

A Comparative Analysis of the Productivity of Islamic Banking in Indonesia, Malaysia and Brunei Darussalam during the period 2012–2017

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The development of Islamic banks has occurred very rapidly in the Association of Southeast Asian Nations (ASEAN), such as Indonesia, Malaysia and Brunei Darussalam. The comparison among the three countries is very important, as are the operational considerations and consideration of State institutions. Efficiency and productivity are two of the performance indicators of banking. A comparison of the productivity of the banking between these countries would be helpful to identify the successes and failures of the policy bank. The method used in this study is the Malmquist Index. The Malmquist Index is an index used to compare bilateral production technology of the two elements of the economy. In this case, the index consists of several results, including efficiency change, technological change, pure efficiency change, economic change and the scale of the TFP change. The Malmquist Index is a measure of TFP changes from time to time and describes the company's performance during a certain period. The stages of development in this research comprised the collection of data from the Syariah banks in Indonesia, Malaysia and Brunei Darussalam, during the period of 2012–2017 and processing the data using the method of the Malmquist Productivity Index (MPI).

Keywords: *Islamic Bank, Southeast Asia, Productivity, Malmquist Productivity Index.*

Introduction

The development of Islamic banking in the world has increased rapidly. Based on data of the Islamic Financial Services Board (IFSB), the total global Islamic banking industry assets grew by eight per cent from USD 1.573 billion in the first quarter of 2017 to 1.699 billion USD in the first quarter of the year 2018 (IFSB, 2018). Islamic banking is highly developed in particular countries with a Muslim majority, such as in the Association of Southeast Asian Nations (ASEAN), namely Indonesia, Malaysia, and Brunei Darussalam. Up until the year 2017, the number of Public Sharia Banks in Indonesia totalled 13 (data Otoritas Jasa Keuangan), 27 in Malaysia (data Bank Negara Malaysia) and two in Brunei Darussalam.

Indonesia's Islamic banking industry continued to show a strong growth in assets, financing, and third-party funds. The whole Islamic banking industry performance indicators increased (Otoritas Jasa Keuangan, 2017). The total assets of Islamic banking in Indonesia in 2017 was IDR 18.97 trillion or rose 435.02 per cent. The total financing channelled through Islamic banking in 2017 was IDR 291.18 trillion or rose 15.23 per cent. Meanwhile, the total third-party funds of the Islamic banking industry was IDR 341.70 trillion or rose 19.83 per cent (Otoritas Jasa Keuangan, 2017).

The development of Islamic banking, which continued to show positive trends, also occurred in Malaysia. Malaysia is a country with total assets of Islamic banking that are the second highest in the world (Standard & Poor, 2018). Malaysia's Islamic banking industry has grown significantly over the last decade. The positive performance was demonstrated by an increase in deposits and investments in Shariah-compliant banking. Malaysia amounted to 11.7 per cent in 2017. From a market share of just 5.3 per cent in the year 2000, Malaysian Islamic banking is now capable of mastering 34.9 per cent of the banking industry in Malaysia (Bank Negara Malaysia, 2017).

By the year 2017, the Brunei Darussalam Islamic banking industry showed negative trends, with a decrease in overall assets of 2.6 per cent, a decrease of third-party funds amounting to 1.6 per cent, and a decrease in the corporate sector's financing amounting to 7.8 per cent (Autoriti Monetari Brunei Darussalam, 2017). Even so, the biggest financial institution in Brunei Darussalam, the Bank Islam Brunei Darussalam (BIBD), successfully recorded the highest profit in its history, amounting to \$169 million in 2017. The highest profit of the BIBD was obtained after the negative growth experienced by the BIBD for four years in a row.

Although the system of Islamic banking and finance has increased rapidly in the last few years, many studies highlight the level of efficiency of the financial institution, where the efficiencies are used as indicators to measure the performance of the bank (Mochtar etc,

2008). Behind the increasing public attention on the Shariah banking sector, a number of earlier research studies show that the Islamic banking industry is still less efficient than conventional banking (Beck, dkk., 2013 dan Ariss, 2010). This is due to the research, that has been done up to this point in the Islamic banking sector, is generally focussed on theoretical issues and empirical work, mainly relying on statistical or descriptive analysis rather than a strict statistical estimation (El-Gamal dan Inanoglu, 2004). Although the rivalry between Islamic banks and conventional banks is not at significant levels in the current moment, Islamic banking has its own characteristic among the community. Therefore, the study of the level of productivity of the Islamic banking sector has become an important part of the literature of banking.

On the other hand, Bahrini (2015) concluded that after the onset of the global financial crisis in 2007–2008, it boosted worldwide attention towards Islamic banking which was assessed as being more stable than conventional banking. This led Islamic financial institutions to become of interest to non-Muslim investors. Based on this, the topics surrounding the factors that affect performance are important to many people.

The Malmquist Productivity Index (MPI) or Malmquist Index is a part of the DEA method that specifically looks at the productivity level of each business unit, so that changes in the level of efficiency and technology will be seen based on predetermined inputs and outputs. The Malmquist index is also used to analyse performance changes over time (Bahrini, 2015). Based on the study of Bahrini (2015), regarding the importance of comparing productivity among countries and at least those who research productivity, this study intends to examine productivity comparisons between Indonesia, Malaysia and Brunei Darussalam. The purpose of this study was to determine productivity changes in all three countries using the Malmquist Index through the elements of efficiency change, technological change, pure efficiency change, economic scale change and TFP change.

Based on the background of the previous research, the formulation of this study is whether there are differences in the productivity of Islamic banks in Asian countries, namely Indonesia, Malaysia and Brunei Darussalam. Furthermore, it is accompanied by an analysis of the dominant and minority Malmquist Index elements that affect banking productivity.

Literature Review

Islamic banks have operations that are different from conventional ones, according to Arif (2007), the performance of Islamic banking shows an intermediary function that does not obtain interest payments at the beginning. On the other hand, Sharia banking services are similar to conventional banks but without transactions with interest payments at the

beginning. Sharia banking forbids interest and is replaced by the principle of profit sharing for parties who transact based on the risks that occur.

Efficiency and productivity are important things to consider for Islamic banks. Several studies discuss efficiency, but there are still a few that discuss the productivity of Islamic banks. Despite the rapid growth of interest in the Islamic banking and financial industry, the analysis of Islamic banking at the cross-country level is still in its infancy (Noor & Ahmad, 2012). Literature in existing studies can be classified into two groups. The first study group included evaluating the efficiency of Islamic banks based on geographical factors. The second group of studies included a comparative analysis of the level of efficiency between Islamic banks and/or conventional banks (Rosman et al., 2014).

Beck et al. (2013) compared the business model, efficiency, asset quality, and stability of both Islamic and conventional banks during the period 1995–2009. Data included 510 banks in 22 countries, including 88 Islamic banks. Using various indicators built from the balance sheet and income statement data, the contribution of this paper is consistent with Hasan and Dridi's (2010) study. It confirms that Islamic banks are less cost effective but better at stock performance than those Islamic banks registered during the crisis, also because of their higher capitalisation and better asset quality.

Several research studies that apply the measurement of banking productivity with the value of TFP changes were carried out by Yaumidin (2007), Saad et al. (2010), Raphael (2013), and Yildirim (2015). Yaumidin (2007) tried to compare the efficiency level of Islamic banks in the Middle East and Southeast Asia regions. This is based on bank failures which then have an impact on the financial crisis, both domestic and international. Overall, the calculation results show that Islamic banks in Southeast Asia are slightly more efficient compared to Islamic banks in the Middle East. One of the reasons was the tragedy of 11 September 2001 (9/11) and the Iraq war of 2002. Likewise, the value of TFP changes.

Saad et al. (2010) examined the efficiency of selected conventional and Islamic unit trust companies in Malaysia during the 2002–2005 period. Overall, the efficiency of Sharia unit trust companies is comparable to conventional unit trusts, and at a certain time, some Sharia unit trusts are found to be above the average in TFP. During the analysis period, the average Malaysian unit trust experienced a TFP decline; the main reason was due to a decrease in technical efficiency. However, changes in efficiency contribute positively to TFP.

Meanwhile, Raphael (2013) tried to measure changes in the productivity of commercial banks in Tanzania for seven years. As a result, in general, the majority of commercial banks in Tanzania have increased EFFCH productivity by 67 per cent, TECH by 83 per cent, PECH

by 67 per cent and SECH by 50 per cent. One of the most important recommendations is that small size banks need to invest in IT to increase their level of efficiency and productivity.

Several studies have used the Malmquist Index to examine changes in banking productivity, such as those by Raphael (2013), Yildirim (2015), and Bahrini (2015). This study measures changes in banking productivity and compares them between Islamic banks and conventional banks and compares the influence of banking specific factors on changes in the productivity of Islamic and conventional banking.

Research on the productivity of Islamic banks was also carried out by Anwar (2017). This study aims to examine the productivity level of Islamic banks, especially in selected Southeast Asian countries, namely Brunei, Indonesia and Malaysia, from 2006 to 2014. The results of this study indicate that the capitalisation, liquidity and determinants of the world financial crisis significantly affect the level of the productivity of Islamic banks operating in Brunei, Indonesia and Malaysia during the period under study. The results also show that Islamic banks owned by foreigners have been small.

Methodology

The Malmquist Index was first made by Sten Malmquist in 1953 to measure productivity, which was later developed by Caves et al. (1982) to calculate and analyse the rate of change in total factor productivity (TFPCH) and its components using the Malmquist TFP Index.

The measurement of productivity changes or Total Factor Productivity Change (TFPC) by using the entire output of production with the overall production input in the whole period is more effective than making measurements based solely on one period of input variables and one period of the output variable. Flokou (2017) explains that measuring changes in productivity and decomposition (technical efficiency change, scale efficiency change, and technological change) can use the Malmquist Index introduced by Caves et al. (1982). The Malmquist Index calculation is based on the publication of Fare et al. (1994), which is a non-parametric approach so that it can accommodate multi-input and multi-output research without determining the objective function first (Coelli et al., 2005: 85).

The Malmquist Index is a measure of TFP changes over time, describing the overall performance of a company over a period of time. One limitation of using the Malmquist TFP approach is that it is sensitive to market conditions, so that the downward return period is associated with a decrease in productivity (Caves et.al, 1982).

There are two approaches to measuring changes in productivity. First, using the econometric method, and providing estimates of production functions, cost functions or revenue functions.

The second approach uses index numbers, which use non-parametric methods. It consists of three methods, namely the Malmquist Index (1953), Fisher Index (1992), and Tornqvist Index (1936). The Malmquist Index has several advantages over the other two methods. According to Grifell Tatje and Lovell (1996), the Malmquist Index does not require the assumption of profit maximisation or cost minimisation. Additionally, the Malmquist Index is the most suitable method when input and output, and price information is not available. Finally, if panel data is available, productivity changes can be broken down on technical efficiency changes (also called the Catching Up Index) and technical changes.

There are two Malmquist productivity index models, developed by Caves et al. (in Bjurek, 1996). The first is the 'Malmquist input quantity index' and the second is the 'Malmquist output quantity index'. The Malmquist quantity index input is used to measure a production unit, at the time of observation t and $t + 1$, for technology references in periods k , $k = t$ and $t + 1$. The Malmquist input quantity index only measures changes in input quantity observed between time t and $t + 1$, where:

$$MI_k(y_k, x_t, x_{t+1}) = \frac{E_k^I(y_k, x_t)}{E_k^I(y_k, x_{t+1})}, \quad k = t, t + 1 \quad (1)$$

Furthermore, for Malmquist output quantity index is used to measure a production unit, at the time of observation t and $t + 1$, for technology references in periods k , $k = t$ and $t + 1$. This Malmquist output quantity index only measures changes in output quantity observed between time t and $t + 1$, where:

$$MO_k(y_t, y_{t+1}, x_k) = \frac{E_k^O(y_{t+1}, x_k)}{E_k^O(y_t, x_k)}, \quad k = t, t + 1 \quad (2)$$

Bjurek (1996) introduced a new definition of the Malmquist productivity index for production units between t and $t + 1$ based on the level of technology at time k , $k = t$ and $k = t + 1$, following the tradition of most productivity indices. Adjusting to the Tornqvist productivity index, the index built is a ratio between an output index and an input index:

$$MTFP_k = \frac{MO_k(y_t, y_{t+1}, x_k)}{MI_k(y_k, x_t, x_{t+1})} = \frac{E_k^O(y_{t+1}, x_k)/E_k^O(y_t, x_k)}{E_k^I(y_k, x_t)/E_k^I(y_k, x_{t+1})}, \quad k = t, t + 1 \quad (3)$$

The data used in this study is data from Islamic banking in Southeast Asian countries, namely Indonesia, Malaysia and Brunei Darussalam. The input and output variables used are obtained from the balance sheet and profit and loss of each bank and are based on the study of Bahrini (2015). An input variables are labour (X1), using employee salary data; fixed assets (X2) uses book value data from property, plant and equipment; and total deposit (X3) uses total third-party funds data. The Sharia banking output variables used in this study are

total loans/financing (Y1) which uses total credit and/or bank financing data; investment portfolio (Y2) which uses bank investment data; and net operating income (Y3) which uses the bank's non-business income.

Meanwhile, for stage two, the variables used to determine the effect on the total factors of Sharia banking productivity are capital adequacy bank using data on capital adequacy ratio (CAR); bank size using natural logarithm data from total bank assets; bank management quality using data ratios non-operational costs compared to total bank assets; business diversification using non-operational income data compared to total bank assets; and credit risk uses non-performing financing (NPF) data, return on equity (ROE), financing to deposit ratio (FDR), and cash ratio compared to total bank assets.

Empirical Result

The aim is to analyse the growth rate of productivity of Sharia Banks in the ASEAN by using the Malmquist Total Factor Productivity Index (MTFPI) approach. The total productivity or commonly called the Total Factor Productivity (TFP), measures the relationship between output and several inputs together. The relationship is expressed in the ratio of the output index to the aggregate input index. If the ratio increases, it means more output can be produced using a certain number of inputs, or a certain amount of output can be produced using fewer inputs.

The Malmquist Productivity Index (MPI) was first made by Sten Malmquist in 1953 to measure productivity. However, in its development, this MPI was introduced by Caves et al. (1982). There are two items that are calculated in the measurement of the Malmquist Index. Namely, the catch-up effect and the frontier shift effect. The catch-up effect measures the level of efficiency change relative to period one to period two. Meanwhile, the frontier shift effect measures the level of technological change, which is a combination of input and output from period one to period two. The effect of the frontier shift is often referred to as an innovation effect.

The MPI is a bilateral index that is used to compare the production technology of two economic elements and is based on the production function concept that measures the maximum production functions with predetermined input limits. The MPI has several beneficial characteristics. First, this index is a non-parametric method, so it does not require a specification of the form of production function. Second, MPI does not require the assumption of unit production economic behaviour, such as cost minimisation or profit maximisation. Thus, it is very useful if the objectives of the producer are different or unknown. Third, the calculation of this index does not require price of input and output data,

which is often not available. Fourth, the MTFPI can be decomposed into two components, namely Technical Efficiency Change (EFFCH) and Technological Change (TECHCH).

According to Avenzora (2008), this is very useful because analysis can be completed more specifically based on the components. A positive EFFCH (positive efficiency change) is evidence that efficiency changes are close to the frontier, while if the TECHCH is positive (positive technological change), it is known that technological change is innovation. Then, EFFCH can be decomposed into two components, namely Pure Technical Efficiency Change (PECH) and Scale Efficiency Change (SECH) (Fare et al., 1994).

The following below is the estimation of the Malmquist Productivity Index (MPI) value of the Sharia banks in the ASEAN, which is included in the observation with the average value per period.

Table 1: Productivity Index of ASEAN Islamic Banking Industry (Annual Means)

PERIOD	EFFCH	TECHCH	PECH	SECH	TFPCH
2012–2013	1.070	1.186	0.968	1.105	1.270
2013–2014	0.759	1.529	0.875	0.867	1.160
2014–2015	1.326	0.687	1.153	1.150	0.911
2015–2016	0.915	1.203	0.972	0.942	1.101
2016–2017	0.883	1.314	0.927	0.953	1.160
Mean	0.973	1.145	0.975	0.998	1.114

Table 1 above shows that throughout the duration of the study of Islamic Banks, it appears to experience an increase in the level of productivity growth. This is indicated by the increase in TFPCH to only 1.114 based on geometric mean results, caused by a TECHCH increase of 1.145. Meanwhile, from the aspect of efficiency, there is a decrease in the EFFCH index of 0.973. An enhanced TECHCH shows high levels of innovation, such as online banking, financial technology (fintech), and so on. The EFFCH index shows a decrease of 0.973, whose main source of decline is caused by a decrease in pure technical efficiency of PECH of 0.975, and a change in the level of efficiency of the SECH scale of 0.998.

Finally, the results of the research explain the occurrence in the growth of productivity of Sharia banks in the Asian Countries from 2012 to 2017. It was found to generally be caused by technological change, as described by the increase in TECHCH level in all bank periods, other than 2014–2015. This shows the importance of more innovative financial services in relation to the development of banking technology, such as infrastructure including telephone banking, mobile banking, and internet banking (Kumar & Gulati, 2008). This is in addition to the application of financial technology (fintech) in the banking industry, both in the ASEAN and Islamic banks.

Meanwhile, related to the details of each bank, the following are the estimation results of the Malmquist Productivity Index (MPI) value of 28 Sharia banks in the ASEAN, which are included in the observations from 2012–2017.

Table 2: Productivity Index of ASEAN Islamic Banking Industry (Firms Mean)

BANK	EFFCH T	ECHCH	PECH	SECH	TFPCH
Maybank Syariah	1.000	1.231	1.000	1.000	1.231
Panin Syariah	0.460	1.204	0.498	0.924	0.554
Victoria Syariah	1.220	1.679	1.104	1.105	2.048
Bank Jabar Banten Syariah	1.258	1.583	1.121	1.122	1.991
BCA Syariah	1.377	0.994	1.000	1.377	1.369
BTPN Syariah	0.880	1.138	0.815	1.080	1.002
Bank Muamalat Indonesia	0.754	0.786	0.821	0.918	0.592
Bank Syariah Mandiri	1.389	1.028	1.225	1.134	1.428
Bank Mega Syariah	0.974	1.140	0.992	0.982	1.110
Bukopin Syariah	1.000	1.569	1.000	1.000	1.569
BRI Syariah	1.051	1.729	1.019	1.031	1.818
BNI Syariah	1.000	1.060	1.000	1.000	1.060
Affin Islamic Bank	0.963	1.060	1.000	0.963	1.022
Al Rajhi Islamic Bank	0.587	1.420	0.842	0.697	0.833
Alliance Islamic	1.000	1.165	1.000	1.000	1.165
Bank Islam Malaysia	0.965	0.966	1.000	0.965	0.932
Bank Muamalat Malaysia	0.970	1.012	1.000	0.970	0.981
CIMB Islamic Bank	1.000	1.048	1.000	1.000	1.048
Hong Leong Islamic Bank	1.012	1.036	1.027	0.985	1.048
HSBC Amanah Malaysia	0.992	1.036	1.010	0.983	1.028
Kuwait Finance House Malaysia	0.998	1.081	1.015	0.984	1.079
Maybank Islamic Bank	1.000	1.107	1.000	1.000	1.107
MBSB Bank	0.912	1.031	1.000	0.912	0.940
OCBC Al Amin	1.000	1.039	1.000	1.000	1.039
Public Islamic Bank	1.000	1.197	1.000	1.000	1.197
RHB Islamic Bank	1.053	1.114	1.048	1.005	1.173
Standard Chartered Saadiq	1.000	1.139	1.000	1.000	1.139
Bank Islam Brunei Darussalam	0.985	1.011	1.033	0.953	0.995
mean	0.973	1.145	0.975	0.998	1.114

MPI Results per Country: Indonesia

After explaining the overall results of the productivity level of Islamic banks in the ASEAN, the following is the estimation of the Malmquist Productivity Index (MPI) value of Islamic banks in each ASEAN country included in the observation, with the average value per period. For the first, the following is the value of the TFP change in the Islamic banks in Indonesia.

Table 3: Productivity Index of Indonesian Islamic Banking (Annual Means)

PERIOD	EFFCH	TECHCH	PECH	SECH	TFPCH
2012–2013	1.147	2.419	1.023	1.121	2.774
2013–2014	0.609	1.847	0.805	0.756	1.124
2014–2015	1.625	0.421	1.110	1.465	0.685
2015–2016	0.889	1.340	0.974	0.912	1.191
2016–2017	0.817	1.621	0.910	0.897	1.324
Mean	0.962	1.325	0.959	1.003	1.275

Table 3 above shows that throughout the duration of the study of the Islamic banks in Indonesia, it appears to experience an increase in the level of productivity growth. This is indicated by the increase in TFPCH to only 1.275, based on geometric mean results and caused by an increase in TECHCH of 1.325. Meanwhile, in terms of efficiency, there was a decrease in the EFFCH index of 0.962.

An enhanced TECHCH shows high levels of innovation such as online banking, financial technology (fintech) and so on. The EFFCH index shows a decrease of 0.962, whose main source of decline was caused by a decrease in the PECH's full technical efficiency of 0.959, despite an increase in the level of efficiency of the SECH scale of 1.003.

The results of this analysis were similar to the overall results. The increase that occurred in the growth of productivity of Islamic banks in Indonesia from 2012 to 2017, was found to be generally caused by technological change, as described by the increase in the TECHCH level in all bank periods, other than 2014–2015.

Meanwhile, related to the details of each bank, the following is the estimation of the Malmquist Productivity Index (MPI) value of the 12 Islamic banks in Indonesia included in the observations from 2012–2017.

Table 4: Productivity Index of Indonesian Islamic Banking Industry (Firms Mean)

BANK	EFFCH	TECHCH	PECH	SECH	TFPCH
Maybank Syariah	1.000	1.252	1.000	1.000	1.252
Panin Syariah	0.492	1.743	0.541	0.910	0.858
Victoria Syariah	1.048	2.107	1.000	1.048	2.208
Bank Jabar Banten	1.276	1.584	1.143	1.116	2.020
BCA Syariah	1.000	1.096	1.000	1.000	1.096
BTPN Syariah	0.901	1.396	1.000	0.901	1.258
Bank Muamalat Indonesia	0.754	0.766	0.825	0.914	0.578
Bank Syariah Mandiri	1.370	1.041	1.178	1.163	1.427
Bank Mega Syariah	0.974	1.140	0.992	0.982	1.110
Bukopin Syariah	1.000	1.583	1.000	1.000	1.583
BRI Syariah	1.050	1.730	1.013	1.037	1.817
BNI Syariah	1.000	1.060	1.000	1.000	1.060
mean	0.962	1.325	0.959	1.003	1.275

MPI Results per Country: Malaysia

After explaining the productivity level of the Islamic banks in Indonesia, the following is the estimation of the Malmquist Productivity Index (MPI) value of the Islamic banks in Malaysia which are included in the observation with the average value per period.

Table 5: Productivity Index of Malaysian Islamic Banking (Annual Means)

PERIOD	EFFCH	TECHCH	PECH	SECH	TFPCH
2012–2013	1.009	1.030	0.987	1.022	1.039
2013–2014	0.907	1.113	1.004	0.903	1.009
2014–2015	1.036	1.036	1.032	1.004	1.073
2015–2016	1.028	0.990	0.997	1.031	1.018
2016–2017	0.953	1.141	0.984	0.968	1.087
Mean	0.985	1.061	1.001	0.985	1.045

Table 5 above shows that throughout the duration of the research on Sharia banks in Malaysia, it seemed to have increased levels of productivity growth. This is indicated by an increase in TFPCH worth 1.045, based on geometric mean results and caused by an increase in TECHCH of 1.061. Meanwhile, from the efficiency aspect, there was a decrease in the EFFCH index of 0.985. An enhanced TECHCH shows high levels of innovation such as online banking, financial technology (fintech) and so on. The EFFCH index shows a decrease of 0.985, whose main source of decline is due to a decrease in the SECH scale efficiency of 0.985.

Reviewing the results of this analysis, it is very interesting to note that the increase that occurred in the growth of the productivity of the Islamic banks in Indonesia from 2012 to 2017, was generally caused by technological change, as described by an increase in the TECHCH level in all bank periods. This shows the importance of more innovative financial services in relation to the development of banking technology, such as infrastructure including telephone banking, mobile banking, and internet banking (Kumar & Gulati, 2008). This is in addition to the application of financial technology (fintech) in the banking industry in Malaysia, as well as Islamic banks.

Meanwhile, related to the details of each bank, the following is the estimation of the Malmquist Productivity Index (MPI) value of 15 Islamic banks in Malaysia included in the observations from 2012-2017.

Table 6: Productivity Index of Malaysian Islamic Banking Industry (Firms Mean)

BANK	EFFCH	TECHCH	PECH	SECH	TFPCH
Affin Islamic Bank	0.963	0.997	1.000	0.963	0.960
Al Rajhi Islamic Bank	0.904	1.098	0.930	0.971	0.992
Alliance Islamic	1.000	1.114	1.000	1.000	1.114
Bank Islam Malaysia	0.960	0.960	1.000	0.960	0.921
Bank Muamalat Malaysia	0.985	0.974	1.000	0.985	0.959
CIMB Islamic Bank	1.000	1.046	1.000	1.000	1.046
Hong Leong Islamic Bank	1.014	1.030	1.027	0.987	1.044
HSBC Amanah Malaysia	0.993	1.009	1.008	0.985	1.002
Kuwait Finance House Malaysia	1.000	1.103	1.000	1.000	1.103
Maybank Islamic	1.000	1.104	1.000	1.000	1.104
MBSB Bank	0.917	1.025	1.000	0.917	0.940
OCBC Al Amin	1.000	1.040	1.000	1.000	1.040
Public Islamic Bank Malaysia	1.000	1.195	1.000	1.000	1.195
RHB Islamic Bank	1.053	1.114	1.048	1.005	1.173
Standard Chartered Saadiq	1.000	1.128	1.000	1.000	1.128
Mean	0.985	1.061	1.001	0.985	1.045

MPI Results per Country: Brunei

After explaining the productivity level of Sharia banks in Malaysia, the following is the estimation of the Malmquist Productivity Index (MPI) value of Sharia banks in Brunei which are included in the observation with the average value per period.

Table 7: Productivity Index of Brunei Islamic Banking (Annual Means)

PERIOD	EFFCH	TECHCH	PECH	SECH	TFPCH
2012–2013	1.000	1.063	1.000	1.000	1.063
2013–2014	1.000	0.979	1.000	1.000	0.979
2014–2015	1.000	0.820	1.000	1.000	0.820
2015–2016	1.000	0.937	1.000	1.000	0.937
2016–2017	1.000	1.141	1.000	1.000	1.141
Mean	1.000	0.982	1.000	1.000	0.982

Table 7 above shows that throughout the duration of the study of Sharia banks in Brunei, it appeared to experience a decrease in the level of productivity growth. This is indicated by the decrease in TFPCH to only 0.982, based on geometric mean results and caused by a TECHCH decrease of 0.982. Meanwhile, in terms of efficiency, there was a stagnation of the EFFCH index of 1.000. The decline in TECHCH shows low levels of innovation, such as online banking, financial technology (fintech) and so on. The EFFCH index shows stagnation or does not rise and does not go down with an EFFCH value of 1.000.

The results of this analysis are very interesting to note, given the decline in the growth of the productivity of Islamic banks in Brunei from 2012 to 2017. It was found to generally be caused by technological change, as illustrated by a decrease in the TECHCH level in almost all bank periods, in addition to the periods of 2012–2013 and 2016–2017. This shows the importance of more innovative financial services in relation to the development of banking technology in the banking industry in Brunei, as well as Islamic banks.

Meanwhile, related to the details of each bank, the following is the estimation of the Malmquist Productivity Index (MPI) from Sharia banks in Brunei which are included in the observations from 2012–2017.

Table 8: Productivity Index of Brunei Islamic Banking Industry (Firms Mean)

BANK	EFFCH	TECHCH	PECH	SECH	TFPCH
Bank Islam Brunei Darussalam	1.000	0.982	1.000	1.000	0.982
mean	1.000	0.982	1.000	1.000	0.982

Conclusions

Based on the data analysis, there was an increase in the productivity of Islamic banks in the ASEAN countries from 2012 to 2017. However, during the period of 2014–2015, there was a decrease in the productivity of the Islamic banks. The increase that occurred in the productivity growth of Sharia banks in the ASEAN countries from 2012 to 2017 was caused



by technological change, as illustrated by the increase in TECHCH levels in all bank periods, in addition to 2014–2015.

The most productive Sharia bank in the ASEAN region is the Victoria Syariah Bank in Indonesia, with a TFPCH score reaching 2.2. Furthermore, based on the data analysis, the most productive Malaysian Islamic bank is the Public Islamic Bank Malaysia with a TFPCH score of 1.19.

The suggestion of this research is that Islamic banking needs to improve technology in order to increase productivity. This technology improvement can be in the form of increasing digital-based services, improving customer data security systems, and implementing branchless banking. This technology improvement will encourage increased productivity of Islamic banks so that banks can operate more efficiently.

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ATTACHMENT

MALMQUIST INDEX SUMMARY (OUTPUT DEAP 2.1)

year = 2

firm	effch	techch	pech	sech	tfpch
1	1.000	1.455	1.000	1.000	1.455
2	1.000	3.734	1.000	1.000	3.734
3	1.611	1.177	1.117	1.442	1.895
4	1.180	1.401	1.060	1.114	1.654
5	0.936	1.002	0.214	4.379	0.938
6	0.442	1.213	1.000	0.442	0.537
7	1.000	1.624	1.000	1.000	1.624
8	10.005	1.070	2.761	3.624	10.706
9	1.000	1.131	1.000	1.000	1.131
10	1.000	1.945	1.000	1.000	1.945
11	0.863	1.082	0.750	1.151	0.933
12	1.000	1.291	1.000	1.000	1.291
13	0.738	0.957	0.766	0.963	0.706
14	0.972	1.112	1.037	0.938	1.081
15	1.000	1.481	1.000	1.000	1.481
16	1.283	1.310	1.000	1.283	1.680
17	1.380	0.651	1.000	1.380	0.899
18	1.000	1.008	1.000	1.000	1.008
19	1.130	1.027	1.091	1.036	1.161
20	0.915	0.969	0.885	1.034	0.886
21	0.986	1.168	1.077	0.915	1.151
22	1.000	0.979	1.000	1.000	0.979
23	1.000	1.027	1.000	1.000	1.027
24	1.000	0.804	1.000	1.000	0.804
25	1.000	1.380	1.000	1.000	1.380
26	0.964	1.056	1.033	0.934	1.018
27	1.000	0.966	1.000	1.000	0.966
28	0.793	1.153	0.914	0.867	0.915
mean	1.070	1.186	0.968	1.105	1.270



year = 3

firm	effch	techch	pech	sech	tfpch
1	1.000	15.448	1.000	1.000	15.448
2	0.370	0.226	0.459	0.806	0.083
3	1.676	5.219	1.469	1.141	8.748
4	7.050	1.951	2.086	3.381	13.753
5	0.611	1.493	0.562	1.087	0.912
6	1.009	1.388	1.000	1.009	1.401
7	1.000	1.163	1.000	1.000	1.163
8	0.077	2.496	0.231	0.335	0.193
9	0.431	2.558	1.000	0.431	1.103
10	0.313	3.007	0.552	0.567	0.940
11	0.377	4.582	1.467	0.257	1.727
12	0.284	2.634	0.286	0.992	0.748
13	0.932	1.082	1.306	0.714	1.008
14	0.831	1.287	0.795	1.045	1.070
15	0.632	0.678	0.633	0.999	0.429
16	0.504	0.808	1.000	0.504	0.407
17	0.822	1.263	1.000	0.822	1.038
18	0.816	1.165	1.000	0.816	0.950
19	1.023	1.083	1.031	0.992	1.108
20	1.186	1.178	1.186	1.000	1.396
21	1.098	1.209	1.000	1.098	1.327
22	1.000	1.189	1.000	1.000	1.189
23	0.921	1.005	1.000	0.921	0.926
24	1.000	1.188	1.000	1.000	1.188
25	1.000	1.413	1.000	1.000	1.413
26	0.877	1.335	1.028	0.853	1.170
27	1.000	1.363	1.000	1.000	1.363
28	0.827	1.162	0.690	1.199	0.960
mean	0.759	1.529	0.875	0.867	1.160



year = 4

firm	effch	techch	pech	sech	tfpch
1	1.000	0.067	1.000	1.000	0.067
2	2.706	0.480	2.180	1.241	1.298
3	1.000	1.335	1.000	1.000	1.335
4	1.000	1.747	1.000	1.000	1.747
5	4.052	0.326	3.982	1.018	1.319
6	1.958	0.789	0.497	3.944	1.545
7	1.000	0.151	1.000	1.000	0.151
8	8.514	0.278	4.330	1.967	2.363
9	0.368	0.297	0.179	2.050	0.109
10	3.198	0.382	1.813	1.764	1.221
11	2.811	0.444	0.722	3.896	1.248
12	3.523	0.259	3.496	1.008	0.913
13	0.931	1.096	1.000	0.931	1.020
14	1.061	1.058	1.223	0.867	1.122
15	1.582	1.273	1.581	1.001	2.014
16	1.234	0.933	1.000	1.234	1.151
17	0.962	0.988	1.000	0.962	0.950
18	0.954	1.035	1.000	0.954	0.987
19	0.844	1.009	0.928	0.910	0.852
20	0.766	1.061	1.000	0.766	0.813
21	0.799	1.034	1.000	0.799	0.826
22	1.000	1.244	1.000	1.000	1.244
23	0.845	1.142	1.000	0.845	0.965
24	1.000	0.895	1.000	1.000	0.895
25	1.000	1.101	1.000	1.000	1.101
26	1.089	1.071	1.123	0.969	1.166
27	1.000	1.559	1.000	1.000	1.559
28	1.499	0.722	1.736	0.863	1.083
mean	1.326	0.687	1.153	1.150	0.911



year = 5

firm	effch	techch	pech	sech	tfpch
1	1.000	1.289	1.000	1.000	1.289
2	1.000	4.319	1.000	1.000	4.319
3	1.000	0.930	1.000	1.000	0.930
4	1.000	0.670	1.000	1.000	0.670
5	2.133	3.527	2.088	1.022	7.523
6	0.763	1.306	0.748	1.019	0.996
7	0.894	0.634	0.905	0.989	0.567
8	0.722	1.613	1.000	0.722	1.165
9	0.793	2.256	1.099	0.721	1.789
10	1.000	3.003	1.000	1.000	3.003
11	1.403	1.035	1.386	1.012	1.452
12	0.152	0.957	0.238	0.641	0.146
13	1.563	0.982	1.000	1.563	1.534
14	0.339	0.996	0.820	0.414	0.338
15	1.000	1.031	1.000	1.000	1.031
16	1.105	0.907	1.000	1.105	1.003
17	0.991	0.973	1.000	0.991	0.964
18	1.246	1.081	1.000	1.246	1.347
19	0.997	0.930	1.097	0.909	0.927
20	1.061	0.863	1.000	1.061	0.915
21	0.958	0.883	1.000	0.958	0.846
22	1.000	1.330	1.000	1.000	1.330
23	0.777	1.105	1.000	0.777	0.858
24	1.000	0.980	1.000	1.000	0.980
25	1.000	1.079	1.000	1.000	1.079
26	1.103	1.052	0.945	1.168	1.160
27	1.000	1.164	1.000	1.000	1.164
28	0.754	1.247	1.036	0.727	0.940
mean	0.915	1.203	0.972	0.942	1.101



year = 6

firm	effch	techch	pech	sech	tfpch
1	1.000	1.458	1.000	1.000	1.458
2	0.021	1.449	0.031	0.675	0.030
3	1.000	1.752	1.000	1.000	1.752
4	0.378	3.108	0.800	0.472	1.174
5	1.000	0.566	1.000	1.000	0.566
6	0.793	1.102	0.968	0.819	0.873
7	0.272	1.661	0.411	0.660	0.451
8	1.086	0.960	1.000	1.086	1.042
9	6.970	0.991	4.864	1.433	6.906
10	1.000	1.418	1.000	1.000	1.418
11	1.000	6.794	1.000	1.000	6.794
12	6.560	1.585	4.202	1.561	10.399
13	0.830	1.205	1.000	0.830	1.000
14	0.239	3.821	0.511	0.467	0.913
15	1.000	1.625	1.000	1.000	1.625
16	0.952	0.937	1.000	0.952	0.892
17	0.795	1.339	1.000	0.795	1.065
18	1.031	0.962	1.000	1.031	0.992
19	1.090	1.145	1.000	1.090	1.248
20	1.090	1.145	1.000	1.090	1.248
21	1.198	1.145	1.000	1.198	1.372
22	1.000	0.864	1.000	1.000	0.864
23	1.042	0.896	1.000	1.042	0.933
24	1.000	1.450	1.000	1.000	1.450
25	1.000	1.059	1.000	1.000	1.059
26	1.273	1.082	1.122	1.135	1.378
27	1.000	0.801	1.000	1.000	0.801
28	1.250	0.874	1.039	1.203	1.093
mean	0.883	1.314	0.927	0.953	1.160



MALMQUIST INDEX SUMMARY OF ANNUAL MEANS

year	effch	techch	pech	sech	tfpch
2	1.070	1.186	0.968	1.105	1.270
3	0.759	1.529	0.875	0.867	1.160
4	1.326	0.687	1.153	1.150	0.911
5	0.915	1.203	0.972	0.942	1.101
6	0.883	1.314	0.927	0.953	1.160
mean	0.973	1.145	0.975	0.998	1.114