

PRODUCTIVITY AND ITS DETERMINANTS IN ISLAMIC BANKS: EVIDENCE FROM INDONESIA

Siti Annita Otaviya¹ and Lina Nugraha Rani²

¹ Airlangga University, Indonesia, itaotaviya13@gmail.com.

² Airlangga University, Indonesia, linanugraha@feb.unair.ac.id.

ABSTRACT

This study aims to determine the level of productivity of Islamic banks in Indonesia during the period 2011-2018 using indicators of Total Factor Productivity Change (TFPCH) or changes in productivity, and to identify potential determinants of TFPCH. In the first stage, the Malmquist Productivity Index (MPI) is employed to analyse the TFPCH of eight Islamic banks operating between 2011 and 2018. In the second stage, panel data regression is applied to assess the potential determinants of TFPCH. The research findings show that Indonesian Islamic banks experience productivity growth, and that the Technical/Technological Change (TECHCH) component has had a significant influence on this growth, with the GDP and BI rate variables being potential determinants of TFPCH. The research contributes to the renewal of interest in studies of Islamic bank productivity performance in Indonesia, and is accompanied by analysis of the specific determinants of the potential of private banks and the macroeconomics of productivity, research on which is still limited in the related literature.

Keywords: Determinant, Islamic banks, Total factor productivity, Malmquist productivity index.

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I. INTRODUCTION

1.1. Background

Over the past few decades, the Islamic banking sector has become one of the fastest-growing in the world. At present, more than 300 Islamic banks are operating globally, with a total asset value of more than US \$ 1.50 trillion. These banks are projected to continue to proliferate in the countries where they operate due to the increase in the Muslim population, which is predicted to reach 2.3 billion by 2030. Although Islamic finance has not significantly penetrated the banking market in western countries, serving the banking market needs of a sizeable Muslim population is an essential opportunity for future growth (Olson & Zoubi, 2017).

The Islamic banking system received worldwide attention after the 2007 global financial crisis. Islamic banking is believed to emphasise transparency and avoidance of undue risk and appeared to be more isolated from the crisis than conventional banking (Hamdan, 2009; Willison, 2009; Warde, 2000). Islamic banking is different from conventional banking; it applies sharia principles that prohibit usury (interest) and non-commodity money, justice, and forbid the existence of gharar (uncertainty) (Hamdan, 2009). Islamic banks apply a profit-loss sharing system, under which depositors are not guaranteed any predetermined profits and borrowers are not forced to pay a predetermined amount. They also offer cost-based services, a characteristic which is considered to have positive implications for economic growth and stability (Alexakis et al., 2019).

Khan and Bhatti (2008) affirm that Southeast Asia is one of the centres of Islamic banking and finance. Islamic economics and finance have had a great influence on the economic growth of these countries in the last decade. In relation to this, the Islamic banking industry has developed rapidly, particularly in Indonesia. At present, Islamic banks must also be able to compete with conventional banks. In order to improve the competitiveness of the sharia bank industry, it is necessary to operate efficiently to achieve optimal profit and productivity (Rodoni et al., 2017). The rapid development of the Islamic banking sector means that the performance of Islamic banks has become the centre of attention of managers, stakeholders, policymakers, and regulators. The focus on the efficiency of financial institutions has been an essential part of the banking literature since the early 1990s (Berger & Humphrey, 1997).

In general, the existence and development of the Islamic banking industry has become one of the leading indicators of Islamic economic and financial development. Therefore, a measurement is needed for the performance of Islamic banking in order to establish the level of efficiency of inter-Islamic banking performance. The use of formulations measures the level of efficiency and productivity and involves multiple variables, which are also needed to overcome the problem of determining the factors to be selected, being able to represent all aspects of a company (Rusyadiana, 2018).

Productivity is an approach that regulates strategies for performance enhancement, which is one of a company's main objectives and establishes the foundation for economic growth. Diaz-Chao et al. (2015) emphasise that productivity refers to the optimal use of company resources to achieve effective and efficient targets within the agreed value framework. It involves the use and integration of resources that are effectively available as a necessary step in the

growth and development of the company, and can lead to the internalisation of the increasing array of (sub) systems company. Productivity is therefore considered to be a necessity for economic development and the possibility of gaining a competitive edge. The idea of productivity and utilising resources optimally can increase a company's capacity (Diaz-Chao et al., 2015).

Contradictory to the results of previous studies related to banking efficiency, those with regard to the measurement of the productivity of the Islamic banking industry are still limited and relatively rare, especially with a focus on one country, such as Indonesia. This is supported by Rani et al. (2017) and Rusydiana (2018). Most studies mainly focus on measuring the level of efficiency of financial institutions, with efficiency used as the indicator to measure bank performance (Mokhtar et al., 2008). Islamic banking has its place in society; therefore, the study of Islamic banking should be part of banking studies in general.

Productivity analysis using the Malmquist Productivity Index (MPI) is still relatively limited in banking studies in Indonesia. According to Al-Muharrami (2007), information on productivity growth will greatly assist regulators in evaluating the impact of changes in market structure, bankers, and other companies that acquire subsidiaries or build alliances.

Increased productivity is expected to lead to improvements in bank performance, competitive prices, improved service quality and increased resource allocation (Koutsomanoli-Filippaki et al., 2009). The security and soundness of the banking system can be affected by productivity growth. This growth can contribute to the security and soundness of the banking system, as long as large amounts of profit are channelled to strengthen capital, so that risk can be reduced (Casu et al., 2004). Considerable interest in bank productivity has arisen as a responsive action to changes in the structure of the financial services industry and advances in financial and non-financial technology (Berger & Mester, 2003).

Concerning other situations, it is also time for the relevant parties to pay serious attention to ascertaining the potential determinants that affect the productivity of Islamic banking. A good understanding of these will help know what steps should be taken to improve performance. Several developed countries have invested funds in research programs that have examined the impact of potential determinants on bank productivity (Kamarudin et al., 2017).

By studying such determinants, banks will be able to recognise and categorise their strengths and weaknesses. In this way, weaknesses can be reduced and anticipated by taking comprehensive action, while strengths will be maintained and increased to become capital for the development of more productive institutions. In the empirical findings of the study, more detailed information and guidance for related parties is provided.

The rapid growth in the Islamic finance industry may also become a strong indication for various parties to pay more attention to this area in order to be able to observe the business continuity of the Islamic finance industry. Aside from being the country with the largest Muslim population in Southeast Asia, Indonesia was also ranked in the top 10 of Global Islamic Finance Development in 2018 (Thomson Reuters, 2018).

Based on the above, this study focuses on the issue of the level of productivity of Islamic banks in Indonesia and the potential determinants which affected

this during the period 2011-2018. The study is also expected to contribute to the renewal of interest in the study of Islamic banking productivity performance in Indonesia, accompanied by consideration of the specific determinants of the potential of private banks and the macroeconomics of productivity, areas which are still limited in studies that address these topics. The study believes that the measurement of productivity is also an important issue when assessing its relationship to the development of the Islamic banking industry in Indonesia.

1.2. Objective

Despite significant developments in the Islamic banking sector throughout the world, most studies focus more on how to expand sharia banking, rather than paying attention to levels of efficiency and productivity. Testing these levels will ensure increased performance and long-term sustainability.

The study measures productivity growth over time and the potential determinants which affect the productivity of Islamic banks in Indonesia, using an intermediation approach. Productivity growth is defined as changes in output as a result of Technical Efficiency Change (EFFCH) and Technical Change (TECHCH) (Grosskopf, 1993; Färe et al., 1994).

II. LITERATURE REVIEW

2.1. Background Theory

The operation of Islamic financial institutions is mainly based on the principle of profit and loss sharing (PLS). In their operations, Islamic banks do not charge interest, but rather provide a yield from the use of funds. The benefits of depositors are also divided according to predefined ratios; therefore, there is an element of partnership between Islamic banks and their depositors.

Islamic banks provide interest free services to their customers, as in all transactions they are prohibited from paying or charging interest. Fundamentally, the prohibition of riba transactions differentiates Islamic banking systems from conventional banking ones. Technically, riba is the addition to loan amounts based on the borrowing period and the loan amount.

In the early 1980s Indonesia saw the beginning of Islamic financial institutions with the establishment of Baitut Tamwil Salman in Bandung and a Koperasi Ridho Gusti in Jakarta. Bank Muamalat Indonesia was the first Islamic bank in Indonesia, established in 1922. The development of Islamic banks in Indonesia has been growing rapidly, since Bank Indonesia provides the opportunity for conventional banks to open Islamic branches, with the Sharia products and services offered separate from their conventional ones, and with a separate infrastructure, including staff and branches.

The opening of a conventional bank opportunity has Islamic windows , triggering competition in the fight for customer funds. Therefore, to be able to face this competition, Sharia banks are expected to demonstrate good operational performance, with efficiency and productivity indicators.

The concept of efficiency and productivity is the ratio of the results of the comparison between input and output. Productivity and efficiency are two

important ideas for evaluating organisational performance. Efficiency refers to usage patterns and the benefits from facilities, such as nature, finance, and capital resources. From an economic standpoint, it is the relationship between input and output, or between the effort made and profit gained. The idea of productivity as “more output with less input” became a topical notion, introduced in “resource productivity”. Productivity is a concept that measures the ratio of the total output to the weighted average of the inputs; the two important variants are the productivity of labour, which calculates the number of outputs per unit of labour, and the total productivity factor, which measures the output per unit of the total input (Samuelson & Nordhaus, 2001).

There are various methods to measure efficiency and productivity, including the DEA and Malmquist indexes. Both have certain advantages. While there are many methods for measuring productivity, a comparison of all the methods suggests that DEA provides a better way to sort and analyse data. It is actually a mathematical planning model used to evaluate the productivity of a unit of decision-making (DMU). The method uses multiple inputs and outputs to compare the relative productivity of a DMU, such as schools, an organization’s industry, or airports. In it, the boundary curve is efficiently determined through a series of existing points that are designed through linear programming.

The Malmquist Productivity Index (MPI) has been widely used as a measurement tool of productivity change in much of the literature in recent years (Grifell-Tatjé & Lovell: 1995). Based on DEA, three alternatives are intended to measure changes in productivity, namely the Fisher Index (1922), the Tornqvist Index (1936), and the Malmquist Index (1953). The three main advantages of the Malmquist Index compared to the other two are: (1) it does not require profit maximisation or the assumption of cost minimisation; (2) it does not require information about input or output prices; and (3) if the researcher possesses panel data, it is possible to decompose the productivity changes into two components, namely changes in inefficiency (catching up) or technical changes (innovation). However, MPI has the disadvantage of only focusing on calculating the distance function, although DEA can be used to overcome this problem.

In general, non-parametric MPI is used to measure total productivity change in various industries (Simar & Wilson, 2019). Total Factor Productivity (TFP) is a multifactorial measurement intended to measure accounts that use several input factors in the production process and are considered to be more suitable for measuring performance and making comparisons between companies over time.

TFP is applied to measure the relationship between outputs and inputs. This relationship is expressed as the ratio of the output index to the aggregate input index. If the ratio increases, more output can be produced using a certain number of inputs, or some outputs can be produced using fewer inputs (Coelli et al., 2005).

2.2. Previous Studies

Empirical studies of productivity performance are in their infancy. Due to the rapid development and projected growth of Islamic banking, several economic aspects, including productivity, have been identified in many literature studies of MENA (Middle East and North Africa) and GCC countries.

Productivity studies of the MENA and GCC financial industry concurred in finding a decrease in productivity in their entire sample during the related study period (Al-Muharrami, 2007; Ariss et al., 2007; Bassem, 2014).

Similar research conducted by Ramanathan (2007) obtained results that contradicted previous studies. It was found that four (Bahrain, Kuwait, Saudi Arabia, and UAE) of the six banks operating in the GCC during the period 2000-2004 recorded an increase in productivity due to growth in technical efficiency, while most of the sample experienced technological setbacks.

Srairi (2011) conducted a productivity study to observe the impact of financial liberalisation on banks in the GCC countries between 1999 and 2007. The results showed that conventional and Islamic GCC banks had increased productivity by 1.8 percent annually. From the results of the comparison, it was found that conventional banks had better productivity (2.2 percent higher) than Islamic banks during the period studied. In terms of the determinants of changes in productivity with the fixed effect regression model, the results found that size, loans, monetisation rates, gross domestic product, and the development of the banking sector had positive and significant impacts on changes in productivity of both conventional and sharia banks in GCC countries.

Bahrini (2015) conducted a study of productivity and its determinants in Islamic banking, based on 33 banks operating in 10 MENA countries. It was concluded that the productivity of Islamic MENA banks had experienced a slight average growth in the period 2006-2011. The global financial crisis caused a decrease in productivity, and also known determinants of MENA Islamic bank productivity growth are capital adequacy, size, quality of management, diversification, profitability, and liquidity.

Empirical studies on productivity performance have also been identified in studies of Asian countries. For example, Yaumidin (2007) analysed efficiency comparisons between Islamic banks in the Middle East and Southeast Asia. It was found that the latter were more efficient than the former; the tragedy of 9/11 in 2001 and the Iraq war in 2002 were suspected as the causes. It was also found that the TFPCH value of Islamic banks in Southeast Asia was higher than that of their counterparts in the Middle East.

Norma et al. (2010) examined the efficiency of conventional and Islamic bank units in Malaysia during the period 2002-2005. The study concluded that Islamic bank units received above-average TFP values. Bank units in Malaysia experienced a TFP setback, with a decrease in technical efficiency being the main factor. However, changes in efficiency had a positive impact on TFP.

George Assaf . et al. (2010) analysed the productivity and efficiency of Shinkin banks and various prefectures in Japan during the period 2000-2006. The findings indicated that the efficiency and productivity growth of these banks had not improved significantly, and that the size of the larger banks contributed to performance.

Suzuki and Sastrosuwitro (2011) studied the efficiency and productivity of commercial banks in Indonesia during the 1994-2008 period. The research findings indicated an average efficiency of all the samples of 0.866. State-owned banks (0.953) were the most efficient, followed by foreign-owned joint venture banks (0.943). Productivity growth also increased by 0.5 percent annually, supported

by growth in a technological change of 1.7 percent every year, and a decrease in efficiency changes of 1.1 percent per year.

Muda et al. (2013) used Generalized Least Squares and the financial ratios of 17 Malaysian Islamic banks during the period 2007-2010. Their results showed that domestic Islamic banks were more profitable than foreign Islamic banks. The global financial crisis also affected the profitability of domestic banks. Determining factors such as overhead costs, financing, efficiency, gross domestic product growth, and bank size significantly influenced Malaysian domestic banks.

Abbas et al. (2015) made an evaluation of changes in productivity in the banking sector and compared the performance of Islamic and conventional banks in Pakistan. The research findings show that the level of productivity of Islamic and conventional banks in the country had decreased as a result of the crisis faced after 2007, but that the Pakistani banking sector was able to minimise the damage and control the situation.

Rodoni et al. (2017) conducted an empirical study comparing the efficiency and productivity of Islamic banking in Indonesia, Malaysia, and Pakistan. The results found that Islamic banking in Indonesia tended to be less efficient. That in Malaysia also experienced inefficiencies but showed better results compared to Indonesia, while Islamic banking in Pakistan experienced a positive productivity trend.

Kamarudin et al. (2017) examined operational productivity and potential determinants that influenced Islamic banks in Brunei, Indonesia, and Indonesia during the period 2006-2014. Their research findings show that there had been progress in terms of TFPCH associated with an increase in EFFCH. Other findings also proved that capitalisation, liquidity, and the world crisis economy were determinants of the potential productivity of Islamic banks operating in all three countries during the study period.

Rani et al. (2017) analysed a productivity comparison between Islamic and conventional banks in Indonesia during the 2008-2016 period, and also used determinant variables to observe their effect on productivity. The results of the study revealed that the productivity of Islamic and conventional banks during the study period had decreased, and that bank size in the two types of banks significantly influenced the level of productivity.

Rusydiana (2018) examined the efficiency and productivity of Islamic Commercial Banks (BUS) in Indonesia during the 2012-2016 period. The results of the study were displayed in the form of a quadrant of four groups, which showed that 8 out of 11 BUS had experienced productivity growth. One BUS was in quadrant 1 (high technical change and efficiency change); four in quadrant 2 (high technical change but low-efficiency change); and six in quadrant 3 (low technical change but low-efficiency change high). None of the Islamic commercial banks was in quadrant 4.

Efficiency and productivity research in Asia shows that most studies used the DEA and MPI methods and similar data (Yaumidin, 2007; Norma et al., 2010; George Assaf . et al. 2010; Suzuki & Sastrosuwitro, 2011; Abbas et al., 2015; Rodoni et al. 2017; Rusydiana, 2018). On the other hand, Muda et al. (2013), Kamarudin et al. (2017) and Rani et al. (2017) sought to add potential determinants of banking productivity, with varying results. The measurement of efficiency and productivity

in specific industries has become common. Therefore, the researcher concludes that there is a literature gap that needs to be filled, which not only contributes to the renewal of scientific work, but also recognises the need for comprehensive studies related to productivity and productivity determinants in the Indonesian sharia banking industry.

III. METHODOLOGY

3.1. Data

The data were gathered from annual reports, specifically the balance sheets and income statements of eight Islamic banks operating in Indonesia during the period 2011-2018. These were available online on the websites of the Islamic banks sampled and the website of Bank Indonesia. From the financial statements, several inputs and outputs were taken and used to estimate the TFPCH index from MPI. In addition, various accounting ratios were used as a proxy for the specific determinants of banks from TFPCH or changes in Islamic bank productivity. Indonesian macroeconomic indicators were obtained from macroeconomic data collected from the Central Statistics Agency (BPS), Central Bank of Indonesia (BI), and World Bank.

3.1.1. Input-Output Data

In determining input and output, two main approaches are widely used, namely the production and intermediation approaches (Sealey & Lindley, 1977). Based on recommendations from Yudistira (2004) and Sufian and Noor (2009), this study adopts an intermediary approach, as the role and function of Islamic banks are as intermediaries for channelling funds for investors and as fund collectors in the form of deposits from depositors.

Therefore, the three predefined inputs are Labour Costs (X1), measured by employee operational expenses/staff costs; Fixed Assets (X2), measured by the value of property, plant, and equipment; and Third-Party Funds (X3), measured by the total funds of customers, other banks and other financial institutions. From the use of these inputs, Islamic banks will then produce the following outputs: Financing (Y1), as measured by Murabahah, deferred sales, ijarah, Musyarakah, and Mudharabah; Portfolio Investments (Y2), including investment funds and shares, placements with other banks, bills, bonds, securities, and investments in property and real estate; and Total Operating Income (Y3), which includes bank income as mudarib, banks' profit-sharing rights and other operating income after deducting operating expenses.

3.1.2. Determinant Productivity Variables

A series of variables was collected as specific determinants of bank potential and macroeconomics to identify the determinants of TFPCH of Indonesian Islamic banks during the period 2011 to 2018 (Mukherjee et al., 2001; Chiou, 2009; Sufian, 2011; Srairi, 2011; Bahrini, 2015; Kamarudin et al., 2017; Rani et al., 2017).

The bank-specific variables used included Quality Management (MQ), as measured by total non-operational costs to total assets; Diversification (DIV), measured by total non-operating income to total assets; Credit Risk (RISK), measured by the ratio of loan provision to total loans; Return On Equity (ROE), the return on capital ratio; the Financing to Deposit Ratio (FDR), the ratio of financing/loans to deposits; and Liquidity (LIQ), as measured by cash to total assets. The macroeconomic variables consisted of four variables, which were used as proxies for the economic conditions of the Indonesian state, namely Gross Domestic Product (GDP), as measured by nominal GDP; Inflation (INFLS), measured using the GDP deflator; Value (KURS) measured by the exchange rate of the rupiah against the USD; and the BI Rate (BIRATE), as measured by the BI 7-day (Reverse) Repo Rate.

3.2. Model Development

The study employed a quantitative method, which is a research methodology that when measuring data generally applies several forms of statistical analysis. In the first stage, MPI was used to measure and estimate TFPCH or productivity changes in the case study of Islamic banks in Indonesia during the period 2011-2018. After obtaining the estimation results from MPI, in the second stage the results of the TFPCH potential determinant test were obtained, which can be further achieved by applying regression analysis.

3.2.1. Data Envelopment Analysis (DEA)

Charnes, Cooper and Rhodes first introduced DEA in 1978. This is a non-parametric approach that is quite popular due to its flexibility and ability to accommodate multiple inputs and outputs. Researchers can choose such outputs and inputs in complex production environments based on managerial focus. In addition, DEA does not need to determine the functional form of the model to be tested or the weight to be used in combining several inputs and outputs. However, DEA efficiency estimation results will be susceptible to data errors and outliers, so the application and interpretation of these results must be carefully addressed.

DEA identifies a reference point (a relatively efficient DMU) based on a set of available data. Border efficiency as the best technology will then be determined and finally the inefficiencies of other interior points evaluated (Jemric & Vujcic, 2002). In addition, DEA will also determine which DMUs will be the reference for other inefficient DMUs.

$$Efficiency\ DMU_0 = \frac{\sum_{k=1}^p \alpha_k y_{k0}}{\sum_{i=1}^m v_i x_{i0}} \quad (1)$$

- DMU = Decision Making Unit
- n = Number of DMUs Evaluated
- m = Different Inputs
- p = Different Outputs
- x_{ij} = Number of Input i Consumed by DMU
- y_{kj} = Number of Output k Produced by DMU

The CCR (Charnes, Cooper, and Rhodes, 1978) model and the BCC (Banker, Charnes, and Cooper, 1984) model are the most commonly used DEA models. That distinguishes both in the return to scale treatment . CCR assumes that each DMU operates with a constant return to scale, while BCC assumes that each DMU operates with a variable return to scale. The CCR model represents the efficiency of Pure Technical Efficiency Change (PECH) and the Scale of Efficiency Change (SECH), while BCC represents Technical Efficiency Change (EFFCH).

3.2.2. Malmquist Productivity Index (MPI)

The MPI was used to calculate TFPCH and its constituent components. Caves, Chirstensen, and Diewert (CCD) This model introduced this model in 1982 . This was further developed by Färe et al. (1992) using Farrell’s (1957) efficiency measures and non-parametric techniques, making it possible to decompose TFPCH into EFFCH (catching-up) and TECHCH (innovation). With reference to Caves et al. (1982) and Färe et al. (1992), MPI can be presented as follows:

$$M_i(x_i^{t+1}, y_i^{t+1}, x_i^t, y_i^t) = \frac{D_i^{t+1}(x_i^{t+1}, y_i^{t+1})}{D_i^t(x_i^t, y_i^t)} X \left[\left(\frac{D_i^t(x_i^{t+1}, y_i^{t+1})}{D_i^{t+1}(x_i^{t+1}, y_i^{t+1})} X \frac{D_i^t(x_i^t, y_i^t)}{D_i^{t+1}(x_i^t, y_i^t)} \right)^{\frac{1}{2}} \right] \tag{2}$$

Or alternatively as:

$$M_i^{t,t+1} = \Delta Eff^{t,t+1} X \Delta Tech^{t,t+1} \tag{3}$$

where $\Delta Eff^{t,t+1}$ and $\Delta Tech^{t,t+1}$ measure changes in efficiency and technical changes from bank i, i = 1, L. The MPI presentation above was made for the case of constant return to scale (CRS) technology. Färe et al. (1994) assume the variable return to scale (VRS) technology, efficiency changes are decomposed into Pure Technical Efficiency Change (PECH) and Scale of Efficiency Change (SECH) by the mathematical model below:

$$\frac{D_i^{t+1}(x_i^{t+1}, y_i^{t+1})}{D_i^t(x_i^t, y_i^t)} = \frac{D_{iVRS}^{t+1}(x_i^{t+1}, y_i^{t+1})}{D_{iVRS}^t(x_i^t, y_i^t)} X \frac{D_{iCRS}^{t+1}(x_i^{t+1}, y_i^{t+1}) / D_{iVRS}^{t+1}(x_i^{t+1}, y_i^{t+1})}{D_{iCRS}^t(x_i^t, y_i^t) / D_{iVRS}^t(x_i^t, y_i^t)} \tag{4}$$

which can alternatively be presented as:

$$M_i^{t,t+1} = \Delta PureEff^{t,t+1} X \Delta Scale^{t,t+1} \tag{5}$$

The output orientation at MPI is used to measure and analyse TFPCH between two periods, t and t +1, with a combination of three components, namely PECH, SECH and TECHCH, as presented in the following mathematical model:

$$M_i^{t,t+1} = \Delta PureEff^{t,t+1} X \Delta Scale^{t,t+1} X \Delta Tech^{t,t+1} \tag{6}$$

TECHCH can be identified by observing the shift in the production frontier, while EFFCH is identified by observing the movement along the production frontier border. TECHCH and EFFCH are illustrated as follows:

$$\text{TECHCH} = \left[\frac{D^{t+1}(y_{t+1}, x_{t+1})}{D^t(y_{t+1}, x_{t+1})} \times \frac{D^{t+1}(y^t, x^t)}{D^t(y^t, x^t)} \right]^{1/2} \quad (7)$$

$$\text{EFFCH} = \left[\frac{D^{t+1}(\text{CRS})(y_{t+1}, x_{t+1})}{D^t(\text{CRS})(y^t, x^t)} \right] \quad (8)$$

EFFCH is divided into two parts, namely PECH where the technical efficiency of catching-up to various return to scale (VRS) technology borders, and SECH, which tends to move along the boundaries or purely inefficient technical units shown by positions that move away from the predicted technology. EFFCH is the result of changes in PECH and SECH, which can be illustrated as follows:

$$\text{PECH} = \left[\frac{D^{t+1}(\text{VRS})(y_{t+1}, x_{t+1})}{D^t(\text{VRS})(y^t, x^t)} \right] \quad (9)$$

$$\text{SECH} = \left[\frac{D^{t+1}(\text{CRS})(y_{t+1}, x_{t+1})}{D^t(\text{CRS})(y^t, x^t)} \right] \left[\frac{D^{t+1}(\text{VRS})(y_{t+1}, x_{t+1})}{D^t(\text{VRS})(y^t, x^t)} \right] \quad (10)$$

3.2.3. Regression Analysis

The second stage of the empirical approach is aimed at testing the potential determinants of TFPCH of Indonesian Islamic banks during the 2011-2018 study period. To that end, a regression model of the TFPCH index was applied, which was obtained in the first stage of testing. Following Sufian (2011), Srairi (2011), Bahrini (2015), Rani et al. (2017), and Kamarudin et al. (2017), a panel data regression estimation model is used in this study, with the estimated equation as follows:

$$Y_{it} = \beta_i + \beta_1 \text{MQ}_{it} + \beta_2 \text{DIV}_{it} + \beta_3 \text{RISK}_{it} + \beta_4 \text{ROE}_{it} + \beta_5 \text{FDR}_{it} + \beta_6 \text{LIQ}_{it} + \beta_7 \text{PDB}_{it} + \beta_8 \text{INFLS}_{it} + \beta_9 \text{KURS}_{it} + \beta_{10} \text{BIRATE}_{it} + e \quad (11)$$

where i is the symbol for the cross-section; t is the symbol for time series; Y_{it} is the i -th bank TFPCH and the t -time; β_i is a constant coefficient; MQ is quality management; DIV is diversified; RISK is credit risk; ROE is return on Equity; FDR is the Financing to Deposit Ratio; GDP is gross domestic product; INFLS is inflation; KURS is the currency exchange rate; BIRATE is the Bank Indonesia reference interest rate; β_1 - β_{10} is a regression coefficient; and e is the error variable. Determination of the panel data regression estimation model was used to choose which model was the most appropriate for use, between Ordinary Least Squares (OLS), Fixed Effects (FEM), or Random Effects (REM). Determining this required testing techniques such as the Chow test (OLS / FEM), Hausman test (FEM / REM), and the LaGrange multiplier test (OLS / REM).

3.3. Method

The study used the MPI quantitative method measured by DEAP 2.1 to estimate TFPCH, in line with Coelli (1996). Furthermore, TFPCH can be decomposed into TECHCH and EFFCH. MPI is a unique measure of productivity that allows researchers to break down the TFPCH index into components so that results can

be obtained for any growth or decline in productivity (Abbas et al., 2015). This method is also believed to be a comprehensive tool for analysing the performance of a sector that involves many inputs and outputs in its operational activities. Various services and products, such as those offered by banks, involve many inputs.

The intermediation approach was adopted to determine the input and output variables used by considering the function of banking institutions as intermediaries for channelling funds for investors and as fund collectors in the form of deposits from depositors (Yudistira, 2004; Sufian & Noor, 2009).

Furthermore, based on the assumption that banks always want an increase their output with a fixed number of inputs, the output orientation approach is applied in research by adopting previous studies conducted by Färe et al. (1994) and Bahrini (2015). In addition, Kamarudin et al. (2017), Casu et al., (2004), and Jaffry et al. (2007) found that the use of an output orientation approach would be more suitable for research in developing countries. To obtain the results of the TFPCH potential determinant test, this study used panel data regression (Sufian, 2011; Srairi, 2011; Bahrini, 2015; Rani et al., 2017; Kamarudin et al., 2017). Potential determinant variables are categorised as specific bank and macroeconomic ones. The following research hypotheses are proposed:

H1: Specific internal variables significantly explain the TFPCH of Islamic banks in Indonesia.

H2: Macroeconomic variables significantly explain the TFPCH of Islamic banks in Indonesia.

The input and output variables were taken from the annual financial statements published by the banks on their websites and from the website of Bank Indonesia, from cash flow statements (balance sheets) and the profit and loss of each sample bank. There were three input variables, consisting of Labour Costs (X1), the cost of human labour; Fixed Assets (X2), the assets used to support the company's ordinary activities; and Third-Party Funds (X3), bank liabilities to residents and non-residents in rupiah and foreign currencies.

On the other hand, the three output variables comprised Financing (Y1), namely bank assets in the form of mudharabah financing, musyarakah financing, receivables, and ijarah; Portfolio Investment (Y2), the investment activities performed by banks in the form of deposits, shares, bonds, bills, securities, property and real estate; and Total Operating Income (Y3), the income obtained by banks in conducting their operations and services.

Bank-specific and macroeconomic variables were used to determine potential changes in productivity from the financial statements of each bank and the economic reports of the Central Statistics Agency (BPS), Bank Indonesia (BI), and the World Bank. The bank-specific variables used included Quality Management (MQ), namely the efforts made by an organisation using all its available human and capital resources to improve performance at each level of operations or processes in each functional area; Diversification (DIV), which is a business development company through the number of companies managed or the level of business segments; Credit Risk (RISK), which is risk resulting from the channelling of funds in the form of loans to the public; Return On Equity (ROE), the net ratio of ordinary equity intended to measure the rate of return on ordinary shareholders'

investments; the Financing to Deposit Ratio (FDR), which is the ratio between total loans made and deposits; and Liquidity (LIQ), which is the company's ability to meet its short-term obligations through its current assets that are ready to be liquidated at any time.

The macroeconomic variables included Gross Domestic Product (GDP), which is related to the final market value of service goods produced from a country's resources within a certain period of time; Inflation (INFLS), general and ongoing price increases; the Exchange Rate (KURS), is the exchange price between currencies; and the BI Rate (BIRATE), the interest rate based on Bank Indonesia's monetary policy, which is a reference for the money market.

IV. RESULTS AND ANALYSIS

4.1. Results

4.1.1. Islamic Bank Productivity and Decomposition

Table 1 presents a summary of the statistical input and output variables in the TFPCH estimate. The table shows that during the study period, the varying standard deviation values that are affected by the differences in size of the Islamic banks studied.

The measurement of productivity performance was made by examining the TFPCH value or index, which was also decomposed into TFPCH, forming TECHCH, EFFCH, and SECH. A positive EFFCH (positive efficiency change) indicates a change inefficiency close to the border, while a positive TECHCH value (positive technological change) means that there is a change in technology or innovation. According to Fare et al. (1994), EFFCH decomposition can be explained by PECH and SECH. The results of the MPI observation of all the sample Indonesian Islamic banks during the 2011-2018 study period are shown in Table 2.

Table 1.
Descriptive Statistics of Input-Output Variables

Note	Labour Costs (X1)	Total Fixed Assets (X2)	Third-Party Fund (X3)	Financing (Y1)	Portfolio Investment (Y2)	Total Operating Income (Y3)
Mean (2011-2018)	5,779.745	4,812.027	7,089.540	5,226.436	5,236.102	3,098.181
St. Dev (2011-2018)	8,625.359	5,319.844	5,114.336	3,8281.332	1,220.704	1,057.3582

From the above figures, it can be seen that Indonesian Islamic banks show TFPCH growth with an average index value of 1,053 (+5.3 percent). The average TFPCH geometry illustrates that the performance of companies, especially in the Islamic banking industry, has been able to manage and make use of the available inputs to achieve maximum output. Further analysis shows that the lowest productivity decline occurred in 2011-2012, at -0.17 percent (0.830), and the highest occurred in 2013-2014, at -26.3 percent (0.737).

This is in line with the results of the research by Kamarudin et al. (2017), who found TFPCH growth in productivity studies on Islamic banks conducted in three

Southeast Asian countries, including Indonesia. Suzuki and Sastrouwito (2011) in their productivity research also confirmed that commercial banks in Indonesia experienced productivity growth.

However, research by Rani et al. (2017) in a comparative study between conventional and Islamic banks found conflicting results, with a decrease in the productivity of the two types of bank during the period 2008-2016. Furthermore, in the same period Islamic banks also saw decreased productivity of -8.6 percent, which was higher than conventional banks, whose decrease amounted to -3.9 percent.

The indication of the +5.3 percent growth in TFPCH in this study is attributed to the growth in the TECHCH value, commonly referred to as a technical increase, with an average of 1,049 (+4.9 percent). These results imply that Islamic banks can improve their productivity performance if they are willing and able to innovate and use technology in their production processes. Srairi (2011) and Beck et al. (2013) also affirm that Islamic banks do not have enough investment to make technological updates, even though the changes and innovations from technology can affect the improvement in productivity performance.

It can be concluded from the study of Islamic banks in Indonesia that there will be an increase in productivity with an increase in the use of technology. Technological innovations in the process of delivering quality products and services, as well as improving the direction of technological changes that are sophisticated and up to date, have proven to be successful in helping Islamic banks achieve productivity performance growth. The use of old technology results in a decrease in the performance of Islamic banks.

Table 2.
Observation Results of MPI Islamic Banks

Period	EFFCH	TECHCH	PECH	SECH	TFPCH
2011-2012	1.015	0.818	0.993	1.021	0.830
2012-2013	0.982	1.183	1.009	0.973	1.161
2013-2014	1.030	0.715	1.001	1.029	0.737
2014-2015	0.993	1.060	0.993	1.000	1.052
2015-2016	1.007	0.986	1.007	1.000	0.994
2016-2017	0.945	1.089	0.957	0.988	1.029
2017-2018	1.058	1.774	1.045	1.012	1.876
Mean	1.004	1.049	1.001	1.003	1.053

Notes: Productivity Growth: TFPCH > 1; Productivity Loss: TFPCH <1; Productivity Stagnation: TFPCH = 1; Technological Progress: TECHCH > 1; Technological Regress: TECHCH <1; Technological Stagnation: TECHCH = 1; Efficiency, Pure Technical and Scale Increase: EFFCH, PEFFCH and SECH > 1; Efficiency, Pure Technical and Scale Decrease: EFFCH, PEFFCH; and SECH <1, No Change in Efficiency, Pure Technical and Scale: EFFCH, PEFFCH and SECH = 1.

Source: DEAP 2.1

The EFFCH index, which was decomposed into PECH and SECH based on the observations made, indicates that the source of growth in the EFFCH value is mainly due to SECH rather than PECH. The composition of SECH of 1,003 (+0.3 percent) means that during the research period Islamic banks were able to manage and utilise the inputs available during the production process so that they

could produce maximum output. The PECH value growth of 1,001 (+0.1 percent) explains that Islamic banks have increased managerial efficiency in their efforts to control operating costs.

4.1.2. Determinant Productivity

To observe the relationship between the specific variables internal to the banks and the macroeconomic ones with regard to the level of productivity of Indonesian Islamic banks . after conducting the Chow test estimation model ($0.6541 > 0.05$), the Hausman test ($0.9095 > 0.05$), and the LaGrange multiplier test ($1,000 > 0.05$). All the estimation results show the value $\text{Prob} > F > \alpha$. It was thus found that the OLS regression method was suitable for this study, with variable (Y) being the level of productivity (TFPCH).

The TFPCH determinant regression results are shown in Table 3, panel A. Two of the ten potential determinants have a significant effect on the TFPCH of all the Indonesian Islamic banks studied during the 2011-2018 period, namely Gross Domestic Product (GDP) and the BI Rate.

Table 3.
OLS Islamic Bank Regression Results

Variable (Panel A)	Coefficient	Probability
C	1.014343	
MQ	-0.004622	0.910
DIV	{.005296}	0.207
RISK	-0.014508	0.548
ROE	{.0022596}	0.853
FDR	-0.0215217	0.298
LIQ	-0.001518	0.947
GDP	{4.94e-16}	(0.004)
INFLS	-0.2513261	(0.050)
KURS	-0.0004028	(0.053)
BIRATE	.3895443	(0.007)
R-Squared		0.3720
Adjusted R2		0.2535
No. of Observations		64

Note: Significant at 5%

Source: Stata 13

4.2. Analysis

Based on the research findings described in the previous section, it was found that there was a growth in the productivity of Indonesian Islamic banks during the 2011-2018 period. TFPCH decomposition found that this increase was related to the increase in technology, as seen by the average geometric values of TECHCH in Table 2. It is clear that the growth of TFPCH of the banks was determined by TECHCH, a fact which is supported by the results of the MPI processing from the periods 2011-2012 (-0.17 percent), 2013-2014 (-0.26 percent), and 2015-2016 (-0.6 percent), which show a decrease in productivity as a result of technical setbacks.

Indonesian Islamic banks will only experience increased productivity if they succeed in shifting their production frontier away. This result is supported by Bahrini (2015), who also found that changes in the productivity of Islamic banks in MENA were determined primarily because of TECHCH rather than EFFCH. In alignment with this study's finding, Viverita and Skully (2007) found that Indonesia was the best-performing country, with +43.1 percent productivity growth dominated by technological developments. They added that this might have been due to investment in banking technology development, which had an impact on technological growth.

At present, the Sharia banking industry has begun to realise the important role of technological developments. It is striving to improve business competitiveness with the application of information technology. Sharia banks have incorporated an element of IT in their strategic planning of both short-term and long-term organizations and demonstrated that the implementation of information systems can improve operational efficiency and innovation, and determine company strategy in reading the changing direction of the dynamic banking industry.

Furthermore, changes in the EFFCH index and its components show the efforts of Indonesian Islamic banks to improve their efficiency. The highest technical efficiency improvement occurred in the 2017-2018 period (+5.8 percent). EFFCH decomposition in this period was due to an increase in PECH of +4.5 percent (1,045), which was linked to appropriate managerial decision making, controlling operating costs, and determining the amount of output. In the same period, SECH also experienced growth of +1.2 percent (1,012), which means that the Islamic banks were able to manage and utilise inputs during the production process so that output results could be optimised.

During the period 2011-2018 EFFCH experienced growth of +0.4 percent, a result which empirically proves that Islamic banks had achieved conditions of technically efficient growth, with steps such as the development of appropriate policies, controlling costs, and optimally managing input-output so that it had an effect on the expansion of economies of scale.

The results of the MPI as a whole prove empirically that innovation or use of technology are needed to support Islamic banking operational activities. It is seen that any increase in productivity is always related to improved technology, and vice versa. It is hoped that Islamic banks in Indonesia will begin to consider the proportion of investment in technological development efforts, so that subsequently the output generated both by Islamic bank products and services will be of higher quality and optimal. The results of this empirical study could also be considered by Islamic banks in their efforts to face business competition with conventional banks. The predetermined times have forced the managers of Islamic banks to be more observant in capturing opportunities and meeting market demands in the climate of digitalisation.

Testing the determinants of Indonesian Islamic bank TFPCH for the period 2011-2018 was conducted with the OLS estimation model on specific internal and macroeconomic bank variables; the regression results are presented in Table 3, panel A. The research findings are described below.

In line with Rani et al. (2017), MQ (quality management) is not significantly negatively related to the TFPCH variable. Abbas (2011) and Rusydiana (2016)

both showed that the aspect of human resources (HR) is still a problem in Islamic banking. The HR competencies of Indonesian Islamic banks are not sufficient to fully understand the principles of Sharia in terms of practical expertise. Yanti and Firdaus (2017) revealed that the implementation of Total Quality Management (TQM) did not directly affect the performance of Islamic banks, but rather first influenced service quality, which then affected the performance of Islamic banks. Sathye (2001) argues that more efficient banks pay higher remuneration to their superior managerial staff. This is fully justified in Islamic banks that require high staff qualifications and professional experts to expand their products and services, which are more complex and sophisticated than those of traditional banks (Solé, 2007).

Diversification (DIV) positive is not significant on the TFPCH variable. The more business segments that are built, the greater will be the decline in company performance. The company's focus will be divided due to the fact that it has several distinct goals, therefore controlling and monitoring actions becomes inefficient and difficult to implement correctly because the costs incurred are high. Another result from Bahrini (2015) shows that diversification had an effect on the productivity of MENA Islamic banks, and had different effects on company performance in different countries. The state of the institutional and economic environment in a particular country will influence its diversification (Cakrabakti, Singh & Mahmood, 2007). The existence of agency theory is also possible, in which managers conduct overinvestment activities to fund high-risk projects.

The negative RISK variable is not significant to the TFPCH variable. This finding contradicts the results of Sufian and Noor (2009), Chiou (2009) and Sufian (2011), but is in line with those of Bahrini (2015) and Kamarudin et al. (2017), who found that credit risk variables showed negative and insignificant coefficients. Bahrini (2015) argues that problem loans do not affect the productivity growth of Islamic banks in MENA countries. The small amount of problematic financing faced by Islamic banks has no effect on bank profitability (Haq, 2015). The amount of return on Islamic bank financing remains relatively stable, so the level of credit risk does not affect banks' business in generating profits. In other words, the level of problem loans for Islamic banks in Indonesia does not have a significant effect on their productivity.

The positive ROE variable is not significant to the TFPCH variable, which is in line with the research by Rani et al. (2017). Another study conducted by Bahrini (2015) contradicts the results of this study, finding a significant positive correlation of ROE variables with the productivity of Islamic banks in MENA.

Hasan and Marton's (2003) research explores the equity ratio, showing a positive correlation that is consistent with inefficiency, and demonstrating that banks that resist relative risks have lower productive assets, so they are less likely to be associated with increased efficiency. Hasan and Marton (2003) and Sufian (2007) argue that higher profitability will correlate to higher efficiency, and Chiou (2009) adds that the higher the profitability of banks, the greater the growth of efficiency and productivity. However, an increase in profitability does not correlate to the efficiency of Islamic banks in Indonesia. Higher bank profitability was not followed by higher efficiency or productivity growth during the study period.

Negative FDR and LIQ variables are not significant to the TFPCH variable. This result contradicts the findings of Chiou (2009), who claimed that an increase in the FDR ratio shows that deposit resources are managed effectively, so productivity can be increased. Bachri and Saifi (2013) add that the distribution of Indonesian Islamic bank financing has not been offset by the addition of the number of funds raised, so the amount of receivables not received erodes the amount of cash. As institutions that have a role and function as channellers of funds, the effectiveness of Islamic banks in lending and using funds, and their ability to meet the obligations of third party funds, have not been managed optimally, meaning this does not affect any increase in productivity.

The LIQ variable results are in line with the research by Rani et al. (2017). LIQ is cash to total assets, with the ratio relatively small because of its function as a liquidity reserve fund for Islamic banks and meaning that there is no effect on their productivity performance. However, in this calculation ratio, there is a value of owned securities, so an increase in the proportion of loans in a bank's asset portfolio is needed to support bank operations (Garcia-Herrero et al., 2009; Naceur and Omran, 2011).

The positive GDP variable has a significant effect on the TFPCH variable. Khizer Ali (2011) confirmed the theory that an increase in GDP will increase people's incomes, which subsequently has an impact on their ability to save. His findings conclude that GDP is positively significantly related to the amount of savings collected by banks in Pakistan. Benes & Kulhof Research (2012) and Wolf (2014) discuss the correlation between Islamic finance and economic growth, emphasising the role of Islamic banks in mobilising savings to stimulate economic growth. Boukhatem and Moussa (2018) examined the dynamic interaction between Islamic banking and economic growth in the MENA region in the period 2000-2014. Their study found that development of the financial system will stimulate economic growth and that the development of Islamic finance is positively correlated with such growth.

Countries with good macroeconomic and institutional policies (low inflation rates, wise government spending, good education policies, ethical regulatory frameworks, and high-quality institutions) are likely to experience GDP growth (Boukhatem & Moussa, 2018). In light of this, this study can be complementary to improvements in both institutional performance and economic growth.

INFLS shows a statistically negative and insignificant effect on the TFPCH variable. This result contradicts that of Sufian and Habibullah's (2010) study, which found that inflation will affect bank efficiency depending on how well inflationary movements can be anticipated. A fully anticipated inflation rate will increase company profits as long as banks can adjust their interest rates appropriately so that income will also increase. Meanwhile, if the change is not appropriately anticipated, it will lead to rising costs as a result of shortcomings in adjusting interest rates (Perry, 1992). These results are consistent with Kamarudin et al. (2017), Muda et al. (2013), Sufian et al. (2012), Uche (1996) and Ogowewo and Uche (2006). Inflation is a challenging condition for Islamic banking; high inflation rates will reduce the performance of banks when inflation is not expected to come. Islamic banks cannot adjust interest rates, which results in a fall in corporate profits (Sufian & Habibullah, 2010).

KURS is statistically negative and does not significantly influence the TFPCH variable. This result inconsistent with the findings of Clair (2014), who found that the exchange rate affected the profitability of banks in Singapore. Hidayati (2014) also showed the effect of exchange rates on the profitability of Islamic banks in Indonesia. However, exchange rate fluctuations had no effect on the productivity performance of Indonesian Islamic banks during the 2011-2018 period. Stable banking conditions with a maintained capital adequacy ratio and ratio of capital core on assets can anticipate the impact of the depreciation of the rupiah. Efforts to maintain the composition of debt and credit portfolios in the form of foreign currency owned by Islamic banks is one strategy which can be undertaken by Islamic banks, so even if they are in a dynamic state, the exchange rate of Islamic banks can still perform well.

BIRATE shows a positive and significant effect on the TFPCH variable. This result is consistent with Ali et al. (2012), who found a significant influence of interest rates on bank profitability in Pakistan. The positive correlation is explained by the empirical studies of Molyneux and Thornton (1992) and Demirgüç-Kunt and Huizinga (1999), who state that a significant increase in interest rates will affect bank profitability. The BI rate is used as a reference in determining the financing rates of Islamic banks. A low BI rate triggers a decline in interest rates, meaning the margins of Islamic banks will be more competitive. The BI interest rate acts as a bridge between Islamic banks and conventional ones, as competitors in the channelling and raising of funds. While inter-Islamic banks will face market risks related to interest rates and value risk-sharing for other Islamic banks, the rise and fall of the BI rate will affect fund raising and financing activities. Therefore, the income and profits of Islamic banks will be affected.

V. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

The productivity performance of the Islamic banking industry in the 2011-2018 period reached an efficient and productive state in the implementation of its operational activities. Productivity growth (TFPCH) was +5.3 percent (1,053), a figure which illustrates that company performance, especially in the Islamic banking industry, was able to manage and utilise available inputs to achieve maximum output levels.

Productivity growth was mainly related to technological or technical changes, with TECHCH growth improving by +4.9 percent (1,049) in Indonesian Islamic banks. The use of old-fashioned technology without innovation will result in a decrease in bank performance.

To maximise their role as intermediary institutions, Islamic banks must begin to take part in the digitalisation era. With the development of information and communication technology, the product marketing process will be beneficial in reaching all potential customers of Islamic banks. For this reason, it is hoped that banks can periodically update their technology by following related developments. EFFCH decomposition in this period occurred due to an increase in PECH of +4.5 percent (1,045).

The GDP and BI rate variables are determinants of the TFPCH of Indonesian Islamic banks during the 2011-2018 period. The influence of these two macroeconomic variables cannot be separated from the role of the banking industry in Indonesia, which is considered to be the driving force of the national economy. Banking fundamentals will depend on how banks utilise the momentum of economic conditions. Their operational activities will also be susceptible to any national economic slowdown. Hence, an accurate strategy is needed in the decision making of an institution in response to macroeconomic variables in order to support the development and improvement of organisational performance.

5.2. Recommendations

The regulator is expected to provide support and facilities to create an environment of sustainable competitiveness for the Islamic banking sector, as well as being able to measure the performance of the banking sector through its level of efficiency and productivity. Regulators should also play their role in supporting the efficient allocation and distribution of risk throughout the banking industry. In the process of developing policies in response to macroeconomic conditions, regulators should make ones with the precautionary principle because the banking industry is known to be closely related to external factors.

Future studies could update this research in terms of methodology, sample and period, and taking input-output variables so that they can be adjusted by taking samples of variables that can accommodate the characteristics of Islamic banking, as well as other determinant variables that are more in line with the dynamics of Islamic banking. It is therefore expected that further research could be conducted on the level of productivity with renewal and adjustment to the development of science .

For practitioners, it is suggested that they could utilise the momentum of the digitalisation era to improve the quality of products and services. In addition, there needs to be a special allocation for investment in technological development, while maintaining managerial efficiency.

REFERENCES

- Abbas, A. J. (2011). *Contemporary Islamic Banking: Principles, Values and Their Development in Indonesia*.
- Abbas, M., Hammad, R. S., Elshahat, M. F., & Azid, T. (2015). *Efficiency, Productivity and Islamic Banks: An Application of DEA and Malmquist Index*. *Humanomics*, 31(1), 118–131.
- Al-Muharrami, S. (2007). The Causes of Productivity Change in GCC Banking Industry. *International Journal of Productivity and Performance Management*, 56(8), 731–743.
- Alexakis, C., Izzeldin, M., Johnes, J., & Pappas, V. (2019). Performance and Productivity in Islamic and Conventional Banks: Evidence from the Global Financial Crisis. *Economic Modelling*, 79, 1–14.
- Ali, K., Akhtar, M. F., & Ahmed, H. Z. (2011). Bank-Specific and Macroeconomic Indicators of Profitability-Empirical Evidence from the Commercial Banks of Pakistan. *International Journal of Business and Social Science*, 2(6), 235-242.

- Ali, S. A., Shafique, A., Razi, A., & Aslam, U. (2012). Determinants of Profitability of Islamic Banks, A Case Study of Pakistan. *Interdisciplinary Journal of Contemporary Research in Business*, 3(11), 86-99.
- Alimohammadlou, M., & Mohammadi, S. (2016). Evaluating the Productivity using Malmquist Index based on Double Frontiers Data. *Procedia-Social and Behavioral Sciences*, 230, 58-66.
- Ariss, R. T., Rezvanian, R., & Mehdian, S. M. (2007). Cost Efficiency, Technological Progress and Productivity Growth of Banks in GCC Countries. *International Journal of Business*, 12(4), 471.
- Ascarya, A., & Yumanita, D. (2008). Comparing the Efficiency of Islamic Banks in Malaysia and Indonesia. *Buletin Ekonomi Moneter dan Perbankan*, 11(2), 95-119.
- Assaf, A. G., Barros, C. P., & Matousek, R. (2011). Productivity and Efficiency Analysis of Shinkin Banks: Evidence from Bootstrap and Bayesian Approaches. *Journal of Banking & Finance*, 35(2), 331-342.
- Bachri, S., & Saifi, M. (2013). Effect of Financial Ratios on Financial Performance of Islamic Banks. *Journal of Business Administration*, 1(2), 177-185.
- Bahrini, R. (2015). The Productivity of MENA Islamic Banks: A Bootstrapped Malmquist Index Approach. *International Journal of Islamic and Middle Eastern Finance and Management*, 8(4), 508-528.
- Bassem, B. S. (2014). Total Factor Productivity Change of MENA Microfinance Institutions: A Malmquist Productivity Index Approach. *Economic Modelling*, 39, 182-189. doi: 10.1016/j.econmod.2014.02.035
- Beck, T., Demirgüç-Kunt, A., & Merrouche, O. (2013). Islamic vs. Conventional Banking: Business Model, Efficiency and Stability. *Journal of Banking & Finance*, 37(2), 433-447.
- Berger, A. N., & Humphrey, D. B. (1997). Efficiency of Financial Institutions: International Survey and Directions for Future Research. *European Journal of Operational Research*, 98(2), 175-212.
- Berger, A. N., & Mester, L. J. (2003). Explaining the Dramatic Changes in Performance of US Banks: Technological Change, Deregulation, and Dynamic Changes in Competition. *Journal of Financial Intermediation*, 12(1), 57-95.
- Boukhatem, J., & Moussa, F. B. (2018). The Effect of Islamic Banks on GDP Growth: Some Evidence from Selected MENA Countries. *Borsa Istanbul Review*, 18(3), 231-247.
- Casu, B., & Girardone, C. (2004). Financial Conglomeration: Efficiency, Productivity and Strategic Drive. *Applied Financial Economics*, 14(10), 687-696.
- 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.
- Caves, D. W., Christensen, L. R., & Diewert, W. E. (1982). The Economic Theory of Index Numbers and the Measurement of Input, Output, and Productivity. *Econometrica*, 50(6), 1393 .
- Chakrabarti, A., Singh, K., & Mahmood, I. (2006). Diversification and Performance: Evidence from East Asian firms. *Strategic Management Journal*, 28(2), 101-120.
- Chiou, C.-C. (2009). Effects of Financial Holding Company Act on Bank Efficiency and Productivity in Taiwan. *Neurocomputing*, 72(16-18), 3490-3506.

- Clair, R. S. (2014). Macroeconomic Determinants of Banking Financial Performance and Resilience in Singapore. *Monetary Authority of Singapore (MAS) Staff paper No. 38*, 1-34.
- Coelli, T. (1996). *A Guide to DEAP version 2.1: A Data Envelopment Analysis (Computer) Program*. Centre for Efficiency and Productivity Analysis, University of New England, Australia.
- Coelli, T. J., Rao, D. S. P., O'Donnell, C. J., & Battese, G. E. (2005). *An Introduction to Efficiency and Productivity Analysis*. Springer Science & Business Media.
- Demircuc-Kunt, A., & Huizinga, H. (1999). Determinants of Commercial Bank Interest Margins and Profitability: Some International Evidence. *The World Bank Economic Review*, 13(2), 379-408.
- Färe, R., & Grosskopf, S. (1992). Malmquist Productivity Indexes and Fisher Ideal Indexes. *The Economic Journal*, 102(410), 158-160.
- Färe, R., Grosskopf, S., & Lovell, C. A. K. (n.d.). *Production Technology*. Production Frontiers, 24 -60.
- Färe, R., Grosskopf, S., Norris, M., & Zhang, Z. (1994). Productivity Growth, Technical Progress, and Efficiency Change in Industrialized Countries. *The American Economic Review*, 66-83.
- Farrell, M. J. (1957). The Measurement of Productive Efficiency. *Journal of the Royal Statistical Society: Series A (General)*, 120(3), 253-281.
- Fisher, I. (1922). The making of Index Numbers: A Study of their Varieties, Tests, and Reliability (No. 1). *Houghton Mifflin*.
- García-Herrero, A., Gavilá, S., & Santabárbara, D. (2009). What explains the Low Profitability of Chinese Banks?. *Journal of Banking & Finance*, 33(11), 2080-2092.
- Grifell-Tatjé, E., & Lovell, C. K. (1995). A Note on the Malmquist Productivity Index. *Economics Letters*, 47(2), 169-175.
- Grosskopf, S. (1993). Efficiency and Productivity. The measurement of Productive Efficiency: Techniques and Applications, 160-194 .
- Hamdan, C. (2009). Banking on Islam: A Technology Perspective. *Islamic Finance News*, 6(19), 20-21.
- Hasan, I., & Marton, K. (2003). Development and Efficiency of the Banking Sector in a Transitional Economy: Hungarian Experience. *Journal of Banking & Finance*, 27(12), 2249-2271.
- Haq, R. N. A. (2015). Effect of Financing and Efficiency Profitability of Islamic Commercial Banks. *Perbanas Review*, 1(01).
- Hidayati, A. N. (2014). Effect of Inflation, BI Rate And Exchange To Profitability Islamic Bank in Indonesia. *An-Nisbah: Journal of Sharia Economics*, 1(1), 72-97.
- 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.
- Jemric, I., & Vujcic, B. (2002). Efficiency of Banks in Croatia: A DEA Approach. *Comparative Economic Studies*, 44(2-3), 169-193.
- Kamarudin, F., Hue, C. Z., Sufian, F., & Mohamad Anwar, N. A. (2017). Does the Productivity of Islamic Banks endure Progress or Regress? Empirical Evidence using Data Envelopment Analysis based on the Malmquist Productivity Index. *Humanomics*, 33(1), 84-118.

- Koutsomanoli-Filippaki, A., Margaritis, D., & Staikouras, C. (2009). Efficiency and Productivity Growth in the Banking Industry of Central and Eastern Europe. *Journal of Banking & Finance*, 33(3), 557-567.
- Lewis, M. K., & Algaoud, L. M. (2001). *Islamic Banking. Books*.
- Malmquist, S. (1953). Index Numbers and Indifference Surfaces. *Trabajos de Estadística y de Investigación Operativa*, 4(2), 209-242.
- Mansoor Khan, M., & Ishaq Bhatti, M. (2008). Islamic Banking and Finance: On Its Way to Globalization. *Managerial Finance*, 34(10), 708-725.
- Mokhtar, H. S. A., Abdullah, N., & Alhabshi, S. M. (2008). Efficiency and Competition of Islamic banking in Malaysia. *Humanomics*, 24(1), 28-48.
- Molyneux, P. & Thornton, J. (1992). Determinants of European Bank Profitability: A Note. *Global Business Review*, 10, 225 - 241.
- Muda, M., Shaharuddin, A., & Embaya, A. (2013). Comparative Analysis of Profitability Determinants of Domestic and Foreign Islamic Banks in Malaysia. *International Journal of Economics and Financial Issues*, 3(3), 559.
- Mukherjee, K., Ray, S. C., & Miller, S. M. (2001). Productivity Growth in Large US Commercial Banks: The Initial Post-Deregulation Experience. *Journal of Banking & Finance*, 25(5), 913-939.
- Naceur, S. B., & Omran, M. (2011). The Effects of Bank Regulations, Competition, and Financial Reforms on Banks' Performance. *Emerging Markets Review*, 12(1), 1-20.
- Norma, Saad, M., Shabri Abd. Majid, M., Kassim, S., Hamid, Z., & Yusof, R. M. (2010). A Comparative Analysis of the Performance of Conventional and Islamic Unit Trust Companies in Malaysia. *International Journal of Managerial Finance*, 6(1), 24-47.
- Ogowewo, T. I., & Uche, C. (2006). (Mis) using Bank Share Capital as a Regulatory Tool to Force Bank Consolidations in Nigeria. *Journal of African Law*, 50(2), 161-186.
- Olson, D., & Zoubi, T. (2017). Convergence in Bank Performance for Commercial and Islamic Banks during and after the Global Financial Crisis. *The Quarterly Review of Economics and Finance*, 65, 71-87.
- Perry, P. (1992). Do Banks Gain or Lose from Inflation?. *Journal of Retail Banking*, 14(2), 25-31.
- Rani, L., Rusydiana, A., & Widiastuti, T. (2017). Comparative Analysis of the Islamic Bank's Productivity and the Conventional Bank is in Indonesia period 2008-2016. In *1st International Conference on Islamic Economics, Business and Philanthropy (ICIEBP 2017)* (pp. 118-123).
- 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), 227-242.
- Rusydiana, A. S. (2016). Analysis Problem Development of Islamic Banking Indonesia: An application of Analytic Network Process Method. *Esensi: Journal of Business and Management*, 6(2), 237-246.
- Rusydiana, A. S. (2018). Malmquist Index for Measurement of Efficiency and Productivity in Islamic Bank Indonesia. *Journal of Economics and Development*, 26(1).

- Samuelson, P. A., & Nordhaus, W. D. (2001). *Microeconomics*, 17. Aufl., Boston ua .
- Sathye, M. (2001). X-efficiency in Australian Banking: An Empirical Investigation, *Journal of Banking and Finance*, 25(3), 613-630.
- Sealey Jr, 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.
- Sole, M. J. (2007). Introducing Islamic Banks into Coventional Banking Systems (EPub) (No. 7-175). International Monetary Fund.
- Srairi, S. A. (2011). Productivity Growth in the GCC Banking Industry: Conventional versus Islamic Banks. *Journal of Knowledge Globalization*, 4(2).
- Sufian, F. (2007). The Efficiency of Islamic Banking Industry: A Non-Parametric Analysis with Non-Discretionary Input Variable. *Islamic Economic Studies*, 14(1).
- Sufian, F. (2011), Banks Total Factor Productivity change in a Developing Economy: Does Ownership and Origins Matter?, *Journal of Asian Economics*, 22(1), 84-98
- Sufian, F., & Akbar Noor Mohamad Noor , M. (2009). The Determinants of Islamic Banks' Efficiency changes: Empirical Evidence from the MENA and Asian Banking Sectors. *International Journal of Islamic and Middle Eastern Finance and Management*, 2(2), 120-138.
- Sufian, F., & Shah Habibullah, M. (2010). Developments in the Efficiency of the Thailand Banking Sector: A DEA Approach. *International Journal of Development Issues*, 9(3), 226-245..
- Suzuki, Y., & Sastrosuwito, S. (2011). Efficiency and Productivity change of Indonesian Commercial Banks. In *International Conference on Economics, Trade and development IPEDR (Vol. 7)*.
- Thomson Reuters. (2018). Islamic Finance Development Report. Retrieved from <https://repository.salaamgateway.com/images/iep/galleries/documents/20181125124744259232831.pdf>
- Törnqvist, L. (1936). The Bank of Finland's Consumption Price Index.
- Uche, C. U. (1996). The Nigerian failed Banks Decree: A Critique. *Journal of International Banking Law*, 11(10), 436-441.
- Viverita, K. B., & Skully, M. (2007). Efficiency Analysis of Islamic Banks in Africa, Asia, and the Middle East. *Review of Islamic Economics*, 11(2), 5-16.
- Warde, I. (2000). *Islamic Finance in the Global Economy*. Edinburgh University Press.
- Willison, B. (2009). Technology Trends in Islamic Investment Banking. *Islamic Finance News*, 6(19), 22-23.
- Yanti, L. D., & Firdaus, A. (2017). Impact of Total Quality Management (TQM) Implementation on Service Quality and Performance of Islamic Banks. *Millah: Journal of Religious Studies* 1(1), 31-46.
- Yaumidin, U. K. (2007). Efficiency In Islamic Banking: A Non-Parametric Approach. *Bulletin of Monetary Economics and Banking*, 9(4). doi: 10.21098/bemp.v9i4.213
- Yudistira, D. (2004). Efficiency in Islamic Banking: An Empirical Analysis of Eighteen Banks. *Islamic Economic Studies*, 12(1).