# Productivity of Islamic banks in Malaysia during the pre and post global financial crisis.

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## Abstract

This study aims to evaluate and distinguish the productivity change of Malaysian Islamic banks during the pre and post global financial crisis. To estimate total productivity change of Islamic banks, this study employs the Malmquist Productivity Index (MPI) method. In calculating the MPI, the study considers total deposits, personnel expenses and fixed assets as the inputs while for the outputs, the study considers loans, investment and non-interest income. The empirical findings indicated that the Islamic banks are relatively more efficient before the crisis period compared to the post crisis period. Based on decomposition of Islamic banks' productivity, the results revealed that wrong scale of operation is the factor that lead to unproductive Islamic banks during the period of observation.

***Keywords:*** Malmquist Productivity Index, Total Factor Productivity, Islamic banks

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# PRODUCTIVITY OF ISLAMIC BANKS IN MALAYSIA DURING THE PRE AND POST GLOBAL FINANCIAL CRISIS:

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**Abstract.** This study aims to evaluate and distinguish the productivity change of Malaysian Islamic banks during the pre and post global financial crisis. To estimate total productivity change of Islamic banks, this study employs the Malmquist Productivity Index (MPI) method. In calculating the MPI, the study considers total deposits, personnel expenses and fixed assets as the inputs while for the outputs, the study considers loans, investment and non-interest income. The empirical findings indicated that the Islamic banks are relatively more efficient before the crisis period compared to the post crisis period. Based on decomposition of Islamic banks' productivity, the results revealed that wrong scale of operation is the factor that lead to unproductive Islamic banks during the period of observation.

**Keywords:** Malmquist Productivity Index, Total Factor Productivity, Islamic banks

## 1. Introduction

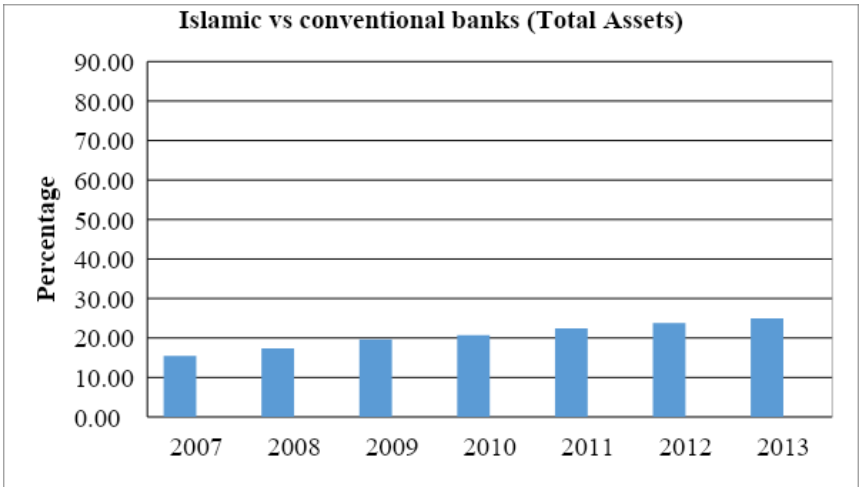
Global financial crisis refers to the period whereby the global financial markets and banking systems faced extreme stress during mid 2007 till early 2009. Although the crisis was originated from the United States, the shock of the crisis reached Malaysia between 2008 and 2009. This is evidenced by the sharp declining trend of Malaysian gross domestic product (GDP) from 6.30 percent in 2006 to 4.83 percent and -1.51 percent in the years of 2008 and 2009, respectively.

Nevertheless, in the case of Malaysia, the impact was minimal (Zainal Abidin & Rasiah, 2009) as the impact was more on trade and GDP growth crises rather than a financial crisis (Khoon & Mah-Hui, 2010, 2012). Beginning from 2010 onwards, the Malaysian economy started to pick-up in a positive trend and remained between the range of 4 and 6 percent. In the process of recovery, Malaysian banking sector, including the Islamic banking sector, has continuously support the growth of economic activities.

Despite its infancy age, the Islamic banking sector has achieved tremendous growth especially in the past global financial crisis. In Malaysia, for example, the market share of Islamic banks in term of total assets has increased from 15.5 per cent in the year 2007 to 25 per cent in the year 2013 (Figure 1). Foundation for the establishment of Islamic banking

sector in Malaysia is due to the strong effort by its government in becoming the hub for Islamic financial services (Abdul Alim, 2014).

*Figure 1: Market share (total assets) Malaysian Islamic and conventional banks from 2007 – 2013*




*Source:Financial stability and payment systems report of the Central Bank of Malaysia with author's amendment*

Although Islamic banks recorded growth during this period, it is important to highlight that from 2007 to 2009, the progress of Malaysian banking sector has been sluggish, due to the impact of global financial crisis. Data shows that percentage of Malaysian banking assets growth in 2008 is only 3.91 per cent compared to 14.74 per cent in 2007. Similar trend can be observed in terms of percentage of Malaysian banking deposits growth in 2007 which stood at 6.83 per cent compared to 16.52 per cent in 2006. Corresponding to the reduction in growth of banking asset and deposits, the percentage of loans growth have also reduced to 5.68 per cent in 2009 compared to 11.09 per cent in 2008. Furthermore, few regulatory requirements have led to changes in the financial environment. These scenarios may have impact on the productivity of the Malaysian banking institutions. This motivates the present study.

By employing the Malmquist Productivity Index method, this study provides empirical evidence on the productivity of Malaysian Islamic and conventional banks. Although studies examining the productivity of banking institutions are numerous, to the best of our knowledge, only limited number of publications can be found comparing the productivity of Malaysian Islamic and conventional banks taken into consideration the period of pre and post 2007 – 2009 global financial crisis.

## 2. Literature review

Numerous papers can be found examining bank productivity in a cross-country setting. Recent papers concerning this field have been focusing on the productivity of banks following the financial crisis. In general, these literatures suggest that banks have faced a deterioration of productivity levels during the crisis period. This can be observed in number of literature namely Kevork et al. (2017) which involves Eastern European countries, Degl'Innocenti et al. (2017) which involves 28 European Union countries, Bahrini (2015) which involves Gulf Cooperation Council (GCC) countries banks. Similar observation could be found in the literature which focus Islamic banks in Southeast Asian countries (Kamarudin, Hue, Sufian, & Anwar, 2017) and Qatar (Abdul-Wahab & Haron, 2017).

Despite declining trend of bank productivity, Nurboja & Košak (2017) which examined ten South East European Union countries revealed that banks' cost efficiency in the region has improved during the 2008 global financial crisis. This supported the study by Rosman et al. (2014) which found that Islamic banks were able to sustain operations during the crisis period. Abdul-Majid et al. (2011) revealed the possibility of increase in efficiency might be due to cost-cutting initiatives by the banking institutions.

With regards to Islamic banks, recent studies on bank productivity have put emphasize on comparing Islamic banks' productivity with the conventional banks. Abbas et al. (2015) which examined productivity change of Pakistan Islamic and conventional banking sector from 2005 to 2009 revealed that Islamic banks have higher productivity index in 2007 and 2008 compared to conventional banks. In contrast, in 2009, the index revealed that conventional banks have higher productivity change. In different study, Khan & Shah (2015) compared the productivity of Pakistan's Islamic banks, Islamic windows and conventional banks from 2007 – 2011. The study revealed that the Islamic banks have the highest productivity score. Another study by Rodoni et al. (2017) distinguished the efficiency and productivity of Islamic banks in Indonesia, Malaysia and Pakistan. The research revealed that among those three countries, Pakistan Islamic banks have the highest efficiency rate followed by Malaysia and Indonesia.

Based on the review, study that compares the productivity of Islamic banks in Malaysia during the pre and post 2007-2008 global financial crisis is missing from the literature. Therefore, our study tends to fill in this gap.

# 3. Methodology

## 3.1 Data collection

The present study gathers data on Malaysian Islamic banks from the period of 2004 – 2017. The data that are used for this study are derived from the Bankscope database. Should the database not complete, the study used the financial statement published in the website of each individual banks.

The number of observations differed across time for Islamic banks. This is due to entry of new bank during the early period of study. In total, the observation involves a sample of 15 Islamic banks. We exclude a bank which involved in merger and acquisition during the period of observation.

## 3.2 Specification of input and output

An intermediation approach that has been widely used in banking literature (Kamarudin et al., 2017; Sealey & Lindley, 1977; Sufian & Kamarudin, 2017; Wahid, 2016), is adopted in this study due to its suitability with Islamic banks play its' role as an intermediary between the depositors and the borrowers. In this study, three inputs and three outputs are used. On one hand, the inputs are total deposits (X1), personnel expenses (X2) and fixed assets (X3). The outputs, on the other hand, are loans (Y1), investment (Y2) and non-interest income (Y3).

## 3.3 Data analysis method – Malmquist Productivity Index (MPI)

This study employed Malmquist productivity index to measure the productivity changes between total outputs relative to total inputs. The selection of the MPI is due to its

advantages as highlighted by Griffel-Tatje and Lovell (1996). Firstly, the MPI eliminates the requirement for assumptions of profit maximization or cost minimization. Secondly, this index does not require inputs' price and outputs' price. Lastly, the MPI can be break down into technical efficiency change and pure technical change.

This study employs the output orientation analysis due to its suitability with the aims of banking sectors in developing countries (Casu, Girardone, & Molyneux, 2004; Jaffry, Ghulam, Pascoe, & Cox, 2007). This study measures these items, following Färe et al. (1994) and Fukuyama (1995):

1. Total factor productivity index (TFPCH)
2. Technology change index (TECHCH)
3. Technical efficiency change index (EFFCH)
4. Pure technical efficiency change index (PTECH)
5. Scale efficiency change index (SECH)

According to Färe et al. (1994), the Malmquist index can be written as:

$$M\left(x^{t+1}, y^{t+1}, x^{t}, y^{t}\right) = \frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^{t}(x^{t}, y^{t})} \times \left[\left(\frac{D_0^{t}(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^{t+1}, y^{t+1})}\right) \times \left(\frac{D_0^{t}(x^{t}, y^{t})}{D_0^{t+1}(x^{t}, y^{t})}\right)\right]^{1/2} \quad (1)$$

*M* is the productivity index between years' *t* (previous period) and *t+1* (recent time period) where recent time period production point $(x^{t+1}, y^{t+1})$ relates with the previous time period production point $(x^{t}, y^{t})$ and *D*s are functions of output distance.

The relationship between the MPI and its sub-indices can be written as:

$$M_0 = Efficiency\ Change \times Technical\ Change \quad (2)$$

where:

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

$$Technical\ Change = \left[\left(\frac{D_0^{t}(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^{t+1}, y^{t+1})}\right) \times \left(\frac{D_0^{t}(x^{t}, y^{t})}{D_0^{t+1}(x^{t}, y^{t})}\right)\right]^{1/2} \quad (4)$$

The EFFCH index can be further decomposed into PTECH $\left(\Delta PureEff^{t,t+1}\right)$ and SECH $\left(\Delta Scale^{t,t+1}\right)$. This is in accordance to the recommendation by Färe et al. (1994) as presented below:

$$Efficiency\ Change = \Delta PureEff^{t,t+1} \times \Delta Scale^{t,t+1} \quad (5)$$

where:

$$\Delta PureEff^{t,t+1} = \frac{D_{VRS}^{t+1}\left(x_j^{t+1}, y_j^{t+1}\right)}{D_{VRS}^{t}\left(x_j^{t}, y_j^{t}\right)} \quad (6)$$

$$\Delta Scale^{t,t+1} = \frac{\frac{D_{CRS}^{t+1}\left(x_j^{t+1}, y_j^{t+1}\right)}{D_{VRS}^{t+1}\left(x^{t+1}, y^{t+1}\right)}}{\frac{D_{CRS}^{t}\left(x_j^{t}, y_j^{t}\right)}{D_{VRS}^{t}\left(x_j^{t}, y_j^{t}\right)}} \quad (7)$$

Since 2004 is considered as the reference year, the MPI and its components in this year take a preliminary score of 1.000. Based on the MPI, any value that is bigger than 1.000 represents growth of total factor productivity, whereby any value smaller than 1.000 represents regress of total factor productivity between two periods. Where else, any value that is equal to 1.000 represents unchanged productivity level of a firm.

### 3.4 Research procedure

In this study, the output-oriented Malmquist productivity index is employed to measure the Islamic banks' productivity changes. The MPI will allow this study to calculate the levels of TFPCH amongst two data points by computing the distances ratio of each data point in comparison to a common technology. The indices in Malmquist productivity index evaluation are constructed on an evaluation of pre and post crisis period for Islamic banks. The VRS technology is used to calculate TFPCH(Mo) to EFFCH and TECHCH as presented in equation (2).

Subsequent to that, following Färe et al. (1994), the EFFCH is segregated into an element of PTECH and SECH based on equation (5). This allows the present study to identify the source of inefficiency for each bank. In the event PTECH is lower than the SECH, the source of inefficiency is coming from the lack of managerial efficiency. In contrast, if the SECH is lower than PTECH, the source of inefficiency would be coming from the wrong scale of operation.

## 4. Results and analysis

Table 1 highlights inputs and outputs that are used for analysis of Malmquist Productivity Index. In general, it can be observed from Table 1 that both Malaysian Islamic banks showed an upward business trend between the years 2004 – 2017. Mainly, this observation can be evidenced from the total loans and total deposits which indicate an increase from year to year. Furthermore, it is found that on average the inputs and outputs for Malaysian Islamic banks were lesser than the conventional banks.

*Table 1: Input and output for analysis of Malmquist Productivity Index*

| **2004** | **Mean** |
|---|---|
| Total loans | 5,171,898 |
| Investments | 2,502,429 |
| Non-interest income | 27,018 |
| Total deposits | 9,538,527 |
| Personnel expenses | 80,253 |
| Fixed assets | 72,517 |
| **2005** | **Mean** |
| Total loans | 3,330,875 |
| Investments | 1,452,555 |
| Non-interest income | 28,084 |
| Total deposits | 6,322,861 |
| Personnel expenses | 48,518 |
| Fixed assets | 31,851 |
| **2006** | **Mean** |

| | |
|---|---|
| Total loans | 2,437,279 |
| Investments | 876,953 |
| Non-interest income | 28,067 |
| Total deposits | 4,780,731 |
| Personnel expenses | 31,583 |
| Fixed assets | 22,943 |
| **2007** | **Mean** |
| Total loans | 3,127,149 |
| Investments | 1,068,912 |
| Non-interest income | 40,753 |
| Total deposits | 5,985,002 |
| Personnel expenses | 39,798 |
| Fixed assets | 20,995 |
| **2008** | **Mean** |
| Total loans | 5,390,659 |
| Investments | 1,362,192 |
| Non-interest income | 30,695 |
| Total deposits | 8,459,475 |
| Personnel expenses | 36,623 |
| Fixed assets | 18,403 |
| | |
| **2009** | **Mean** |
| Total loans | 6,798,291 |
| Investments | 1,988,132 |
| Non-interest income | 37,567 |
| Total deposits | 10,824,310 |
| Personnel expenses | 49,607 |
| Fixed assets | 20,628 |
| **2010** | **Mean** |
| Total loans | 8,424,918 |
| Investments | 2,579,068 |
| Non-interest income | 44,613 |
| Total deposits | 12,568,279 |
| Personnel expenses | 66,454 |
| Fixed assets | 23,254 |
| **2011** | **Mean** |
| Total loans | 10,915,985 |
| Investments | 3,039,593 |
| Non-interest income | 44,873 |
| Total deposits | 16,517,251 |
| Personnel expenses | 62,011 |
| Fixed assets | 23,482 |
| **2012** | **Mean** |
| Total loans | 15,118,709 |
| Investments | 4,006,308 |
| Non-interest income | 75,160 |
| Total deposits | 19,159,512 |
| Personnel expenses | 72,297 |
| Fixed assets | 13,784 |
| **2013** | **Mean** |
| Total loans | 16,507,699 |
| Investments | 3,820,557 |
| Non-interest income | 120,038 |
| Total deposits | 22,694,531 |
| Personnel expenses | 78,755 |
| Fixed assets | 23,008 |
| **2014** | **Mean** |
| Total loans | 21,688,648 |

| | |
|---|---|
| Investments | 2,818,101 |
| Non-interest income | 86,402 |
| Total deposits | 28,088,158 |
| Personnel expenses | 84,339 |
| Fixed assets | 29,273 |
| **2015** | **Mean** |
| Total loans | 25,375,800 |
| Investments | 3,407,415 |
| Non-interest income | 95,335 |
| Total deposits | 28,990,273 |
| Personnel expenses | 84,405 |
| Fixed assets | 44,491 |
| **2016** | **Mean** |
| Total loans | 28,382,804 |
| Investments | 3,505,845 |
| Non-interest income | 111,700 |
| Total deposits | 30,321,994 |
| Personnel expenses | 83,821 |
| Fixed assets | 44,531 |
| **2017** | **Mean** |
| Total loans | 31,430,086 |
| Investments | 3,849,612 |
| Non-interest income | 114,353 |
| Total deposits | 33,569,253 |
| Personnel expenses | 91,824 |
| Fixed assets | 54,564 |

*Source:Bank financial statement and Bankscope database. All figures are in thousands ringgit Malaysia (RM).*

This study investigates the productivity of Islamic banks in the pre and post-crisis period. The results are tabulated in Table 2 where Panel A is productivity change (TFPCH) for Islamic banks in the pre-crisis period, while Panel B is productivity change (TFPCH) for Islamic banks in the post-crisis period. Based on the MPI, any value that is bigger than 1.000 represents growth of total factor productivity, whereby any value smaller than 1.000 represents regress of total factor productivity between two periods. Where else, any value that is equal to 1.000 represents unchanged productivity level of a firm.

For the purpose of examining the possible reason that contributes to the non-productivity of Islamic banks, Table 2 also highlights the decompositions of productivity change into TECHCH and EFFCH. The EFFCH is then further decomposed into PTECH and SECH.

*Table 2: TFPCH of Islamic banks, and its decompositions*

| | TFPCH | TECHCH | EFFCH | PTECH | SECH |
|---|---|---|---|---|---|
| **Panel A: Pre-crisis** | | | | | |
| 2004-2005 | 1.049 | 1.442 | 0.743 | 1.061 | 0.695 |
| 2005-2006 | 1.090 | 0.875 | 1.222 | 1.042 | 1.168 |
| 2006-2007 | 1.814 | 0.567 | 3.040 | 2.887 | 1.104 |
| 2007-2008 | 1.016 | 1.313 | 0.789 | 1.081 | 0.856 |
| 2008-2009 | 0.957 | 0.881 | 1.086 | 1.044 | 1.040 |
| 2009-2010 | 1.112 | 1.100 | 1.011 | 0.976 | 1.035 |
| Mean | 1.173 | 1.030 | 1.315 | 1.349 | 0.983 |

| Panel B: Post-crisis | TFPCH | TECHCH | EFFCH | PTECH | SECH |
|---|---|---|---|---|---|
| 2010-2011 | 0.902 | 0.931 | 0.969 | 0.995 | 0.974 |
| 2011-2012 | 1.178 | 1.183 | 0.996 | 1.001 | 0.994 |
| 2012-2013 | 1.049 | 1.015 | 1.034 | 1.016 | 1.017 |
| 2013-2014 | 0.788 | 0.786 | 1.002 | 1.010 | 0.992 |
| 2014-2015 | 1.203 | 1.162 | 1.035 | 1.021 | 1.014 |
| 2015-2016 | 1.081 | 1.120 | 0.965 | 0.970 | 0.995 |
| 2016-2017 | 0.968 | 1.020 | 0.972 | 0.996 | 0.621 |
| Mean | 1.024 | 1.031 | 0.996 | 1.001 | 0.944 |

*Source: Author's own calculation*

Based on Panel A in Table 2, the mean productivity change (TFPCH) for Islamic banks in the pre-crisis period is 1.173. In all period of observation during the pre-crisis period in exception the year 2008-2009, the productivity change (TFPCH) for Islamic banks are more than 1. These indicate the growth of total factor productivity for Islamic banks from one year to another. However, in 2008-2009, the mean productivity change is 0.957, indicating the productivity of Islamic banks in this year have been regressed from the previous year.

On the other hand, Panel B in Table 2 highlights results of productivity change (TFPCH) for Islamic banks in the post-crisis period. During this period, the Islamic banks have been inefficient in 2010-2011, 2013-2014, and 2016-2017. The score of efficiency during these three periods are 0.902, 0.788, and 0.968 respectively. These results have affected the mean productivity change of Islamic banks for the post-crisis period. The mean productivity change for the post-crisis period is 1.024. Although the score of productivity change indicating that Islamic banks have been productive in the post-crisis period, the result is still lower when compared to the score of productivity change in the pre-crisis period. This finding is in accordance with Alexakis, Izzeldin, Johnes, & Pappas (2018); Degl'Innocenti et al. (2017).

If anything could be suggested, one of the reasons why Islamic banks have been unproductive in the post-crisis period compared to the pre-crisis period is due to changes in government policy related to statutory reserve requirement (SRR) and overnight policy rate (OPR). An increase in SRR from 1 percent to 4 percent in 2011 has led to a drop of deposit supply for bank to grant financing. In tandem with this change, the Islamic banks have to attract more deposits by offering higher return to depositors, in which led to an increase in cost of funds for Islamic banks. In order to cover this cost, the Islamic banks, on average, has increased the base financing rate (BFR) by 27 basis point and 25 basis point in the year 2011 (BNM, 2011) and 2014 (BNM, 2014) respectively. The increase in BFR could have reduced the growth of new financing for Islamic banks in the post crisis period. Although in 2017, the BNM has started to reduce the SRR, BNM reported that there is still a reduction in growth of outstanding financing. Hence, resulted in a less productive use of input by the Islamic banks.

Further analysis on pure technical efficiency change (PTECH) and scale efficiency change (SECH) reveal that the source of inefficiency for Islamic banks is due to running of business at the non-optimal scale of operations. Based on the analysis, the score of SECH in eight years of observation, namely 2004-2005, 2007-2008, 2008-2009, 2010-2011, 2011-2012, 2013-2014, 2014-2015, and 2016-2017, are lower than the score of PTECH. This indicates that the principle source of inefficiency for Islamic banks is mainly due to wrong scale of operation. If anything is possible, this might be due to the increase trend of input related to personnel expenses and fixed assets in the post-crisis period. These could have

increased the scale of operation for Islamic banks. However, the increased in scale of operation is not in parallel with the increase in production of output. Thus, the scenario gives negative impact to the productivity of Islamic banks.

## Conclusion

The primary objective of this study is to evaluate and distinguish the productivity change of Malaysian Islamic banks during the pre and post global financial crisis. To address this objective, this study estimates total productivity change of Malaysian Islamic banks by employing the DEA-based Malmquist Productivity Index method on a data set of 16 Islamic banks over the period of 2004 – 2017.

The empirical results reveal that the Islamic banks have experienced a reduction of productivity index from the pre-crisis period to the post-crisis period. Furthermore, the findings seem to suggest that both Islamic banks are efficient in term of utilizing their inputs productively, but they fail to operate at an optimal scale of operations.

Based on the above, the empirical results are useful for different group of people such as bank managers and researchers. First, the finding that is gained from this study offers assistance for the bank managers in Islamic banks to understand the potential impact of changes in regulatory financial environment to the productivity of the bank. This allows bank managers to take accurate precaution in order to address the issue of productivity. Besides, awareness on the issue of scale of operation that affects Islamic banks productivity needs to be addressed by bank managers. Lastly, very few studies have focused on examining the productivity of Malaysian Islamic banks especially comparing the pre and post-crisis period. Hence, researchers in this area could utilize findings of this study in order to fill up research gaps in this field.

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## References

Abbas, M., Hammad, R. S., Fathy, M. F., & Azid, T. (2015). Efficiency, productivity and Islamic banks: an application of DEA and Malmquist index. *Humanomics*, *31*(1), 118–131.

Abdul-Majid, M., Saal, D. S., & Battisti, G. (2011). Efficiency and total factor productivity change of Malaysian commercial banks. *The Service Industries Journal*, *31*(13), 2117–2143. https://doi.org/10.1080/02642069.2010.503882

Abdul-Wahab, A.-H., & Haron, R. (2017). Efficiency of Qatari banking industry: an empirical investigation. *International Journal of Bank Marketing*, *35*(2), 298–318. https://doi.org/10.1108/IJBM-07-2016-0090

Abdul Alim, E. (2014). *Global Leaders in Islamic Finance* (First; J. W. & S. Singapore, Ed.). Singapore: John Wiley & Sons Singapore Pte. Ltd.

Alexakis, C., Izzeldin, M., Johnes, J., & Pappas, V. (2018). Performance and productivity in Islamic

and conventional banks: Evidence from the global financial crisis. *Economic Modelling*. https://doi.org/10.1016/j.econmod.2018.09.030

Bahrini, R. (2015). Productivity of MENA Islamic banks: a bootstrapped Malmquist index approach. *International Journal of Islamic and Middle Eastern Finance and Management*, *8*(4), 508–528. https://doi.org/10.1108/IMEFM-11-2014-0114

Bank Negara Malaysia (2011). Annual Report Bank Negara Malaysia 2011. Kuala Lumpur. Malaysia.

Bank Negara Malaysia (2014). Annual Report Bank Negara Malaysia 2011. Kuala Lumpur. Malaysia.

Casu, B., Girardone, C., & Molyneux, P. (2004). Productivity change in European banking: A comparison of parametric and non-parametric approaches. *Journal of Banking & Finance*, *28*(10), 2521–2540. https://doi.org/10.1016/j.jbankfin.2003.10.014

Degl'Innocenti, M., Kourtzidis, S. A., Sevic, Z., & Tzeremes, N. G. (2017). Bank productivity growth and convergence in the European Union during the financial crisis. *Journal of Banking & Finance*, *75*, 184–199. https://doi.org/https://doi.org/10.1016/j.jbankfin.2016.11.016

Färe, R., Grosskopf, S., Norris, M., & Zhang, Z. (1994). Productivity growth, technical progress, and efficiency change in industrialized countries. *The American Economic Review*, *84*(1), 66–83.

Fukuyama, H. (1995). Measuring efficiency and productivity growth in Japanese banking: a nonparametrie frontier approach. *Applied Financial Economics*, *5*(2), 95–107.

Jaffry, S., Ghulam, Y., Pascoe, S., & Cox, J. (2007). Regulatory changes and productivity of the banking sector in the Indian sub-continent. *Journal of Asian Economics*, *18*(3), 415–438.

Kamarudin, F., Hue, C. Z., Sufian, F., & Anwar, N. A. M. (2017). Does productivity of Islamic banks endure progress or regress?: Empirical evidence using data envelopment analysis based Malmquist Productivity Index. *Humanomics*, *33*(1), 84–118. https://doi.org/10.1108/H-08-2016-0059

Kevork, I. S., Kollias, C., Tzeremes, P., & Tzeremes, N. G. (2017). European financial crisis and bank productivity: evidence from Eastern European Countries. *Applied Economics Letters*, 1–7. https://doi.org/10.1080/13504851.2017.1319548

Khan, M. I., & Shah, I. A. (2015). Cost Efficiency and Total Factor Productivity of Islamic and Conventional Banks in Pakistan. *Research Journal of Finance and Accounting*, *6*(5), 135–146.

Khoon, G. S., & Mah-Hui, M. L. (2010). The Impact of the Global Financial Crisis: The Case of Malaysia. In *Management*. Penang: Third World Network.

Khoon, G. S., & Mah-Hui, M. L. (2012). *How Malaysia Weathered the Financial Crisis: Policies and Possible Lessons*.

Nurboja, B., & Košak, M. (2017). Banking efficiency in South East Europe: Evidence for financial crises and the gap between new EU members and candidate countries. *Economic Systems*, *41*(1), 122–138. https://doi.org/https://doi.org/10.1016/j.ecosys.2016.05.006

Rodoni, A., Salim, M. A., Amalia, E., & Rakhmadi, R. S. (2017). Comparing Efficiency and Productivity in Islamic Banking : Case Study Indonesia, Malaysia and Pakistan. *Al-Iqtishad: Journal of Islamic Economics*, *9*(2). Retrieved from http://journal.uinjkt.ac.id/index.php/iqtishad/article/view/5153

Rosman, R., Wahab, N. A., & Zainol, Z. (2014). Efficiency of Islamic banks during the financial crisis: An analysis of Middle Eastern and Asian countries. *Pacific-Basin Finance Journal*, *28*(2014), 76–90. https://doi.org/10.1016/j.pacfin.2013.11.001

Sealey, C. W., & Lindley, J. T. (1977). Inputs , Outputs , and a Theory of Production and Cost at

Depository Financial Institutions. *The Journal of Finance*, *32*(4), 1251–1266.

Sufian, F., & Kamarudin, F. (2017). Forced Mergers on Bank Efficiency and Productivity: Evidence from Semi-parametric Malmquist Productivity Index. *Global Business Review*, *18*(1), 19–44. https://doi.org/10.1177/0972150916666850

Wahid, M. A. (2016). Comparing the efficiency of Islamic and conventional banks based on the evidence from Malaysia. *The Journal of Muamalat and Islamic Finance Research*, *13*(1), 35–65.

Zainal Abidin, M., & Rasiah, R. (2009). The Global Financial Crisis and the Malaysian Economy: Impact and Responses. In *Stimulus*. Kuala Lumpur.