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Evaluating the efficiency and productivity of Vietnamese commercial banks: A data envelopment analysis and Malmquist index

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Abstract. This paper provides a new evidence on the performance of twenty Vietnamese commercial banks over the period 2007-2010. The study used Data Envelopment Analysis to analyze the efficiency and productivity change of Vietnamese commercial banks. The results show that the efficiency of Vietnam commercial banks increased from 0.7 in 2007 to 0.818 in 2010. However, the results suggest that Vietnamese banks suffer slight inefficiencies during the global financial crisis in 2008. In addition, the results show the average annual growth of the Malmquist index 8.8 percent over the study period despite having dropped by 24.9 percent in 2009. These findings can help bank managers and government to understand banks' efficiency performance and the underlying reasons of inefficiency.

Keywords: Bank efficiency, data envelopment analysis (DEA), Malmquist index, Vietnam.

1. Introduction

Over the years the intensive and continuously increasing competition in the Vietnamese banking sector has created a need to evaluate the efficiency of the commercial banks. Such evaluations are essential to both bank managers and customers who expect high-level financial profit performances. To estimate the efficiency of the banks, we can apply different methods. Analysis of financial indicators is the most popular efficiency analysis method used to assess banks' efficiency, but this method applies so many financial indicators that it has probably caused difficult for the interpretation of the results. Non-parametric frontier method - Data Envelopment Analysis (DEA) has become increasingly popular in measuring bank efficiency in the countries with developed banking systems.

This study used Data Envelopment Analysis (DEA) approach to measure the efficiency of the Vietnamese commercial banks from 2007 to 2010. The study investigates how efficient is the Vietnamese banking system and what need to be changed to improve the performance of the banking sector. Panel data of twenty Vietnamese commercial banks was used for the empirical research.

The research findings present a number of challenges, which will provide useful

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opportunities for further research in the future. They are also useful for bank management in identifying sources of inefficiency, particularly for banks failing to achieve satisfactory levels of output given the resources they have been utilizing.

The rest of the paper is structured as follows. Section 2 reviews the recent developments of the Vietnamese banking sector Section 3 discusses previous approaches to the measurement banks' efficiency. Section 4 discusses the method and data use in the study. Empirical results are presented in section 5. Section 6 offers concluding remarks of the study.

2. Recent development of the banking sector in Vietnam

The Vietnamese banking system is experiencing significant changes since Vietnam became a member of WTO in 2007. Over the last twenty years, the Vietnamese financial system and particularly the banking system have transferred from a monopoly system into a diversified system which allows all participants to compete fairly and effectively.

Over the years, the banking system in Vietnam has gradually developed with the number of banking institutions, the size of the banking sector, the amount of credits and banking services increased.

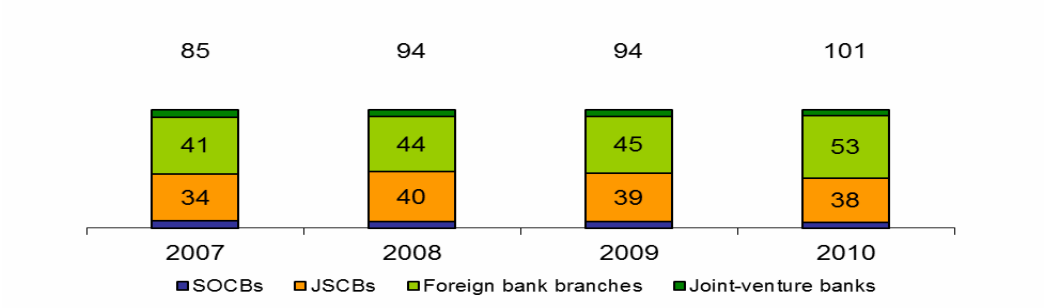

Figure 1: Number of Commercial banks in Vietnam, 2007-2010.
Source: State Bank of Vietnam, 2007-2010.

Figure 1 shows the number of banks in Vietnam over the period 2007-2010. By the end of 2010, the financial and banking system developed rapidly: the number of banking institutions in Vietnam reached 101; the credit institutions comprised of five state owned commercial banks (SOCBs); one social policy bank; 37 joint stock commercial banks (JSCBs); five joint venture banks; 48 foreign bank branches; and five 100% foreign owned banks.

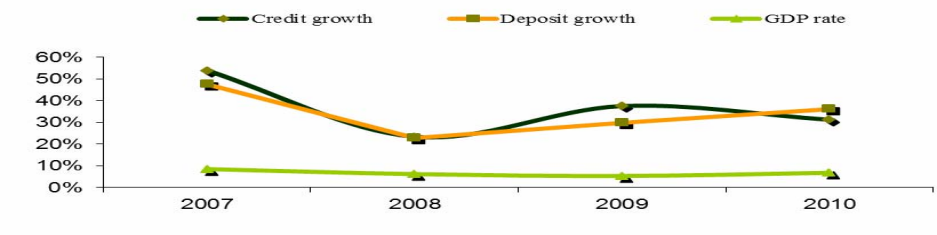

Figure 2: Credit growth, deposit growth and GDP rate, 2007-2009.
Source: State Bank of Vietnam, 2007-2010.

Figure 2 shows the credit growth in Vietnam is much higher than the growth rate of GDP and this leads to increase in liquidity risk. Credit growth averaged 36% over the period 2007-2010, while GDP growth averaged only 7.15% during the same period. If the GDP growth rate is around 7%, credit growth may reach 14-20% which may not cause the credit bubble. However, when this ratio exceeds 20% it will negatively affect the health of the economy.

The scale of Vietnamese banking sector has expanded significantly in recent years. According to the IMF (2010), the total assets of bank branches have double in the period 2007-2010, from 1,097 trillion dong (52.4 billion dollars) to 2,690 trillion dong (128.7 billion dollars). This was forecasted to rise to 3,667 trillion dongs (175.4 billion dollars) by the end of 2012.

Despite of its development in the recent years, the Vietnam banking sector is not immune from the global financial crisis which started in 2008. This posed a challenge to the banking sector in Vietnam in terms of effective performance. One of the main problems the Vietnamese banking sector especially the commercial banks is facing now is how to effectively improve their operation efficiency.

3. Literature review on measuring efficiency of commercial banks

A financial institution or a bank can be said to be efficient if it has the ability to produce a result with minimum effort or resources. It measures how close a production unit gets to its production possibility frontier, which is composed of sets of points that optimally combine inputs in order to produce one unit of output. (Kablan, 2010).

There are several methods to measure banks' efficiency. These methods can be classified into (1) traditional method of financial indices based on balance sheet analysis, (2) parametric methods based on the knowledge of production function, and (3) non-parametric methods that do not require such knowledge.

Popular approaches to measurement of efficiency are inclined to focus on simple financial ratios, but they have a number of deficiencies. Berger et al. (1997) noted that financial ratios may be misleading because they do not control for product mix or input prices.

The second approach focuses on production function or cost function of banks, in which the estimated function can be viewed as an optimal function of the banking system (Banker & Maindiratta, 1988). This parametric estimate is based on a regression model with certain confidence intervals and deviations, therefore, the parametric is statistically recognized. In their survey from 1992-1997, Berger and Humphrey (1997) reported that more than 52 percent of researchers preferred using parametric approach in measuring the efficiency of the financial institutions. However, the assumption of this estimation is often not tenable, especially when the scale of measurement (sample size) is small. In this situation, the nonparametric approach was preferred.

This study uses Data Envelopment Analysis (DEA), a non-parametric technique originally developed by Charnes Cooper & Rhodes (1978) to measure banks' efficiency. The method developed on the basis of constant returns to scale, but subsequently extended by Banker Charnes & Cooper (1984) into a model providing for variable returns to scale. It does not specify any functional form for the data, allowing it (reflected in the weights for the inputs and outputs) to be determined by the data.

This modern efficiency measurement begins with Farrell (1957) who defined a simple measure of firm efficiency which could account for multiple inputs. Farrell proposed that the efficiency of a firm consists of two components: *Technical Efficiency (TE)*, which

reflects the ability of a firm to obtain maximal output from a given set of inputs, and *Allocative Efficiency (AE)*, which reflects the ability of a firm to use the inputs in optimal proportions, given their respective prices. These two measures are then combined to provide a measure of total *economic efficiency*. Two other terms used to measure efficiency of a firm are Scale efficiency and Cost efficiency. *Scale Efficiency* (SE) is the scale of operation maximizing the ratio of the linear sum of outputs to the linear sum of inputs. *Cost Efficiency* (CE) measures the possible reductions in cost that can be achieved if a bank is technically and allocatively efficient (Elyasiani and Mehdian, 1990).

In the past few years, DEA has frequently been applied to banking industry studies. The first application analyzed efficiencies of different branches of a single bank. Sherman and Gold (1985) studied the overall efficiency of 14 branches of a U.S. savings bank. The DEA results showed that six branches were operating inefficiently compared to the others. A similar study by Parkan (1987) suggested that eleven branches out of thirty-five were relatively inefficient.

In addition to the heavy concentration on the U.S, DEA has fast become a popular method to assess the efficiency of financial institutions in other nations. Fukuyama (1993, 1995) was among the early researchers among Asian countries to employ DEA to investigate banking efficiency. Fukuyama (1993) considered the efficiency of 143 Japanese banks in 1990. He found that the pure technical efficiency averaged around 0.86 and scale efficiency around 0.98 implying that the major source of overall technical inefficiency is purely technical inefficiency. Xiaogang Chen (2005) examines the cost, technical and allocative efficiency of 43 Chinese banks over the period 1993 to 2000. Results show that the large state-owned banks and smaller banks are more efficient than medium sized Chinese banks. In addition, technical efficiency consistently dominates the allocative efficiency of Chinese banks.

In Vietnam, there are some researchers who have studied the liberalization process of the Vietnamese financial system as well as the banking sector (Le, 2006; Ngo, 2004, 2009a) such as measuring the efficiency of the Vietnamese commercial banks (Ngo, 2010b; Nguyen, 2007), using bootstrapping technique to improve the Malmquist productivity index for these banks (Nguyen & DeBorger, 2008).

Nguyen (2007) conducted a research on 13 commercial banks in Vietnam for the period 2001-2003. The study focused on the efficiency performance of 13 Vietnamese commercial banks in terms of efficiency change, productivity growth, and technological change. The author found that these banks were inefficient in both allocative (regulatory) and technical (managerial capacity), of which the technical inefficiency was more imminent (Nguyen, 2007).

Recently, Ngo (2010) evaluates the efficiency of 22 Vietnamese commercial banks in 2008. This research comes to a conclusion that the average of the efficiency scores of these banks is close to optimal score, which means they are producing close to the frontier. X. Q. Nguyen & DeBorger (2008) studies the efficiency and productivity change of a sample of Vietnamese commercial banks for the period 2003-2006, using a Malmquist index approach. It is found that the productivity of Vietnamese banks tended to decrease over the small sample period, except for the year 2005.

4. Method, data and definitions of variables

4.1. Data envelopment analysis (DEA) and the malmquist index

DEA is a linear programming technique for examining how a particular decision making unit (DMU, or bank in this study) operates relative to the other banks in the sample. The technique creates a frontier set by efficient

banks and compares it with inefficient banks to produce efficiency scores. Furthermore, banks bordered between zero and one scores with completely efficient bank have an efficiency score of one.

The basic or multiplier form of the DEA in the constant returns to scale version, can be expressed as a requirement to maximize efficiency, for output weights u and input weights v, for i inputs x and j outputs y (with u and v indicate vectors). If we set the weighted sum of inputs as 1, a bank can maximize its efficiency by solving the following equation:

$$\max_{uv} (\mathbf{u}y_j) \quad (1)$$

$$\text{st} \quad \mathbf{v}x_i = 1$$

$$\mathbf{u}y_j - \mathbf{v}x_i \leq 0$$

$$u, v > 0$$

Because DEA assesses the efficiency by comparing a financial institution's efficiency with those of others, each inefficient financial institution will have a group of efficient institutions against which its performance is identified as inefficient. This group of efficient institutions is then described as being the reference set for that inefficient institution. This is the basis for arguing that DEA provides an operational approach to measurement of efficiency, in that it more directly identifies ways in which inefficiency can be reduced.

DEA can be used to derive measures of scale efficiency by using the variable returns to scale. Coelli et al (1998) note that variable returns to scale models have been most commonly used since the beginning of the 1990s. As Dyson et al (2001) note, if a variable returns to scale model is used, small and large units will tend to be over-rated in the efficiency assessment. This means that scale inefficiencies identified for such institutions may be spurious, with the actual cause of inefficiency. If a constant return to scale model shows a DMU as inefficient, it may be difficult to ascertain whether the source of that inefficiency is scale or technical inefficiency.

The Malmquist productivity index can be used to identify productivity differences between two firms or one firm over two-time periods. To estimate technical efficiency changes and technological changes over the period in question, we used a decomposed Malmquist productivity index based on ratios of output distance functions.

Fare et al (1994) specifies an output-based Malmquist productivity change index as:

$$m_0(x^{t+1}, y^{t+1}, x^t, y^t) = \sqrt{\left(\left[\frac{D_0^t(x^{t+1}, y^{t+1}}{D_0^t(x^t, y^t)} \right] \middle| \frac{D_0^{t+1}(x^{t+1}, y^{t+1}}{D_0^{t+1}(x^t, y^t)} \right)} \quad (2)$$

Therefore, we have equation of technological efficiency (TE):

$$TE = \frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^t(x^t, y^t)} \quad (3)$$

And technical change (TC) is calculated as:

$$TC = \sqrt{\left(\left[\frac{D_0^t(x^{t+1}, y^{t+1}}{D_0^{t+1}(x^{t+1}, y^{t+1})} \right] \middle| \frac{D_0^t(x^t, y^t}{D_0^{t+1}(x^t, y^t)} \right)}$$

In each of the equation above, a value greater than one indicates an improvement and a value smaller than one presents deteriorations in performance over time. If productivity increases, it implies that the Malmquist index is greater than 1. Productivity decreases in association with the Malmquist index lower than 1. In addition, the increase in each division

of the Malmquist index will lead to the value of the parts if it is greater than 1. By definition, the product of efficiency and technical change will equal to the Malmquist index, and these components can change in opposite directions.

4.2. Descriptions of data and variables

The panel data set is extracted from non-consolidated income statements and balance sheets of twenty Vietnamese commercial banks during the period of 2007-2010. The twenty Vietnamese commercial banks sampled include three State-owned banks (SOCB), and seventeen joint-stock commercial banks (JSCB). Most of the banks that the author can not get data for are joint-venture banks and small banks. Indeed, the time period 2007-2010 was specifically chosen to study the impacts of the recent financial crisis on the efficiency of Vietnamese banks.

In measuring the technical efficiency and productivity of banks, the most difficult problem is how outputs and inputs of banking activities should be defined. In the banking literature, such as Berger and Humphrey (1997), there are two main approaches to measure the flow of services provided by financial institutions: the production and intermediation approaches.

The input and output definition used in this study is a variation of the intermediation approach, which was originally developed by Sealey and Lindley (1977). The intermediation approach assumes that financial firms act as an intermediary between savers and investors. It may be more appropriate for evaluation of the entire financial institution because this approach is inclusive of interest expenses, which often accounts for one-haft to two-thirds of the bank's total costs. Further, the intermediation approach may be superior for evaluating the importance of frontier efficiency of the financial institution, since minimization of total costs, not just production costs, is needed to maximize profits.

Following Drake (2003), Sathye (2001), and Fukuyama (1993, 1995) among others, the intermediation approach or asset approach to define bank inputs and outputs would be adopted. Based on available data sources and previous studies (Denizer and Dinc (2000), Matthews and Tripe (2002), and Nguyen (2007) as well as the actual operation of commercial banks, this study chooses two outputs and three inputs (Table 1) Specifically, outputs in this study are defined to include *interest and similar income* and *non-interest income* which relates to income from fees and commission, income from dealing with foreign currencies and gold, and income from investments or securities. These items represent important earning assets of the commercial banks. To produce these outputs, this study assumes banks use three kinds of inputs: *labor, fixed assets,* and *deposit from customers*. The labor input is simply measured as the number of employees. Fixed assets serves as a proxy for a more refined capital input: they are defined as the book value of fixed assets on balance sheets. Finally, deposits from customers are an important input of commercial banks.

Table 1: Outputs and Inputs of commercial banks in the study.

Output	Input
y1: Interest income	*x1*: Labor expenses (Labor)
y2: Non-interest income	*x2*: Fixed assets (Capital)
	x3: Savings deposits (Deposits)

5. Empirical results

Table 2 reports the summary statistics for the variables used in the models to estimate the efficiency measure. The statistics are calculated from yearly data in which all variables are expressed in VND million. From the data in Table 2, it is evident that commercial banks in

Vietnam are very much diversified in size and activity. Three inputs tend to increase over time, particularly the Savings deposits rises strongly between 2009 and 2010. This may be due to improvements in technology and the growth of commercial bank system. Table 2 also shows the trend of the two outputs. We can see the bank's income is primarily from interest income and non-interest income has increased over this period but only a small proportion. Thus, it is clear that the income from credit operations remains as a high proportion of the income structure of banks. This shows the income structure of banks has not been diversified.

Table 2: Vietnamese banks summary statistics 1997-2000

	Mean	Med	Sd	Max	Min
2007					
Interest Income	3349976	1667396	4401884	15431166	395574
Non-Interest Income	752096	213495.5	1714662	7652195	56438
Labor Expenses	304413.6	103518	464593.9	1619189	31595
Physical Capital	304345.3	192824.5	305492.4	996671	47250
Saving Deposits	32531343	10345051	44715053	141589093	2804869
2008					
Interest Income	5557246	3268587	6210778	22124352	1031749
Non-Interest Income	708091.3	298271	778253.1	2549575	38627
Labor Expenses	490073.6	165234.5	749475	2947019	68380
Physical Capital	429871.9	290685	369479.3	1279280	64178
Saving Deposits	38684132	13070056	50367715	166290689	4336883
2009					
Interest Income	5188448	3548057	5313382	21183619	1015237
Non-Interest Income	884600.7	392978	1038285	3599177	75545
Labor Expenses	603824.7	223769.5	863402.2	3480790	91848
Physical Capital	525489.7	291331	490899.7	1775244	97167
Saving Deposits	48968719	22527565	56217863	188828078	8051896
2010					
Interest Income	9022319	5550310	8958951	31919188	1595968
Non-Interest Income	1239629	720138.5	1255971	4146303	113228
Labor Expenses	812736	378933.5	1078130	3928879	137121
Physical Capital	648540.9	447485.5	587000.4	2206346	126554
Saving Deposits	64783220	36787327	72421676	244700635	339560

5.1. Bank efficiency measures

Table 3 presents the average technical efficiency (TE) scores for each of the commercial banks over four year period from 2007-2010. The results suggest that the TE over the sample increases substantially in the last two sample years, and the highest value obtained for 2009 is 0.865. On average TE scores, private banks (JSCB) have greater efficiency than state-owned commercial banks SOCB (78.3% compared with 63%). This suggests that during the study period, JSCB

used their resources slightly more effectively. This may be the consequence of a number of advantages that joint-stock commercial banks had during this period. They managed risk better, and their pressure of finance crisis were less than state-owned, customers have trust in these banks; moreover, they are more competitive in raising funds, opening new branches, etc.

The average technical efficiency of the entire sample of twenty commercial banks for the study period reached 0.767 suggesting that the commercial banks in Vietnam produce the same output level each other, used 76.7% of the inputs, which implies the bank's resources were wasted at a rate of 23.3%.

Table 4 shows the average interest cost of SOCBs is about 3.5 times higher than JSCBs, and the average labor cost of SOCBs is about 9 times higher than JSCBs. Due to higher costs, SOCBs has a lower TE than JSCBs.

Table 3: Technical efficiency of commercial banks, 2007-2010

Bank's Name	**TE**				
	2007	**2008**	**2009**	**2011**	**Mean (2007-2010)**
ABB	0.606	0.644	0.753	0.702	0.676
ACB	0.434	0.622	0.924	0.820	0.700
BIDV	1.000	0.650	0.966	0.591	0.802
EIB	0.463	0.535	0.847	0.699	0.636
HBB	1.000	0.659	1.000	1.000	0.915
HDB	0.788	1.000	0.630	0.804	0.806
MB	0.677	0.565	1.000	0.775	0.754
MHB	0.811	0.848	1.000	0.644	0.826
MSB	0.987	0.664	1.000	1.000	0.913
OCB	0.627	0.574	0.724	0.767	0.673
SEAB	1.000	1.000	0.772	1.000	0.943
SGB	0.595	0.560	0.744	1.000	0.725
SHB	0.850	0.802	0.878	0.730	0.815
PNB	0.561	0.653	1.000	1.000	0.804
STB	0.334	0.611	1.000	0.717	0.666
TCB	0.504	0.796	1.000	0.748	0.762
VAB	1.000	1.000	0.787	1.000	0.947
VIB	0.466	0.545	1.000	1.000	0.753
VCB	0.707	0.492	0.874	0.822	0.724
ICB	0.591	0.498	0.394	0.541	0.506
Mean TE SOCBs	0.577	0.547	0.745	0.651	0.630
Mean TE JSCBs	0.688	0.710	0.886	0.847	0.783
Mean TE all banks	**0.700**	**0.686**	**0.865**	**0.818**	**0.767**

Source: Author's estimates based on DEA result.

Table 4: Average interest cost and labor cost of Vietnam commercial banks, 2007-2010

		2007	2008	2009	2010
Average interest cost (million VND)	**SOCBs**	916,420	1,108,250	1,385,169	1,623,859
	JSCBs	196,332	310,158	240,014	476,426
Average labor cost (million VND)	**SOCBs**	1,269,856	2,042,702	2,419,417	3,191,562
	JSCBs	134,041	216,080	283,426	392,943

Source: Author's estimates based on banks' Annual Reports.

Table 5: Summary of estimated efficiency measures, 2007-2010

Year	ALL OBS	Mean	Std. Dev	Max	Min	Obs
	TE	0.700	0.217	1.000	0.334	20
	PE	0.806	0.201	1.000	0.468	20
2007	**SE**	0.867	0.139	1.000	0.592	20
	AE	0.784	0.163005	1.000	0.373	20
	CE	0.548	0.21852	1.000	0.254	20
	TE	0.686	0.166	1.000	0.492	20
	PE	0.871	0.138	1.000	0.665	20
2008	**SE**	0.794	0.161	1.000	0.492	20
	AE	0.81	0.18289	1.000	0.383	20
	CE	0.565	0.218655	1.000	0.191	20
	TE	0.865	0.162	1.000	0.394	20
	PE	0.963	0.101	1.000	0.586	20
2009	**SE**	0.894	0.126	1.000	0.63	20
	AE	0.81	0.164	1.000	0.384	20
	CE	0.701	0.203	1.000	0.307	20
	TE	0.818	0.153	1.000	0.541	20
	PE	0.943	0.115	1.000	0.644	20
2010	**SE**	0.873	0.149	1.000	0.541	20
	AE	0.825	0.159	1.000	0.471	20
	CE	0.683	0.220	1.000	0.361	20
	TE	0.767	0.112	0.947	0.506	20
	PE	0.900	0.0441	1.000	0.468	20
MEAN 2007-2010	**SE**	0.857	0.015	1.000	0.492	20
	AE	0.807	0.011	1.000	0.373	20
	CE	0.624	0.008	1.000	0.191	20

Note: CE = cost efficiency; AE = allocative efficiency; TE = technical efficiency; PE = pure technical efficiency; and SE = scale efficiency.

Source: Author's estimates based on DEA result.

Table 5 presents the mean score of TE, PE, SE, AE and CE of the twenty Vietnamese banks. In general, these efficiency scores were on an upward trend during the study period. The CE for the banks was 54.8 percent in 2007, 56.5 percent in 2008, 70.1 percent in 2009, and 68.3 percent in 2010. However, it is interesting to note that Vietnam banking industry experienced slight inefficiencies in 2007 and 2008 (0.548 and 0.565, respectively) compared to 2009 and 2010 (70.1 and 68.3 respectively). This is because of the global financial crisis which broke out in 2008.

In addition, the mean TE (at 0.767) was lower than the mean AE (at 0.807) which implies the main source of cost inefficiencies in

the Vietnamese banks was most likely attributable to managerial capacity and much less to regulatory problems of the studied banks. The mean score of the SE for Vietnamese banks (at 0.857) was slightly lower than the PE (at 0.900) over the study period. This result suggests that technical efficiency might be attributable to pure technical efficiency rather than scale efficiency.

Table 6 summarizes the results of the commercial banks in Vietnam operating with decreasing returns to scale, increasing returns to scale, and constant return to scale. In 2010, four out of 20 banks exhibited increasing returns to scale, eight produced on the efficient frontier, and other eight banks exhibited decreased returns to scale. The result indicates a number of banks that had constant returns to scale rise over the years. Thus, if these banks continued to increase their performance scale up, this would lead to an increase of overall efficiency.

Table 6: Number of banks with DRS, IRS, and Cons, 2007-2010

	2007	**2008**	**2009**	**2010**
DRS	6	10	4	8
IRS	10	7	8	4
CONS	4	3	8	8
Total	20	20	20	20

Source: Author's estimates based on DEA result.

5.2. Malmquist index result

Table 7 and 8 summarizes the geometric average productivity indices, listing the Malmquist index or productivity change results (tfpch) and its components, corresponding to efficiency change (effch) and technological change (techch), for twenty Vietnamese commercial banks in each year analyzed. The Malmquist multifactor productivity index improved by 8.8 percent for the four-year period. This positive change was due to both efficiency change, increased by 6.4 percent, and technological change, increased by 2.2 percent. All indices indicate growth during the period 2007-2010 except the Malmquist TFP index from 2008-2009. Multifactor productivity also significantly dropped to 75.1 percent in the period 2008-2009. The main cause of this decrease was that the technological change index was only 59.7 percent. In fact, the efficiency change increased 26.6 percent in the same period.

In addition, the technological change increased from 0.593 in 2009 to 1.499 in 2010. The growth of Malmquist Index in 2010 was 1.424, meaning that there was an increase in TFP by 42.4 percent. This total factor productivity improvement was attributable to technological change than to efficiency change. Indeed, in 2010, the innovation in Vietnam banking technology improved and the technological progress was satisfactory.

Table 7: Malmquist index summary of annual means

Year	**effch**	**techch**	**pech**	**sech**	**tfpch**
2008	1.002	1.200	1.058	0.948	1.203
2009	1.266	0.593	1.125	1.125	0.751
2010	0.95	1.499	0.98	0.97	1.424
Mean	**1.064**	**1.022**	**1.053**	**1.011**	**1.088**

Note: effch = efficiency change; techch = technical or technological change; pech = pure technical efficiency change; sech = scale efficiency change; and tfpch = total factor productivity change

Table 8: Summary of malmquist index components of individual banks

Bank	**Malmquist TFP Index**			**Technological change**			**Efficiency change**		
ID	***2008***	***2009***	***2010***	***2008***	***2009***	***2010***	***2008***	***2009***	***2010***
1	1.334	0.678	1.111	1.256	0.579	1.191	1.063	1.17	0.933
2	1.758	0.857	1.14	1.229	0.576	1.285	1.431	1.487	0.888
3	0.563	1.075	0.868	0.867	0.724	1.418	0.65	1.485	0.612
4	1.382	0.944	1.073	1.196	0.596	1.301	1.156	1.584	0.825
5	0.917	0.797	1.288	1.392	0.525	1.288	0.659	1.518	1
6	1.623	0.314	1.435	1.279	0.499	1.124	1.268	0.63	1.277
7	0.879	1.207	0.96	1.053	0.682	1.239	0.835	1.77	0.775
8	1.456	0.759	0.857	1.393	0.644	1.331	1.045	1.18	0.644
9	1.349	1.066	1.427	2.004	0.709	1.427	0.673	1.505	1
10	1.275	0.724	1.288	1.393	0.574	1.216	0.916	1.261	1.059
11	1.505	0.368	1.169	1.505	0.476	0.924	1	0.772	1.296
12	1.25	0.752	2.309	1.329	0.566	1.717	0.94	1.329	1.344
13	0.766	0.702	1.168	0.812	0.642	1.403	0.943	1.094	0.832
14	1.291	0.884	1.264	1.109	0.577	1.264	1.164	1.532	1
15	2.434	0.844	1.229	1.328	0.516	1.716	1.832	1.636	0.717
16	1.704	0.761	1.031	1.08	0.606	1.378	1.577	1.257	0.748
17	0.673	0.439	2.302	0.673	0.557	1.812	1	0.787	1.27
18	1.666	1.1	1.296	1.423	0.6	1.296	1.171	1.833	1
19	0.718	1.363	1.188	1.033	0.766	1.264	0.696	1.778	0.94
20	1.089	0.429	1.995	1.294	0.541	1.456	0.842	0.793	1.37
Mean	**1.203**	**0.751**	**1.424**	**1.2**	**0.593**	**1.499**	**1.002**	**1.266**	**0.95**

Source: Author's estimates based on DEA result.

6. Concluding remarks

In this paper, the efficiency measures and productivity change are calculated by utilizing the non-parametric technique, Data Envelopment Analysis. Several conclusions have emerged. Firstly, the results indicated that the banks' efficiency average was around 0.7 in 2007, 0.686 in 2008, 0.865 in 2009 and 0.818 in 2010. In addition, joint-stock commercial banks have an efficiency greater than the state-owned commercial banks (78.3% compared with 63%) over the sample period. The overall efficiency (0.767) results suggest that inefficiency across twenty Vietnamese commercial banks is over 30 percent. Secondly, the study suggests that technical efficiency might be attributable to pure technical efficiency rather than scale efficiency because the mean PE (at 0.9) is higher than SE (at 0.857). Similarly, Vietnamese banks in the sample suffered from the global financial crisis in 2007-2008 but performed very well thereafter.

Finally, the study analyzed the changes in total factor productivity (TFP) among the sampled banks. The findings indicate that the average annual growth of the Malmquist index was positive (8.8%) over the study period. The findings can help the Vietnam government to establish suitable policies to improve banks' efficiency in the right direction. As for bank managers, this study can help them to understand the underlying reasons for their banks' efficiency and how to improve it efficiently.

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Đánh giá hiệu quả của các Ngân hàng Thương mại Việt Nam bằng phương pháp phân tích bao dữ liệu và chỉ số Malmquist

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Tóm tắt. Bài viết tập trung đánh giá hiệu quả sử dụng nguồn lực của 20 ngân hàng thương mại giai đoạn 2007-2010. Tác giả dựa trên phương pháp phân tích bao dữ liệu để đo lường hiệu quả kỹ thuật và chỉ số Malmquist của các ngân hàng thương mại. Kết quả cho thấy hiệu quả kỹ thuật của các ngân hàng thương mại tăng từ 0,7 năm 2007 đến 0,818 năm 2010. Tuy nhiên, các ngân hàng thương mại hoạt động vẫn chưa hiệu quả trong giai đoạn khủng hoảng tài chính toàn cầu năm 2008. Nghiên cứu cũng cho thấy chỉ số Malmquist tăng 8,8% trung bình mỗi năm, mặc dù có sự sụt giảm trong năm 2009. Kết quả này giúp cho nhà hoạch định chính sách cũng như nhà quản lý ngân hàng biết được tình hình hoạt động của ngân hàng và những lý do ngân hàng hoạt động chưa hiệu quả, từ đó nỗ lực cải thiện hiệu quả sử dụng nguồn lực của các ngân hàng thương mại.