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FACTORS DETERMINING THE PRODUCTIVITY OF INDONESIAN BANKS DURING RESTRUCTURING PERIOD.

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Abstract

This study aims to analyse the source of productivity growth and its determinants in the Indonesian banking sector during the restructuring period. The period of restructuring following the 1997 Asian financial crisis played an important role in transforming the industry towards a more resilient banking system. The *Malmquist* Productivity Index (MPI) is employed to measure the total factor productivity of the bank in the first stage, then followed by multiple regression analysis is used to explore factors that affect the variation in productivity. The analysis is conducted based on annual financial data of 101 commercial banks in Indonesia. The results show that technological change tends to be the main source of productivity improvement rather than efficiency change. At the second stage of analysis, regression result suggest that productivity growth is mainly influenced by broad money, market concentration and foreign ownership. There is no strong evidence that merger affect productivity growth significantly.

Keywords: Productivity, Banking, Data envelopment analysis; Bootstrap; Malmquist indices
JEL Classification: G21, C14, C61

Introduction

The role of the banking sector in emerging economies is principal to their economic growth, particularly in Indonesia, where the banking sector seems more complex compared to neighbouring countries. Up to the present, hundreds of commercial banks still exist, amidst the efforts to strengthen the sector towards a more resilient banking industry. Having survive the tribulation during the 1997 Asian financial crisis (AFC), the banking sector in Indonesia then entered the more challenging era.

The period of restructuring during 2000 – 2010 marks a crucial part of the development of the Indonesian banking industry. There were various issues facing the industry, starting with a lack of proper supervision systems, inadequate deposit guarantee schemes, and poor economic fundamentals, which have contributed to the weakness of the banking sector during the restructuring process and thereafter. A series of regulations has been launched and some have forced unsound banks to close their business. A wave of mergers and acquisitions has been a feature of the era. The expected outcome was to create a stronger and more resilient banking structure by reducing the number of banks. During the period from 1999 to 2011, there were 56 banks that merged to become 21 banks. The event of merger itself almost occurred in every year during that period, in which the highest number of was in 1999 - 2001 (see Defung, 2014). Some of the merger was forced by the government or regulation in order to comply with capital requirement standard.

Officially Indonesian bank is divided by commercial banks and rural bank. Like many other developing countries, the commercial bank is known as the main engine of the banking industry or even in the financial structure. The commercial bank itself comprises of six groups based on the ownership structure and operational. Table 1 present the group of banks and the number bank in each group from 2000 to 2011.

Table 1. Number of Bank by Group

Group	State-owned bank	Foreign Exchange Bank	Non-foreign exchange bank	Regional development bank	Joint venture bank	Foreign bank	Total
2000	5	37	42	26	29	10	149
2001	5	37	41	26	24	10	143
2002	5	36	40	25	23	10	139
2003	5	36	40	25	20	10	136
2004	5	34	36	25	19	11	130
2005	5	34	36	25	17	11	128
2006	5	35	35	25	16	11	127
2007	5	35	35	25	16	11	127
2008	5	32	32	25	15	10	119
2009	4	34	30	25	16	10	119
2010	4	36	30	25	15	10	120
2011	4	34	28	25	12	10	113

Source: Indonesian banking statistic, various issues

In the last decade, the industry has been highlighted by the establishment of mandatory regulatory institutions, such as the Indonesian Deposit Insurance Corporation (IDIC) and the Financial Service Authority (FSA). The main intention of both institutions is to support the policies in creating a sounder banking system.

Having faced those challenges, the role of the bank in intermediating funds from depositors to borrowers must be affected. When bank could not be properly channelled the fund and/or unable to provide financial services to business, household or other private sectors, it tended to impact the economic growth. Bank management seeks to improve its efficiency and productivity although the surrounded factors are uncertain. The growth of productivity of a bank in response to change in regulation have been varied (see Ataullah and Hang (2006) and Sufian (2011). Empirical studies around the world have produced various results with regard to the effect of financial reforms on productivity. Some show an improvement; other studies reveal the opposite results or that there are no significant changes compared to the period prior to reform. Furthermore, there is no comprehensive result regarding what controls the productivity growth in the banking industry, particularly in an emerging economy. With regard to this perspective, there are still gaps in empirical studies that assess the impact of restructuring policy on productivity growth. Thus, this study fills a gap in the empirical work to address the question of what the dominant factors that influence productivity in the Indonesian bank may be. Previous studies on Indonesian bank productivity have focused the analysis on a short period of data and/or only investigate the performance of a particular group of banks (Omar, Majid and Rulindo 2007; Hadad et al. 2011).

This paper aims to investigate factors that determine the productivity growth in the Indonesian banking industry. First stage the productivity growth is measured by using the *Malmquist* Productivity Index (MPI) to obtain the score. Subsequently, factors that possibly determine the variation in productivity in the Indonesian banking industry will be examined using several variables at the second stage. Those factors include macroeconomics, restructuring, bank status, bank ownership type and bank characteristic. In this study, we investigate the productivity of Indonesian banks as a whole during the period from before the Asian crisis (1993) until recently

(2011) using the bootstrapped Malmquist productivity index (MPI) proposed by Simar and Wilson (1999). This method allows for the assessment of the "null hypothesis" of no efficiency change, no technological change and no productivity gains or losses (Tortosa-Ausina et al. 2008). Thus, with the longer period of data and the provision of statistical tests on the result, this study presents an important extension to the literature, especially in the Indonesian context.

This study is inspired by the increasing need of internal bank management, customers, policy makers, and investors to comprehend bank productivity growth that appear to be affected by various changes in regulation. The rest of this paper is structured as follows. The next section discusses some related studies in the literature review, followed by a brief description of the Indonesian banking sector and the methodology used to carry out the analysis. The empirical analysis, which includes the results and discussion is presented next. The last part is the conclusion.

Literature Review

There is a shifting trend of bank efficiency and productivity research from developed countries to developing economies. The growth of publication related to theoretical perspective and empirical research on efficiency and productivity have expanded widely to various sector including in banking area. Furthermore, a survey by Emrouznejad and Yang (2018) provide evidence that the measurement of productivity growth using Data Envelopment Analysis (DEA) in banking sector has been widely utilised by researchers around the globe. Productivity growth, measured by total factor productivity (TFP) can be estimated using production frontier methods and index number approaches. The first method uses observed data to construct the production frontier for estimating efficiency and productivity gains, while the latter employs the index number to measure change in various economic variables, which can be applied for estimating productivity. The measure of productivity using MPI was first introduced in the work of Caves, Christensen and Diewert (1982). The method has been widely used to measure total factor productivity growth in various sectors, including the banking industry. Some well-known studies that utilise MPI in the banking industry include those by Sathye (2002) for Australian banks, Isik and Hassan (2003) for Turkish banks, Matthews and Zhang (2010) for Chinese banks and Adjei-Frimpong et.al (2015) for New Zealand banks. Research interest on bank productivity has been growing substantially in developing countries over the last decade. Studies on the Indonesian case have also been growing, starting from cross-country research to individual country research in Indonesia itself. In some cross-country studies, such as those by Laeven (1999); (2001); Williams and Nguyen (2005); Ariff and Can (2009); Gardener, Molyneux and Nguyen-Linh (2011) and Thoraneenitiyan and Avkiran (2009), the productivity of the Indonesian banks tends to be low-ranking or even the lowest rank in terms of its efficiency or productivity compared to other countries, although the research has mainly concentrated on banks' performance related to the 1997 Asian financial crisis. On the other hand, there are few scholarly studies focusing on Indonesian banks that use the MPI method. These studies are by Omar et al. (2007), Hadad et al. (2010) and Hadad et al. (2011). Omar et al. assessed private national banks and found that the total factor productivity (TFP) improved during the period of 2002-2004, with the year 2003-2004 noted as having the highest growth. Technical change was found to be the main contributor to the TFP growth. Hadad et al. (2010)'s research listed bank productivity using monthly data from 2003 to 2007 and reported that Indonesia's listed banks' productivity fluctuated and that this was mainly driven by the frontier shift. Using quarterly data from 2003 to 2007, Hadad et al. (2011) found that the main source of productivity change in the financial intermediary activities of Indonesian banks is the improvement in their intermediation technology.

A number of studies research the impact of environmental variables on efficiency and productivity that include a study by Ataullah and Hang (2006) who include some environmental

variables to investigate its impact on Indian banks productivity. Similar study conducted using cross country data by Delis, Molyneux, and Pasiouras (2011 in European countries bank. Furthermore, similar analysis studied by to the Sufian (2011) for Malaysian banks also include macroeconomics variables and internal bank variables. A study by Hsiao and Lin (2013) find that a strong evidence that merger, which is part of restructuring policy, has a positive and impact on bank productivity in Taiwan banks. They also report that merger that force by the government tend to be negative on productivity change.

Those studies have provided important findings, which lay the foundation to further explore the effect of policies, technology, financial regulations and so forth. However, those studies investigate the industry partially with no further evidence in the research on the effect of bank restructuring. This leaves a void in the literature, especially in the context of Indonesian banks, to further the research on the evolution of Indonesian bank productivity.

Data and Methodology

The literature provides two basic approaches used to estimate productivity change: the parametric approach, which is the econometric estimation of a production function; and the non-parametric approach, which is done through the construction of index numbers. This study adopts the latter because it does not require specifying a functional form for the structure of production technology. This paper employs Malmquist productivity index based on DEA approach to obtain total factor productive (TFP) measures. Färe and Lovell (1978) demonstrate that this method is possible to be decomposed into two components, technological change and efficiency change. The decomposition allows to identify whether the source of productivity growth causes by frontier-shift (technological change) or catching-up effect (technical efficiency change). Each of the component can be decomposed into further decomposition. Technological change comprises of scale technology and pure technology, whilst efficiency change consists of pure efficiency and scale efficiency.

a. Data and Sample

The data set used in this study is collected from individual banks' financial statements published by the Indonesian Central Bank (*Bank Indonesia*). The analysis is conducted based on the annual observations of 101 commercial banks, which comprise of four state banks, 53 private banks (combining foreign exchange and non-foreign exchange banks), 25 regional development banks (100%), 11 joint venture banks and 8 foreign banks. Although it does not cover the whole The data represents 96% of total commercial bank assets over the period of analysis.

Selecting input and output variables is crucial to calculate TFP growth. Two famous methods in determining input and output that commonly exhibit in the literature are intermediation approach and production approach. The intermediation approach, pioneered by Sealey and Lindley (1977), treats deposits as an input to produce loans and other productive assets. Therefore, it views bank mainly as intermediation unit between savers and borrowers. On the other hand, the production approach stands on the assumption that bank is a production centres, where the physical inputs such as labour and capital use to produce deposit and loans (measure in term of number of accounts) (Denizer, 2000). Considering the suggestion by Berger and Humphrey (1997) that production approach is more appropriate to analyze bank branch level instead of the whole bank level, therefore this study adopts the intermediation approach with some modification. Following Avkiran (2000), two inputs which consist of Interest Expenses (x_1) and Non-Interest Expenses (x_2) and two outputs which Interest Income (y_1) and Non-Interest Income (y_2). For the purpose of TFP change calculation at the first stage, those data are collected during the period from 1993 to

2011. Summary of the data for inputs and output variables is presented in Table 1. With regard to the variable for determinant of productivity for the second stage analysis will be explained in the next part.

Table 2. Summary Statistics of the Outputs and Inputs (millions of IDR)

Variables	Mean	Maximum	Minimum	Std. Deviation
Interest Expenses (x_1)	7,994.35	361,209.05	0.96	49,257.12
Non-Interest Expenses (x_2)	4,894.40	556,933.81	9.5	24,124.68
Interest Income (y_1)	10,115.41	274,344.02	10.27	28,332.74
Non-Interest Income (y_2)	1,434.00	72,447.24	0.1	4,411.30

a. Methodology

As mentioned earlier, this study follows Färe et al. (1994), to calculate TFP growth which based on the output-orientated Malmquist TFP index. The formula is expressed using the distance function with respect to two periods, period *s* (the base period) and period *t* as follows:

$$m_0\left(y_s, x_s, y_t, x_t\right) = \left[\frac{d_0^s\left(x_t, y_t\right)}{d_0^s\left(x_s, y_s\right)} \times \frac{d_0^t\left(x_t, y_t\right)}{d_0^t\left(x_s, y_s\right)}\right]^{1/2} \quad (1)$$

where $d_0^s\left(x_s, y_s\right)$ and $d_0^t\left(x_s, y_s\right)$ are measures of technical efficiency in period *s* and period *t* respectively; $d_0^s\left(x_t, y_t\right)$ is the distance function from the period *t* observation to the period *s* technology; $d_0^t\left(x_s, y_s\right)$ is the distance function from the period *s* observation to the period *t* technology and $m_0\left(y_s, x_s, y_t, x_t\right)$ is the MPI. The specification for the result is as follows: if the value of m_0 is bigger than one, meaning there is positive improvement of TFP from period *s* to period *t*, whereas a value less than one implies a declining TFP between the two periods and if the value m_0 equal to one it indicates there is no change in productivity.

The MPI can be decomposed into two element to find the catching-up effect (technical efficiency change) and frontier-shift (technological change) effect by rewriting the productivity index as follows (Färe and Lovell 1978):

$$m_0\left(y_s, x_s, y_t, x_t\right) = \frac{d_0^t\left(x_t, y_t\right)}{d_0^s\left(x_s, y_s\right)}\left[\frac{d_0^s\left(x_t, y_t\right)}{d_0^t\left(x_t, y_t\right)} \times \frac{d_0^s\left(x_s, y_s\right)}{d_0^t\left(x_s, y_s\right)}\right]^{1/2} \quad (2)$$

The term outside the square brackets in Equation 2 represents the change in the output-oriented measure of Farrell technical efficiency between periods *s* and *t*. The term in the square brackets stands for the technical change (or the technological change) between period *s* and *t*. Detail of each component is as follows:

$$Efficiency\ Change = \frac{d_0^t\left(x_t, y_t\right)}{d_0^s\left(x_s, y_s\right)} \quad (3)$$

and

$$Technological\ Change = \left[\frac{d_0^s\left(x_t, y_t\right)}{d_0^t\left(x_t, y_t\right)} \times \frac{d_0^s\left(x_s, y_s\right)}{d_0^t\left(x_s, y_s\right)}\right]^{1/2} \quad (4)$$

The drawback to the standard Malmquist index is that it does not provide statistical properties. Simar and Wilson (1999) proposed the bootstrapping method to solve the lack of statistical

inference. Equation (2) does not inform about the statistical reliability of the change in productivity, efficiency or technology. Thus, a consistent bootstrapping procedure is employed in obtaining confidence intervals for the Malmquist index and its components, efficiency change and technological change. In adapting the bootstrapping procedure for Malmquist indices, Simar and Wilson (1999) use a bootstrap algorithm for efficiency scores with a bivariate smoothing procedure to avoid any temporal correlation.

This process can be summarised as follows:

1. Calculate the MPI $\widehat{M}_i(t_1, t_2)$ for each bank $(i = 1, \dots, N)$ at time $(t_1$ and $t_2)$ by solving the linear programming models (see e.g. Coelli et al. 2005, 297).
2. Construct a pseudo-dataset $\{(x_{it}^*, y_{it}^*); i = 1, \dots, N; t = 1,2\}$ to form the reference bootstrap technology using the bivariate kernel density estimation and the reflection method proposed by Simar and Wilson (1999).
3. Calculate the bootstrap estimate of the Malmquist index $\widehat{M}_i(t_1, t_2)$ for each bank using the original estimators for the pseudo-sample obtained in step 2.
4. Repeat steps 2 and 3 B times (in this study, B = 2,000 times) to facilitate a set of estimates for each bank.
5. Construct the confidence intervals for the Malmquist indices accordingly.

Once the bootstrap estimates of the MPI are obtained, a multivariate regression model is employed to estimate the determinants of productivity using a regression equation of the form:

$$Y_{it} = z_i \beta_i + \varepsilon_i \qquad (5)$$

where Y is a measure of the TFP change (productivity change) of bank i in period t. z_i is the vector of observed variables explaining bank productivity, which includes macroeconomic conditions, market concentration, bank-specific factors, bank restructuring, regulatory change, bank status and ownership structure. β is the vector of parameters to be estimated and ε denotes an error term.

Result

a. The Productivity change (TFP) result

Following the procedure from Equation (1) to (4), the result is presented in Table 3. The score of TFP and its components is actually calculated for each individual sample bank in annual basis. However, due to limited space and for the sake of brevity, the result of individual bank is averaged in annual basis. Table 3 shows the annual mean of productivity change, efficiency change and technology change for each year from 1993 to 2011. The estimation for productivity change is intended to cover the period before the crisis to examine the evolution of productivity change in Indonesian banking sector although the focus is mainly during the restructuring period. The results show that the productivity of Indonesian banks has exhibited a slight progress (0.9%) in TFP based on the mean over the considered period. Both components contribute positively to the TFP index, with the technological component shown to be slightly higher (0.46%) than the efficiency change (0.43%). These results suggest that productivity growth largely results from the frontier shift rather than from catching up. This result is in line with the findings of Omar et al. (2007) of a positive contribution of technological change to improvement in TFP. By contrast, Hadad et al. (2008), employing the DEA-Malmquist index, discovered that technological change drives TFP downwards.

Table 3. Annual Mean of TFP, Efficiency and Technological Change

Years	TFP	Efficiency Change (EC)	Technological Change (TC)	Pure Efficiency (PE)	Scale Efficiency (SE)	Pure Technology(PT)	Scale of Technology (ST)
1993-94	1.003	0.998	1.005	0.987	1.011	1.023	0.982
	(0.016)	(0.016)	(0.003)	(0.012)	(0.016)	(0.028)	(0.021)
1994-95	0.953	0.969	0.983	1.037	0.935	0.932	1.054
	(0.041)	(0.050)	(0.010)	(0.027)	(0.015)	(0.008)	(0.008)
1995-96	0.955	0.949	1.007	0.959	0.989	1.007	1.000
	(0.016)	(0.014)	(0.006)	(0.012)	(0.008)	(0.008)	(0.007)
1996-97	1.035	1.076	0.962	1.059	1.017	0.966	0.995
	(0.025)	(0.025)	(0.017)	(0.020)	(0.013)	(0.016)	(0.007)
1997-98	1.314	1.527	0.861	1.271	1.201	0.942	0.906
	(0.280)	(0.229)	(0.030)	(0.119)	(0.192)	(0.036)	(0.017)
1998-99	0.906	1.194	0.759	1.290	0.925	0.726	1.058
	(0.081)	(0.113)	(0.018)	(0.139)	(0.053)	(0.022)	(0.028)
1999-00	0.850	0.669	1.270	0.690	0.970	1.284	0.989
	(0.060)	(0.032)	(0.024)	(0.033)	(0.020)	(0.052)	(0.019)
2000-01	0.915	0.945	0.968	0.985	0.960	0.933	1.038
	(0.024)	(0.024)	(0.012)	(0.022)	(0.010)	(0.015)	(0.015)
2001-02	0.967	1.009	0.959	1.052	0.959	0.916	1.045
	(0.026)	(0.034)	(0.019)	(0.034)	(0.012)	(0.020)	(0.016)
2002-03	1.070	2.694	0.397	1.873	1.438	0.551	0.716
	(0.027)	(0.139)	(0.035)	(0.113)	(0.079)	(0.041)	(0.020)
2003-04	1.103	1.517	0.727	1.269	1.196	0.825	0.879
	(0.064)	(0.076)	(0.008)	(0.105)	(0.039)	(0.023)	(0.041)
2004-05	1.157	0.282	4.108	0.430	0.655	2.719	1.532
	(0.587)	(0.046)	(0.224)	(0.039)	(0.031)	(0.330)	(0.115)
2005-06	0.927	0.909	1.020	0.927	0.980	0.983	1.039
	(0.017)	(0.017)	(0.008)	(0.016)	(0.011)	(0.010)	(0.010)
2006-07	1.034	0.974	1.062	0.992	0.981	1.054	1.006
	(0.011)	(0.010)	(0.005)	(0.009)	(0.008)	(0.017)	(0.009)
2007-08	1.005	0.964	1.042	1.006	0.959	1.016	1.025
	(0.021)	(0.020)	(0.010)	(0.020)	(0.013)	(0.015)	(0.013)
2008-09	0.981	1.225	0.801	1.052	1.165	0.926	0.865
	(0.015)	(0.019)	(0.012)	(0.017)	(0.017)	(0.020)	(0.013)
2009-10	1.059	1.048	1.011	0.989	1.060	1.063	0.953
	(0.018)	(0.019)	(0.021)	(0.017)	(0.013)	(0.021)	(0.030)
2010-11	1.016	0.747	1.361	0.855	0.873	1.216	1.121
	(0.018)	(0.018)	(0.018)	(0.019)	(0.016)	(0.068)	(0.022)
Mean	**1.009**	**1.004**	**1.005**	**1.001**	**1.003**	**1.005**	**1.001**

Sources: Results based on MPI calculation. Note: TFP denotes total factor productivity. The standard errors are in the parentheses.

A further decomposition of efficiency change and technological change reveals that all subcomponents contribute positively to the improvement of efficiency and technological change; particularly, scale efficiency and pure technology are major drivers, respectively. The bootstrap results (presented in the appendix) shows most of the results are significant at 5%, which suggests that the changes in each component are relatively reliable. As emphasised by Simar and Wilson (1999, 471), 'as with any estimator, it is not enough to know whether the Malmquist index estimator indicates increases or decreases in productivity, but whether the indicated changes are

significant in a statistical sense'. On average, 96% of the individual bank results for TFP change are significant, ranging from 91% to 99%. The differences in the TFP scores in each bank suggest that there are factors outside the included variables that contribute to the variation. Next section will discuss the variables that potentially relate to the productivity change in Indonesia

b. Determinant of Productivity

This section presents the result of second procedure adopted in this paper which will discuss factors that possibly affect the variation in productivity. The variables are selected to represent several main aspects in Indonesian banks. This includes, including bank characteristics, macroeconomic conditions, mergers, ownership structures and market concentration. The ability of banks to cope with these factors determines their relative performance and then the performance of the industry as a whole. To estimate what determines bank productivity level, Equation (5) is used to specified as a linear function of explanatory variables as follows:

$$TFP_{it} = \alpha + \beta_1 size_{it} + \beta_2 CAR_{it} + \beta_3 NPL_{it} + \beta_4 ROA_{it} + \beta_5 HHI_t + \beta_6 GDP_t + \beta_7 inlf_t + \beta_8 BMoney_t + \beta_9 Dforex_{it} + \beta_{10} Dlisting_{it} + \beta_{11} Dmerger_{it} + \beta_{12} D\_state_i + \beta_{13} D\_PureFB_i + \beta_{14} D\_private_i + \beta_{15} D\_JVB_i + \varepsilon_{it} \quad (6)$$

where TFP_{it} is the TFP change of bank i in year t as calculated using the bootstrapping MPI estimation. $size_{it}$ is the size of bank measured by the natural log of total assets of bank i in year t. CAR_{it} NPL_{it} and ROA_{it} are the capital adequacy, non-performing loan and return on assets ratio of bank i in year t, respectively. These variables are included as bank characteristics. HHI_t is the Herfindahl index of market concentration in year t, measured as the sum of squared share for each bank of its loans to total loans. GDP_t, $inlf_t$, and $BMoney_t$ capture the macroeconomics conditions, which are annual gross national product growth, inflation measured by the annual percentage of consumer price and broad money measured by the sum of the currency outside the bank as a percentage of GDP, respectively. Bank status is represented by $Dforex_{it}$ = 1 if bank i in year t is a foreign exchange bank, otherwise zero, and $Dlisting_{it}$ =1 if bank i in year t is listed in the Indonesian stock exchange, otherwise zero. To capture the restructuring, $Dmerger_{it}$ = 1 if bank i in year t is a merged bank, otherwise zero. The ownership aspect consists of D_state_i, D_PureFB_i, $D\_private_i$, and D_JVB_i, with each represented by a dummy = 1 if, respectively, bank i is a state bank, pure foreign bank, private national bank, joint venture bank or regional development bank, otherwise zero. ε_{it} is a random error term, i = 1,..., 101, and t = 1,..., 19.

Table 4 provides regression over the period of 2000 – 2010, which includes all variables to capture the period of restructuring. As an additional regression, the period 1993 – 2010 is also included as a comparison. All models show a good explanatory power for both sample periods, and the *Wald* chi^2 tests are all statistically significant at 1%. Among the bank characteristic variables, only the ROA shows negative and strongly significant coefficients at 1%, suggesting that banks with higher profitability have lower productivity growth. This finding confirms those of other studies of Indonesian banks by Hadad et al. (2011), which showed that banks with higher profits have less productivity growth. The negative effect of profitability on productivity suggests highly profitable banks are less engaged in cutting costs through increasing productivity.

Table 4. Determinants of TFP Growth

Variable	1993-2010		2000-2010	
	Coefficient	SE	Coefficient	SE
Size	0.032	0.036	0.046	0.048
CAR	-		0.031	0.046
NPL	-		-0.267	0.638
ROA	-		-3.888***	0.916
HHI	-0.158	0.51	6.817**	3.013
GDP	-0.004	0.028	0.1	0.098
Infl	0.013	0.011	0.02	0.018
BMoney	0.008	0.013	0.044*	0.023
Dforex	-0.08	0.109	-0.048	0.146
Dlisting	0.152	0.131	0.011	0.173
Dmerger	-0.177	0.193	-0.172	0.221
D_state	0.373*	0.224	-0.185	0.296
D_PureFB	0.461***	0.161	0.623***	0.221
D_Private	0.064	0.104	0.023	0.148
D_JVB	0.156	0.151	0.098	0.214
Intercept	0.306	0.746	-6.993**	2.962
/sigma_u	0	0.077	0	0.14
/sigma_e	1.583***	0.026	1.723***	0.035
Log likelihood	-3414.19		-2378.42	
Wald chi^2	42.26***		38.73***	
Observation	1818		1212	

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

Results in Table 3 show no significant effect of bank size on productivity growth. Size has a positive impact on productivity when there are scale economies, but this may not be realised due to complexity of business, bureaucratic procedure and others (Delis, Molyneux and Pasiouras 2011). The *HHI* coefficient is only statistically significant in the restructuring period, suggesting that banks tend to experience higher productivity growth in less competitive markets. The coefficient of broad money is positive and statistically significant for the shorter sample period, which indicates that a higher amount of currency outside of the banks is associated with the higher productivity growth of banks. The DGP growth, however, is shown to be positive but not significant, which is similar to the findings of Sufian (2011) for Malaysian banks. Identical magnitude also exists in the effect of inflation.

Operating as a foreign exchange bank and/or a listing bank has no significant effect on bank productivity. To some extent, this is surprising given that such banks are able to engage in an extended operation, more diversified financial products and has other option to finance their operation. Particularly, in Indonesia these types of banks commonly known as more established, larger business operation and tend to be more advance in technology compare to its domestic counterpart.

Looking at the effect of restructuring policy, which is represented by merger, there is no evidence of the strong effect of bank mergers on productivity growth. This is contradict with the finding of Hsiao and Lin (2013) for Taiwanese banks. As mentioned earlier, the main intention of the restructuring is to drive the banking sector toward a stronger system. One of the target that been practicing by some countries, such Singapore and Malaysia, is by focusing in the few banks with

extended operation and branch. Some arguments about the effect of merger, which also possibly similar to the case of Indonesia, is that the result cannot be seen in the short run instead it appears in a long run due to time needed to consolidate the operational od the bank.

The inclusion of ownership type, exhibits various results. Pure foreign banks consistently present a very strong positively and significant statistically in both periods. This finding indicates the more foreign banks the higher productivity growth in generating revenue. This also suggest that the restructuring period drive the foreign banks to generate larger revenue. This result supports the typical findings in developing country studies, namely that foreign banks outperform their domestic counterparts. On the contrary, the existence of state banks tends to be negative although there is no meaningful power in the coefficient.

Conclusions

This paper investigates the determinants of bank productivity in Indonesian banks during restructuring period. The bootstrap Malmquist productivity index (MPI) approach is used to measure productivity growth. The findings suggest that, overall, the productivity growth of the Indonesian banking industry is positive, with growth appearing to be less volatile towards the end of the period. The source of growth is primarily through technological progress. The regression result provides evidence that the profitability ratio negatively affects productivity growth, while broad money is found to be positively related to productivity growth. There is no strong evidence that bank restructuring (merger), foreign exchange activity and listing bank are related to productivity growth. Turning to bank ownership structure, foreign banks show an important positive effect on bank productivity.

There are several suggestions for future research to explore the effect further. This include the use of more 'direct' variable such as acquisition and alternative variable to represent the restructuring. In addition, the analysis before the restructuring also worth to be explored to present a comprehensive result for policy makers. Some policy implications drawn from the finding is such as the effect of restructuring cannot be expected to be shown directly and in a short term. Other empirical findings also imply similar result. Hence, a more constructive and long-term effect of policy should be considered in the first place.

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