deposits in domestic banks along with the establishment of IBRA (Indonesian Bank Restructuring Agency)
	– New Banking Act, No. 10/1998, introduced as a revision and replacement of Act No 7/1992
	– Reduced 'temporarily' minimum CAR from 8% to 4%
1999	– New Central Bank (*Bank Indonesia*) Act, No 23/1999, launched.
	– Allowed foreign ownership up to 99% as shareholders (Government regulation (PP) No 29/1999).*)
2001	– Amended the regulation by requiring all commercial banks to meet minimum CAR of 8% by the end of 2001
2004	– Set minimum reserve requirement 5 %
	– Amended Act No 23/1999 on Bank Indonesia (Act No 3/2004)
	– IBRA's role and blanket guarantee system terminated.
	– Established the IDIC (Indonesian Deposit Insurance Corporation), Act No 24/ 2004 as a new scheme for deposit insurance.
2006	– Introduced single presence policy, prohibiting investors from holding more than 25% of shares in more than one bank.
2008	– Sharia (Islamic) Banking Act, No 21/2008, launched
	– New minimum reserve requirement 7.5% (main 5%, seconder 2.5%)
	– Minimum CAR 8%
2009	Launched of New Central Bank Act No 6/2009.
2010	– Fit and proper test requirement for board of commissioners.
	– New minimum reserve requirement 10.5% (main 8%, seconder 2.5%).
2011	– The Financial Service Authority (FSA) established, Act No 21/2011.

*) The aim to reduce maximum foreign ownership to 40% of total shares is still an ongoing debate.
Source: Author's compilation from various sources.

domestic and foreign investors during a re-privatization programme from 2000 to 2007 is a major cause (Zhang and Matthews 2012).

The improving shape of the industry can be noticed from the increase in total assets, which has the reverse trend of the number of banks. However, the increase is not a constant growth as the global economic turbulence in 2009 lowered the growth rate to only 9.7% in 2009, while in 2008 growth was 16.3%.

Much of the restructuring of the Indonesian banking industry has been the result of regulations and reforms launched following the AFC crisis to rebuild the industry towards a stronger and resilient system. Table 2 lists important regulations and reforms that followed the crisis.

III. Related studies

Efficiency and productivity studies have increased rapidly during the last decade, including in the banking sector. After being predominantly conducted in developed economies, recent studies consider emerging economies including Asian countries. Some of the studies in emerging economies include Taiwan (Chiu, Chen and Bai 2011), Hong Kong (Drake, Hall and Simper 2006), Bangladesh (Kalirajan and Salim 1997), India (Kumar et al. 2010), Singapore (Lee, Worthington and Leong 2010), the Philippines (Manlagñit 2011), Malaysia (Sufian 2009) and Brazil (Tecles and Tabak 2010).

In the case of Indonesian banks there are only a few studies. Harada and Ito (2005) find the efficiency of Indonesian bank ranges from 80% to 94%, whereas Omar, Majid and Rulindo (2007) report 86.2% to 91.2%. However, both of the studies cover a relatively small sample banks and a short period of data. Margono, Sharma and Melvin (2010), employing parametric stochastic frontier analysis (SFA), find that cost efficiency of Indonesian banks increased from 65% to 91% in the pre-crisis period then later decreased to 53%. Other studies include those by Hadad et al. (2008), Hadad et al. (2011), Sufian (2010) and Zhang and Matthews (2012).

Studies that examine the impact of deregulation and financial reforms in various developing economies provide mixed evidence. Some studies report financial reforms improve bank efficiency, such as in Portugal (Canhoto and Dermine 2003), Korea (Gilber and Wilson 1998), Turkey (Isik and Hassan 2003b), Thailand (Leightner and Lovell 1998) and India (Bhattacharyya, Lovell and Sahay 1997). Other studies find a possible adverse effect of deregulation on bank efficiency (Humphrey and Pulley 1997; Grifell-Tatjé and Lovell 1996; Grabowski, Rangan and Rezvanian 1994). A third group of studies identifies no change in banking efficiency after deregulation, or only shows a limited impact, including studies by Elyasiani and Mehdian (1995), Hao, Hunter and Yang (2001) and Havrylchyk (2006). Thus, the effect of deregulation on bank efficiency remains an empirical question.

The DEA method first developed by Farrell (1957) is extensively used in banking efficiency studies. With the DEA, it is possible to use small sample data. Other attractive features of DEA are that it is not necessary to make assumptions about the functional form of the production frontier and it deals with individual units rather than population averages. Unlike the previous studies, especially in Indonesia, this article offers an advanced DEA method which, as far as our knowledge, has never been applied to analyse the efficiency of Indonesian banking industry. The DEA estimates are bootstrapped using the method of Simar and Wilson (1998). This allows calculation of confidence intervals indicating the statistical reliability of the estimates.

IV. Data and variables

The data are gathered from the individual bank financial statements published by the Indonesian Central Bank (*Bank Indonesia*) over the period from 1993 to 2011. The data set is comprised of 19 annual observations for each of 101 commercial banks. The representation of banks from each group is detailed in Table 3. The banks that are included in the data set are those that existed from 1993 until 2011. 19 banks are excluded from the data set as they have been liquidated or closed during the period of study, have extensive missing data, or are just established within the covered period (11 banks). The sample covers 96% of total commercial bank assets over the period of analysis.

Table 3. Bank groups (2011).

No	Groups	Number of banks	Percentage of total assets for group (%)
1	State-owned bank	4 (4)	100
2	Private national bank*	53 (66)	94
3	Regional development bank	25 (26)	98
4	Joint venture bank	11 (14)	95
5	Foreign bank	8 (10)	77
	Total	101 (120)	96

The number of banks in the sample is followed by the total number of banks in the group in 2011 inside of the brackets. * Private national banks include forex commercial banks and non-forex commercial banks.

Das and Ghosh (2006) and Sathye (2001) emphasize that the input and output specification in banking efficiency and productivity studies has a crucial effect on the outcome. Intermediation and production approaches are the most popular method used in specifying input and output in efficiency and productivity studies (Berger and Humphrey 1997). The production approach regards banks as production centres for depositors and borrowers in which deposits are outputs (Denizer 2000). In contrast, the intermediation approach, introduced by Sealey and Lindley (1977), focuses on the function of banks in intermediating funds from depositors to the borrowers, where deposits are treated as inputs.

Although there is no consensus as to which approach works best, Berger and Humphrey (1997) highlight that the intermediation approach is more appropriate to measure efficiency for the whole financial institution, while the production approach is suitable to be used for the bank branch level. Therefore, this study follows the intermediation approach and specifies two models that are used to relate the input and output variables.

The first model (Model A) focuses on the role of banks in intermediating funds from surplus to deficit units. This model uses bank balance sheet items as inputs and outputs. Total deposits and fixed assets are the inputs, while total loans and other earning assets are the outputs. The second model (Model B) follows Drake, Hall and Simper (2006) and is used to capture bank revenues and expenses. According to Avkiran (1999), this model measures efficiency that is directly attributable to management in controlling costs and generating revenue, whereas the Model A provides a less direct measure of efficiency based on assets and liabilities. The two inputs are interest expenses and non-interest expenses, and the two outputs are interest income and non-interest income. Two separate models similar to Model A and Model B have been used in many studies, such as (Avkiran 1999) for Australian banks, Sathye (2003) for Indian banks and Sufian (2010) for Indonesian banks. The input and output variables included in our Model A and Model B are listed in Table 4.

Table 4. Variables for DEA.

Variable	Model A		Model B	
Outputs	Total loan (y_1)	Other earning Assets (y_2)	Interest income (y_1)	Non-interest income (y_2)
Inputs	Total deposits (x_1)	Fixed assets (x_2)	Interest expenses (x_1)	Non-interest expenses (x_2)

Table 5. Second stage variables and definitions.

Variable		Symbol	Expected sign	Description
Dependent variable				
Bank efficiency	Technical efficiency	TE (A) TE (B)		Technical efficiency of the bank for Model A or Model B
Independent variable				
Macroeconomic condition	Economic growth	GDP	+	Annual GDP growth
	Inflation	Infl	–	Inflation, consumer price (annual %)
	Broad money	Bmoney	±	Broad money is the sum of the currency outside the bank measured as a percentage of GDP
Market concentration	Concentration ratio	HHI	–	Herfindahl index (HHI) measured by sum of squared share of individual bank loans to total bank loans.
Bank characteristic factor	Size	Size	+	Bank size measured by the natural log of total assets
Restructuring	Bank restructuring	Dmerger	+	Represented by a dummy variable that takes a value of 1 for a merged bank and 0 for a bank that did not merge
Bank status	Listing bank	Dlisting	+	Dummy variable that takes a value of 1 for a listing bank and 0 for non-listing
	Foreign exchange operation	Dforex	+	Dummy variable that takes a value of 1 for a foreign exchange bank and 0 otherwise
Ownership structure/group	State bank	D_state	±	Dummy variable equal to 1 for state bank and 0 otherwise
	Private bank	D_private	±	Dummy variable equal to 1 for domestic private bank and 0 otherwise
	Joint venture bank	D_jvb	±	Dummy variable equal to 1 for foreign joint venture bank and 0 otherwise
	Foreign bank	D_purefb	±	Dummy variable equal to 1 for foreign bank and 0 otherwise
Regulatory change	Year 1998	Yr1998	+	Time dummy that takes a value of 1 for all observations in 1998 and 0 otherwise.
	Year 1999	Yr1999	±	Time dummy that takes a value of 1 for all observations in 1999 and 0 otherwise.
	Year 2001	Yr2001	±	Time dummy that takes a value of 1 for all observations in 2001 and 0 otherwise.
	Year 2004	Yr2004	±	Time dummy that takes a value of 1 for all observations in 2004 and 0 otherwise.
	Year 2006	Yr2006	±	Time dummy that takes a value of 1 for all observations in 2006 and 0 otherwise.
	Year 2008	Yr2008	±	Time dummy that takes a value of 1 for all observations in 2008 and 0 otherwise.
	Year 2009	Yr2009	±	Time dummy that takes a value of 1 for all observations in 2009 and 0 otherwise.
	Year 2010	Yr2010	±	Time dummy that takes a value of 1 for all observations in 2010 and 0 otherwise.
	Year 2011	Yr2011	±	Time dummy that takes a value of 1 for all observations in 2011 and 0 otherwise.

Table 6. Descriptive statistics of the outputs and inputs for Indonesia Banks, 1993–2011 (IDR millions at 2000 prices).

	Total loans	Other earning assets	Interest income	Non-interest income	Total deposits	Fixed assets	Interest expenses	Non-interest expenses
Mean	47,898.83	27,410.02	10,115.41	1,434.00	74,765.25	2,179.09	7,994.35	4,894.40
Max	973,979.27	625,001.56	273,344.02	72,447.24	2,461,022.61	54,090.65	1,361,209.05	556,933.81
Min	4.78	39.29	10.27	0.1	14.51	3.64	0.96	9.5
SD	126,638.28	72,941.01	28,332.74	4,411.30	218,286.08	6,111.27	49,257.12	24,124.68

Source: The data were collected from individual bank financial reports published by Bank Indonesia.

A set of explanatory variables is selected to explain the determinants of efficiency the Indonesian banking industry in the second stage. Table 5 lists the included explanatory variables that measure economic conditions, bank size, market concentration, restructuring, bank status, regulatory changes and bank ownership structure. The effect of changes in regulations are captured by including 9 year variables, one for each year in which there is a major regulatory change according to the list in Table 2.

Table 6 provides descriptive statistics of the inputs and outputs used over the study period. The table reveals that total deposit is the dominant input, while total loan is the biggest part of the output.

V. Empirical results

Methodology

This study employs the non-parametric DEA approach with variable returns to scale (VRS) assumption to examine input-oriented technical efficiency of Indonesian banks.[2] We calculate the efficiency score for each observation for $i = 1,\ldots,101$ bank, and $t = 1,\ldots,19$ year, using two inputs and two outputs in each model as specified previously.

[2]A popular alternative approach is stochastic frontier analysis (SFA). Choosing between SFA and data envelopment analysis (DEA) depends on several circumstances such as, data and assumptions about price information. Coelli et al. (2005) argue that if random noises are less an issue, price information is not available, the cost minimization or the profit maximization assumption are difficult to justify or the firm produces various outputs, then the DEA method is commonly chosen.

Following Banker, Charnes and Cooper (1984), the technical efficiency index is estimated by using following model:

$$\text{Min}_{\theta,\lambda} \sum_{t=1}^{19} \sum_{i=1}^{101} \theta_{kt},$$

Subject to

$$\begin{aligned} &\sum_{t=1}^{19} \sum_{i=1}^{101} \lambda_{it} x_{jit} \geq x_{jkt}, j = 1, 2 \\ &-\sum_{t=1}^{19} \sum_{i=1}^{101} y_{rkt} + \lambda_{it} y_{rit} \geq 0, r = 1, 2 \\ &\sum_{t=1}^{19} \sum_{i=1}^{101} \theta_{kt} x_{jkt} - \lambda_{it} x_{jit} \geq 0, \\ &\sum_{t=1}^{19} \sum_{i=1}^{101} \lambda_{it} = 1,\ \lambda_{it} \geq 0, \end{aligned} \tag{1}$$

where λ_{it} is the weight placed on data for the ith bank in year t, θ is a scalar value between 0 and 1 representing the efficiency score for the ith bank, x_{jit} is the quantity of input j used by for the ith bank in year t and y_{rit} is the quantity output r produced by for the ith bank in year t. x_{jkt} and y_{rkt} are the quantities of inputs and outputs of bank being assessed. Here $k = 1, \ldots, 101$ and $t = 1, \ldots, 19$. The VRS assumption is preferred because a bank may not operate at optimal scale due to external factors such as imperfect competition and constraints on finance (Coelli et al. 2005).

One limitation of the DEA result is the lack of statistical distribution, which leads to there being no measure of the accuracy in the estimated efficiency scores (Suyanto and Salim 2013). To address this limitation, this study employs the DEA bootstrapping procedure developed by Simar and Wilson (1998). The process can be summarized in the following steps:

(1) Calculate the DEA efficiency score θ_i for each bank $i = 1, \ldots, n,$ by solving the linear programming models previously.
(2) Using kernel density estimation, generate a random sample of size n from $\widehat{\theta_i} i = 1, \ldots, n,$ given $\theta^*_{1b}, \ldots, \theta^*_{Lb}$.
(3) Calculate a pseudo-data set $(x^*_{ib}, y_i), i = 1, \ldots n$ 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 $i = 1, \ldots, ,$ by solving the bootstrapped input.
(5) Repeat all of the steps B times (in this study, B = 1,000) to generate a set of estimates $\left\{\hat{\theta}^*_{ib}, b = 1, \ldots, B\right\}$.

To construct a confidence interval, Simar and Wilson (2000) propose an improved procedure that automatically corrects for bias, which is performed using Performance Improvement Management software (PIM-DEAsoft) Version 3.1. Following Coelli et al. (2005) and also previous empirical studies such as Tecles and Tabak (2010), Sufian (2009) and Barth et al. (2013), this article adopts the two-stage method to analyse the relationship between bank efficiency measures and selected explanatory variables. The DEA efficiency scores obtained in the first step are used as the dependent variable. Since the efficiency score is bounded between 0 and 1, the use of the common least square regression technique is unsuitable. Instead, this study employs the Tobit regression method that allows for limited-range dependent variables. The standard Tobit model is defined as follows:

$$\begin{aligned} &y^*_i = \beta' z_i + \varepsilon_i;\ y_i = y^*_i,\ \text{if } y^*_i \geq 0\ ,\ \text{and} \\ &y_i = 0,\ \text{otherwise}, \end{aligned} \tag{2}$$

where z_i and β are the vectors of explanatory variables and their coefficients, respectively, whereas y_i and y^*_i are the observed DEA efficiency score and the vector of a latent variable.

To examine the effect of the explanatory factors on Indonesian bank efficiency, the following specification of Equation (2) is used:

$$\begin{aligned} \text{TE}_{it} = {} & \alpha + \beta_1 \text{size}_{it} + \beta_2 \text{HHI}_t + \beta_3 \text{GDP}_t + \beta_4 \text{inlf}_t \\ & + \beta_5 \text{BMoney}_t + \beta_6 \text{Dforex}_{it} + \beta_7 \text{Dlisting}_{it} \\ & + \beta_8 \text{Dmerger}_{it} + \beta_9 \text{D\_state}_i + \beta_{10} \text{D\_PureFB}_i \\ & + \beta_{11} \text{D\_private}_i + \beta_{12} \text{D\_JVB}_i + \beta_{13} \text{D\_RDB}_i \\ & + \beta_{14} \text{Yr1998}_t + \beta_{15} \text{Yr1999}_t + \beta_{16} \text{Yr2001}_t \\ & + \beta_{17} \text{Yr2004}_t + \beta_{18} \text{Yr2006}_t + \beta_{19} \text{Yr2008}_t \\ & + \beta_{20} \text{Yr2009}_t + \beta_{21} \text{Yr2010}_t \\ & + \beta_{22} \text{Yr2011}_t + \varepsilon_{it}, \end{aligned} \tag{3}$$

where for bank i at time t representing annual observation, TE_{it} is the DEA technical efficiency

Table 7. Annual mean efficiency estimates for the Indonesian banking industry.

	Estimated efficiency		Bias-corrected mean		Lower bound		Upper bound	
Year	Model A	Model B	Model A	Model B	Model A	Model B	Model A	Model B
1993	0.4759	0.8117	0.4189	0.7861	0.3349	0.7433	0.4801	0.8127
1994	0.4827	0.8198	0.3947	0.7925	0.2906	0.7491	0.4880	0.8207
1995	0.5611	0.7990	0.4902	0.7747	0.3979	0.7323	0.5648	0.8002
1996	0.5369	0.8250	0.4911	0.8045	0.4302	0.7678	0.5404	0.8257
1997	0.4880	0.7864	0.4181	0.7604	0.3331	0.7215	0.4916	0.7878
1998	0.7136	0.6643	0.6847	0.6180	0.6381	0.5447	0.7157	0.6678
1999	0.6393	0.5317	0.6048	0.4471	0.5485	0.3433	0.6418	0.5380
2000	0.5858	0.7003	0.5420	0.6610	0.4547	0.5908	0.5876	0.7020
2001	0.5583	0.7131	0.4958	0.6725	0.3903	0.6045	0.5618	0.7147
2002	0.6075	0.6857	0.5597	0.6525	0.4716	0.5949	0.6093	0.6878
2003	0.6133	0.4243	0.5646	0.3514	0.4798	0.2446	0.6154	0.4287
2004	0.6668	0.3650	0.6218	0.2849	0.5441	0.1723	0.6688	0.3719
2005	0.6822	0.6700	0.6389	0.6239	0.5645	0.5483	0.6839	0.6718
2006	0.6934	0.7155	0.6516	0.6834	0.5780	0.6256	0.6949	0.7169
2007	0.6981	0.7184	0.6597	0.6868	0.5929	0.6285	0.6994	0.7197
2008	0.5785	0.7198	0.5202	0.6828	0.4327	0.6229	0.5814	0.7218
2009	0.5268	0.6975	0.4705	0.6628	0.3795	0.6049	0.5299	0.6996
2010	0.5851	0.7048	0.5327	0.6632	0.4509	0.6028	0.5878	0.7071
2011	0.5956	0.8022	0.5471	0.7795	0.4676	0.7412	0.5980	0.8033
Mean	0.5942	0.6923	0.5425	0.6520	0.4621	0.5886	0.5969	0.6946

Source: Author's calculations.

obtained either using the intermediation approach (Model A) or the revenue approach (Model B). The definitions of the remaining variables are given in Table 5 above. All of the estimates, including the maximum-likelihood estimates of the coefficients in Equation (3), are obtained using STATA 12.

Efficiency of Indonesian banking sector

Table 7 summarizes the annual means of DEA technical efficiency scores for the entire banking industry during the 1993–2011 periods. Each measure presents the results for Model A and Model B, beginning with the estimated efficiency (the original DEA efficiency score) in Columns 2 and 3, followed by bias-corrected estimates in Columns 4 and 5. The remaining four columns provide the lower and upper bounds of the efficiency estimates for the 95% confidence interval.

The results show generally the Indonesian banking industry is technically inefficient during the period of analysis. The average efficiency estimate for Model A is 59.42% for the entire period, with annual average scores ranging from 48% to 71%. These scores are lower than those found for Model B, for which the average efficiency estimate is 69.23%, with annual average scores ranging from 36% to 82%. The results for Model B suggest that there is a scope for the Indonesian banking industry to reduce its use of inputs by 30.77% on average, given current levels of output. By contrast, the average score for Model A suggests that reductions in inputs can be as high as 40.58%, without a reduction in the amount of output produced. The higher average efficiency scores for Model B than Model A suggest Indonesian banks are more adept at efficiency in turning expenses into revenues than in turning deposits into loans, which is perhaps not surprising given the closer link between the Model B measure of efficiency and the profitability of the bank.

The bootstrap procedure provides the bias corrected estimate of efficiency. The results show the range of inefficiency is even wider than the original estimate. This suggests that comparison between banks should be made with caution when considering the original efficiency estimate. The bias varies not only across the period, but also across the models. For example, in Model A, the bias is less than 0.05 in 1996, 1998–2000, 2002–2007 and 2011, whereas in the remaining years, the bias is above 0.05, with 1994 showing the largest bias.

Turning to the results for groups of banks, for the sake of brevity Table 8 presents only the 1993, 2002 and 2011 annual means of the efficiency scores for each group of banks under Models A and B. The mean in the last two columns is for the whole period of analysis. Similar to Table 7, the measurement results present the original measures of efficiency, the bootstrapped bias-corrected scores, as well as the lower and upper bounds of the 95% confidence interval. To support these broad results and to facilitate identification of the sources of efficiency,

Table 8. Annual means of efficiency estimates per group, 1993–2011.

		1993		2002		2011		Mean*	
Groups		Model A	Model B	Model A	Model B	Model A	Model B	Model A	Model B
State-owned banks	Eff Estimate	0.9883	1	0.9277	0.9625	0.9497	0.9179	0.9325	0.9449
	Bias-corrected	0.9775	1	0.9006	0.9363	0.926	0.8888	0.9033	0.9222
	LB	0.9766	1	0.8553	0.925	0.8994	0.8358	0.8712	0.9028
	UB	0.9899	1	0.9285	0.9646	0.9512	0.9186	0.9345	0.9465
Private national banks	Eff Estimate	0.419	0.8199	0.5482	0.6349	0.5394	0.8524	0.535	0.7085
	Bias-corrected	0.3656	0.7919	0.5003	0.5973	0.4797	0.8325	0.4818	0.6649
	LB	0.2842	0.7478	0.4084	0.5313	0.3842	0.8015	0.3931	0.5987
	UB	0.423	0.8209	0.5501	0.6369	0.5421	0.8535	0.5378	0.7109
Regional development banks	Eff Estimate	0.3385	0.7413	0.52	0.7129	0.4775	0.7452	0.5102	0.6487
	Bias-corrected	0.2854	0.7169	0.4677	0.6816	0.4311	0.7204	0.4628	0.6107
	LB	0.1954	0.6652	0.3776	0.6303	0.3463	0.6757	0.3834	0.5456
	UB	0.3421	0.7425	0.5221	0.7151	0.4803	0.7464	0.5129	0.6509
Joint venture banks	Eff Estimate	0.7758	0.7802	0.7874	0.7123	0.707	0.7855	0.7793	0.6585
	Bias-corrected	0.7181	0.7517	0.7373	0.685	0.6741	0.7594	0.7243	0.6179
	LB	0.6628	0.7059	0.639	0.6251	0.6092	0.7151	0.6541	0.5509
	UB	0.7831	0.7812	0.7887	0.7143	0.7093	0.7866	0.7821	0.6608
Foreign banks	Eff Estimate	0.631	0.9102	0.8582	0.7572	0.9733	0.6324	0.8195	0.6471
	Bias-corrected	0.5236	0.8876	0.817	0.7346	0.956	0.6055	0.7587	0.6124
	LB	0.3718	0.8615	0.7481	0.6906	0.9467	0.5551	0.6918	0.555
	UB	0.6368	0.9111	0.8592	0.7594	0.9738	0.6336	0.8223	0.6494

Source: Author's calculations. LB denotes lower bound; UB denotes upper bound. * The annual mean is for the full period of 1993–2011.

Table 9. Number of efficient banks by group.

	State-owned bank (4 banks)		Private national bank (53 banks)		Regional development bank (25 banks)		Joint venture bank (10 banks)		Foreign bank (9 banks)		Total (101 banks)	
Groups	Model A	Model B	Model A	Model B	Model A	Model B	Model A	Model B	Model A	Model B	Model A	Model B
1993	3	4	3	9	2	0	3	1	2	3	27	36
1994	3	3	1	8	2	4	2	2	0	1	25	30
1995	4	4	4	12	1	2	1	1	2	1	31	36
1996	4	4	5	10	4	3	4	1	1	2	36	44
1997	2	3	3	6	2	4	3	1	2	2	26	34
1998	2	3	10	9	2	4	6	1	5	1	42	55
1999	3	1	8	8	1	2	6	1	3	0	33	43
2000	3	2	7	9	1	3	7	1	5	3	38	54
2001	3	3	3	8	0	2	4	1	5	2	29	41
2002	3	2	6	7	1	3	5	2	5	2	34	48
2003	3	3	5	5	1	0	4	1	5	0	27	37
2004	2	3	4	4	3	0	7	1	5	0	29	42
2005	3	2	3	8	1	2	3	1	4	1	27	36
2006	3	3	5	10	3	2	3	1	5	1	35	45
2007	2	4	5	10	3	2	4	1	6	0	37	48
2008	2	2	2	11	3	1	2	1	5	0	29	37
2009	1	2	4	12	0	2	3	1	7	0	32	43
2010	3	2	4	12	0	1	2	1	5	0	30	38
2011	3	2	4	14	0	3	3	2	8	0	39	52

Source: Author's calculation.

Table 9 shows the number of efficient banks for each group under each model.

Comparison of the results from Model A to those from Model B highlights the sensitivity of the results to the choice of input and output variables. Overall the relative efficiency under Model B shows a higher score for most of the groups except foreign and joint venture banks. As noted with respect to the full sample results, these results imply that banks generally seem more adept at efficiency in turning expenses into revenues than in turning deposits into loans. The divergent result for foreign and joint venture banks suggests that they may be more interested in establishing a substantial presence in Indonesia than in immediately generating profits.

The group of state-owned banks is found to be the best performing group throughout the sample period in both models. For instance, in the Model A, the average efficiency scores of state banks range from 81% to 100%, which is far above the industry average (47.6% to 71.4%), with a minimum of 25% of banks on the efficient frontier. There are only four banks in the state-owned group and they are each large, which provides advantages of scale. The positive impact of size on efficiency is clearly shown in the second-stage estimates below and the advantage of

the state-owned banks diminishes once the effect of size is removed.

In Model A, foreign and joint venture bank groups are the second and third most efficient groups, respectively. The mean efficiency of the foreign banks ranges from 51% to 97%, while and that of the joint venture banks ranges from 66% to 90%, exceeding the average industry efficiency by 18% and 22%, respectively. This result is in line with typical finding in many international studies in which foreign banks are more efficient than domestic banks (Bonin, Hasan and Watchel 2005; Fries and Taci 2005; Hasan and Marton 2003; Kraft, Hofler and Payne 2006). However, foreign and joint venture banks in Model B are shown to be less efficient and close to the bottom in terms of efficiency along with the group of regional development banks. Notably, once the effect of other variables is controlled in the second stage estimates, the differential results for these bank groups between Model A and Model B in terms of relative efficiency greatly diminishes.

The group of private national banks is ranked only slightly above regional development banks in Model A, but much better than the regional banks in Model B. In comparison to both foreign and joint venture banks, the private national banks are inferior in Model A but are superior in Model B. Regional development banks are found to constitute the least efficient group in the industry under both models. Our findings are similar to those of Hadad et al. (2008) and Hadad et al. (2012) with respect to the ranking of groups from the most efficient to the least efficient, although the efficiency scores of the groups differ between these studies. Our results also confirm the result of Salim, Hoquea and Suyanto (2010) for Australian banks in regard that major banks are relatively efficient compared to regional banks.

The number of efficient banks (Table 9) is in line with Table 8, in which the state-owned bank group has the highest number of efficient banks (at least one out of four) and ranks as the top among bank groups. By contrast, the group of regional development banks has the highest proportion only in 1996, with 4 of 25 banks (or 16%) found to be efficient. Moreover, in some years, 1993, 2001, 2003, 2004 and 2009–2011, none of the banks in this group are on the frontier.

The difference in efficiency between state-owned and regional banks is notable. Although both groups are government owned, they are unequal in terms of business size. State-owned banks are owned by the national government, whereas regional development banks are owned by local governments. However, the status of regional development banks as the least efficient among different types of banks has become a serious concern, as this group ranks third in customer deposits as noted by Hadad et al. (2008).

The determinants of Indonesian banks' efficiency

Table 10 presents the regression results for the two models, Model A and Model B. Separate efficiency results are given for the original (non-bootstrap) DEA efficiency measures and for the bootstrap measures. All of the groups of banks (five groups) are included, but no estimated coefficient is shown for the regional development banks as this is the base case. All models have good explanatory power for both models, and the Wald chi-square tests are all statistically significant at 1%. The outcomes of the regressions for the bootstrap and non-bootstrap efficiency show only small variations in the coefficient estimates.

Among the explanatory variables, size shows most clearly as a positive and highly statistically significant influence on efficiency under both Model A and Model B as well as for both DEA (bootstrapped and non-bootstrapped) measures. This supports the idea that larger banks are more efficient than smaller banks and confirms similar findings in other Indonesian studies, such as Zhang and Matthews (2012), Hadad et al. (2008), Hadad et al. (2011) and Hadad et al. (2012), although not all results from those studies are consistently significant. In Indonesia, as noted earlier, large banks possess many bank branches, diversified products and better technology, all of which seem to outweigh any negative effects of being 'large'.

The Herfindahl index (HHI) variable is introduced to the model to assess the effect of market concentration on bank efficiency. Although the estimated coefficients are consistently significant, it exhibits an opposite direction of impact over the different models. The result under intermediation-based efficiency (Model A) suggests that the more concentrated the market the lower the efficiency, whilst under revenue-based efficiency the result it is reversed. The positive significant of HHI under Model B, to some extent confirms the results of Zhang and Matthews (2012) in their Model 2. The

Table 10. Determinants of efficiency (TE) – Tobit regression Model.

	Non-bootstrap efficiency				Bootstrap efficiency			
	Model A		Model B		Model A		Model B	
Variable	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
Size	0.0423***	0.0065	0.0364***	0.0059	0.0367***	0.0070	0.0345***	0.0062
HHI	−0.4137***	0.0447	0.1802***	0.0434	−0.4858***	0.0492	0.1851***	0.0469
GDP	0.0004	0.0047	0.0493***	0.0046	−0.0013	0.0052	0.0555***	0.0050
Infl	0.0016	0.0027	0.0063**	0.0026	0.0015	0.0030	0.0077***	0.0028
BMoney	−0.0058***	0.0014	0.0089***	0.0014	−0.0063***	0.0015	0.0102***	0.0015
Dforex	0.0025	0.0191	−0.0084	0.0176	−0.0085	0.0206	−0.0140	0.0186
Dlisting	0.0039	0.0184	−0.0289*	0.0175	0.0011	0.0201	−0.0286	0.0187
Dmerger	−0.0308	0.0257	0.0106	0.0246	−0.0276	0.0282	0.0030	0.0264
D_state	0.2498***	0.0755	0.1393**	0.0578	0.2999***	0.0752	0.1645***	0.0589
D_PureFB	0.2463***	0.0535	0.1406***	0.0409	0.2490***	0.0532	0.1352***	0.0416
D_Private	0.0239	0.0327	0.0374	0.0250	0.0215	0.0326	0.0375	0.0255
D_JVB	0.3019***	0.0449	0.0737**	0.0354	0.2954***	0.0454	0.0741**	0.0364
Yr1998	0.2093	0.1667	0.4498***	0.1627	0.2205	0.1838	0.4734***	0.1758
Yr1999	0.2182***	0.0505	−0.1337***	0.0493	0.2520***	0.0557	−0.1818***	0.0532
Yr2001	−0.0559**	0.0234	0.0912***	0.0228	−0.0748***	0.0258	0.0942***	0.0246
Yr2004	0.0365*	0.0195	−0.2517***	0.0191	0.0378*	0.0216	−0.2813***	0.0206
Yr2006	−0.0112	0.0229	0.0759***	0.0223	−0.0119	0.0252	0.0871***	0.0241
Yr2008	−0.1504***	0.0217	0.1040***	0.0212	−0.1680***	0.0239	0.1173***	0.0229
Yr2009	−0.1779***	0.0266	0.1736***	0.0259	−0.1947***	0.0293	0.2044***	0.0280
Yr2010	−0.1298***	0.0247	0.0989***	0.0241	−0.1375***	0.0273	0.1127***	0.0260
Yr2011	−0.1286***	0.0242	0.1741***	0.0236	−0.1340***	0.0267	0.2048***	0.0255
Intercept	0.6962***	0.1061	−0.5852***	0.0989	0.7935***	0.1147	−0.7195***	0.1056
/sigma_u	0.1270***	0.0099	0.0926***	0.0076	0.0930***	0.0078	0.0930***	0.0078
/sigma_e	0.1665***	0.0028	0.1626***	0.0027	0.1756***	0.0029	0.1756***	0.0029
Log likelihood	591.59		663.5		414.67		522.20	
Wald chi-square	526.96***		968.33***		532.65***		1062.39***	
Observation	1919		1919		1919		1919	

***, ** and * denote significance at the 1% level, the 5% level and the 10% level, respectively. SE is standard error.

possible explanation is that the market power may boost interest revenue over interest expenses, even if this means that the banks forego some opportunity to convert deposits into loans.

In regard to the macroeconomic factors, all variables seem to have a more powerful positive influence on efficiency in Model B than Model A. The coefficient of the growth of GDP is mostly positive, but it is only significant under Model B. This finding suggests that economic growth is important to bank revenue efficiency, a claim that is supported by Drake, Hall and Simper (2006) and Grigorian and Manole (2006).

The inflation coefficients are positive, which is the opposite of that expected. The results show inflation is positively linked to bank efficiency, but only significantly so in the case of revenue-based efficiency. This finding suggests a higher inflationary environment is favourable to converting expenses into revenue. Although contradictory to the findings of many bank efficiency studies (Barth et al. 2013; Delis, Molyneux and Pasiouras 2011; Castellanos and Garza-García 2013), this result seems to support the argument of Grigorian and Manole (2006).

Last among the macroeconomic variables, broad money has statistically significant coefficients that are negative in Model A but positive in Model B. Increased broad money apparently hinders converting deposits into loans or other income earning assets, but improves the revenue obtained from expenses. This suggests that more broad money is associated with fewer loans relative to deposits but higher interest receipts relative to interest paid, which is consistent with an enhanced supply of deposits to the banks increasing their profitability.

The bank status variables indicate whether a bank deals in foreign exchange (Dforex) or is a listing bank (Dlisting). None of the estimated coefficients of these variables is statistically significant in the results based on the bootstrapped DEA measures and only the coefficient of Dlisting is weakly significant in the results in Model B for the non-bootstrapped measure. Thus, the results do not support the finding of Hadad et al. (2012) that listed banks are more efficient than the industry average, nor do the results support the common prejudice of the public regarding that the 'exclusive' status of foreign exchange banks benefits their performance.

The restructuring variable in Table 10 indicates whether a bank has been involved in a merger (Dmerger). The finding of no statistically significant

impact on efficiency for this variable fails to support common opinion of the positive effect of the restructuring policy on bank efficiency. This result confirms earlier studies, such as those by Schenk (2006) and Halkos and Tzeremes (2013), which indicate that merged banks do not always experience an efficiency gain.

State-owned banks on average are much more efficient than banks in all other groups in both models for both the DEA measures shown in Table 8, but not once other factors affecting efficiency are taken into account with the results in Table 10. In particular, foreign banks appear to be about as efficient as state banks based on the estimated coefficients in the latter table. Joint venture banks are also amongst the most efficient, at least in terms of estimated coefficients under Model A. Both the groups of banks with at least some foreign ownership clearly outperform the purely domestic groups of private national banks and regional development banks (the omitted base case group). With the exception of state banks, these results support the typical findings in developing countries' studies that foreign banks outperform their domestic counterparts, such as those of Hasan and Marton (2003), Grigorian and Manole (2006), Gardener, Molyneux and Nguyen-Linh (2011) and Isik and Hassan (2003a). Moreover, this finding is also consistent with the study by Zhang and Matthews (2012) in the Indonesian case, especially their crisis and post-crisis regressions. However, some other researchers report contrary findings, such as Williams and Nguyen (2005) and Lensink, Meesters and Naaborg (2008).

Turning to regulatory changes, these variables are emphasized as the focus of this study is to analyse the impact of regulatory change on bank efficiency. Interestingly, the results in Table 10 show that in the years with regulatory reforms bank efficiency according to Model A generally moves in the opposite direction to efficiency according to Model B. Mostly, the reforms improve bank revenue efficiency but reduce intermediation efficiency, although the opposite pattern is found for 1999 and 2004. These results suggest that the reforms generally have opposite impacts on the efficiency with which Indonesian banks convert deposits into loans and the efficiency with which they convert expenses into revenues.

An exception to the finding of opposite effects in Model A versus Model B occurs in 1998 when both efficiency measures increase, although the effect is only statistically significant (and much larger) in Model B. This is the year when the blanket guarantee system was implemented and the capital asset ratio (CAR) reduced to help banks overcome the impact of the AFC. The measures allowed the banks to attract deposits more easily and reduce the amount of equity they had to hold against loans, thereby enhancing intermediation efficiency even against the backdrop of the financial crisis. Interest revenue gains relative to interest expense due to the lower CAR and the lower interest rates on deposits were possible because of the deposit guarantee, thereby increasing revenue efficiency. Notably, when the blanket guarantee was lifted in 2004 along with closing the Indonesian Bank Restructuring Agency (IBRA), the effect is shown to be significantly negative in Model B although still positive (but only weakly significant) in Model A. In both 1998 and 2004, the impact on revenue efficiency comes out stronger than the impact on intermediation efficiency.

In 1999, bank efficiency increases significantly according to Model A but falls significantly according to Model B. The policy changes introduced this year were to relax the restriction of foreign ownership and to launch a New Central Bank Act. The extra competition from foreign banks and scrutiny from the central bank may have squeezed the margin between interest earned on loans and interest paid on deposits, thereby lowering efficiency according to Model B. At the same time, as Gardener, Molyneux and Nguyen-Linh (2011) argue, increasing foreign presence encourages domestic banks to increase intermediation efficiency to survive in the more competitive environment.

The single presence policy introduced in 2006 has a positive and statistically significant impact on efficiency under Model B, while there is no strong evidence of relationship with efficiency in Model A. Restricting ownership of multiple banks should encourage competition as with the introduction of foreign ownership. However, the impact on revenue efficiency is opposite to that in 1999 when foreign ownership was introduced, so the result is anomalous in terms of expectations. There is the possibility that, as with all the year variables, the estimated coefficient captures the influence of factors in addition to the regulatory changes during the year.

Reforms introduced in the years 2001 and then in 2008 through 2011 generally were aimed at the strengthening of bank balance sheets, such as higher CAR, higher minimum reserve requirements and enhanced supervision of bank activities. Not surprisingly, these reforms are found to have reduced intermediation efficiency according to the results in Model A. Less obvious are the positive impacts on revenue efficiency in Model B, which suggest that the tightening of capital and reserve requirements pushes banks to generate more revenue per dollar of cost. These results of enhanced revenue efficiency following regulations to strengthen balance sheets are supported in studies by Grigorian and Manole (2006) and Barth, Caprio and Levine (2008).

VI. Conclusions

This article provides an empirical analysis of the technical efficiency of the Indonesian banking sector during the 1993–2011 period. Results are obtained by conducting an input-oriented DEA and, then, the bootstrapped DEA method under the assumption of VRS. Two separate sets of input and output variables are employed, the intermediation approach (Model A) and the revenue approach (Model B), to measure efficiency. Censored Tobit regressions are then applied to the efficiency scores using a set of variables to explain technical efficiency.

The empirical results reveal that the banking sector is less than fully efficient under both approaches. In terms of intermediation services, the average technical efficiency over the period of analysis is found to be 59.4%, with annual values ranging from 47% to 71%. The overall trend indicates improvement, although fluctuations have occurred. The average efficiency of the industry under the revenue approach is found to be 69.2%, with values ranging from 36.5% to 81.9%, with generally higher levels of efficiency than are shown under the intermediation approach. Under the revenue approach, unlike the intermediation approach, the trend shows some decline over the sample period. These results imply that inputs can be reduced by an average of 40.6% and 30.8% under the intermediation and revenue approaches, respectively, relative to best practice.

Based on the group results, state-owned banks are revealed to be the best performers under both approaches, with average efficiency scores of 93% and 94% under the intermediation and revenue approaches, respectively. By contrast, the least efficient groups are found to differ under the two approaches, with regional development banks as the least efficient banks (with an average efficiency score of 51%) under the intermediation approach and foreign banks as the least efficient banks (with an average efficiency score of 64.7%) under the revenue approach.

The regression results suggest that size is a positive influence on bank efficiency. The effect of macroeconomic variables and market concentration are significant and positive in Model B (revenue efficiency). Regarding ownership structure, foreign, state and joint venture banks are shown to have the highest efficiency in both Model A and Model B. Bank status, including whether the bank engages in foreign exchange or is a listing bank does not have any consistently significant impact on efficiency. Neither does whether a bank has been involved in a merger have a significant effect.

Our central concern is with the impact of regulatory reform. The reforms introduced in 1998 to help prop up banks after the AFC are found to have been associated with improved efficiency in both Model A and Model B. Foreign ownership and other reforms in 1999 are also associated with improved efficiency in Model A but reduced efficiency in Model B, suggesting improved intermediation performance for domestic banks in response to increased competitive pressure. Reforms in 2001 and in 2008 through 2011 generally involved strengthening of the banking system through higher capital to asset ratios, higher minimum reserve requirements and enhanced supervision. Not surprisingly, these reforms are found to lower efficiency in intermediation, but, encouragingly, are associated with improved revenue efficiency. Apparently banks have responded to the stricter controls on their balance sheets by improving their performance in income generation.

Our findings suggest ways to improve bank performance. First, considering the positive significant impact of size on both measures of efficiency, bank growth and consolidation should be encouraged in order to attain economics of scale. Second, the fact that foreign-owned or joint venture banks are more efficient than local private banks, suggests that the local banks should seek knowledge transfer from abroad in bank operating management and

technology. Finally, while regulations to enhance bank safety lower their efficiency in intermediation, banks are seemingly able to compensate with higher efficiency in generating revenue, so the strength of the banking system can apparently be improved without destroying bank profitability.

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