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MEASURING BANK EFFICIENCY AND PRODUCTIVITY USING DEA AND MALMQUIST INDEX: A CASE STUDY OF NTB SYARIAH BANK'S PRE- AND POST-CONVERSION PERFORMANCE

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ABSTRACT

Purpose: *This study aims to analyze the performance of Bank NTB Syariah by measuring efficiency and productivity before and after conversion.* ***Methodology:*** *This study uses a quantitative method with a non-parametric approach. The data analysis technique to measure efficiency uses data envelopment analysis (DEA) with MAXDEA software. The data analysis technique to measure productivity uses the Malmquist productivity index (MPI) with DEAP software.* ***Results:*** *The level of productivity of Bank NTB Syariah before the conversion experienced a decrease in productivity, while after the conversion, there was an increase in productivity.* ***Findings:*** *The factor that plays the most role in changes in the productivity of Bank NTB Syariah is the technological change factor (TECHCH).* ***Novelty:*** *The measurement results based on the Malmquist productivity index show that Bank NTB Syariah's productivity levels before and after conversion were different. Before the conversion, productivity decreased, while after the conversion, it increased. The measurement results based on data envelopment analysis show that Bank NTB Syariah's efficiency levels are classified as efficient before and after the conversion.* ***Originality:*** *This study analyzes the productivity and efficiency of Islamic banks before and after the conversion.* ***Conclusion:*** *Bank NTB Syariah must continue to develop and adopt various technologies in order to continue to increase productivity.* ***Type of Paper:*** *Empirical research paper.*

INTRODUCTION

Since 1992, Indonesia's banking system has adopted a dual system. This system allows banks to run conventional and sharia systems side by side. The implementation of this system began to show its impact in 1998 when Law No. 10 of 1998, replacing the Banking Law, was issued (Djayusman & Abdillah, 2015). Since 1998, sharia banks have begun to emerge. In the last twenty (20) years, namely in 2000, the number of Sharia banks was 84, namely 2 Sharia Commercial Banks (BUS), 3 Sharia Business Units (UUS), and 79 Sharia People's Financing Banks (BPRS) (Nofinawati, 2015). It increased drastically to 189 banks, including 14 BUS, 20 UUS, and 163 BPRS. All of these sharia banks have a market share of 8.29 in Indonesia (OJK, 2020). The emergence of Sharia banks has occurred not only in national banks but also in regional banks. Even in some regional banks, conversions have occurred; regional banks that initially used a conventional system have changed to a Sharia system.

A conversion is a change in the bank's business activities from a conventional bank to a Sharia bank so that the conventional bank can fully operate with the Sharia system.

Conversion is a realistic choice for banks, primarily regional ones wanting to change systems. There are at least three factors that regional banks choose to convert to switch systems. First, it requires significant capital. If a regional bank initially used a conventional system by opening a UUS, then the UUS would want to switch to a BUS by spinning off, and significant capital would be needed. Second, targeting the same market. Suppose a regional bank spins off a UUS, which changes to a BUS. Then, in one region, two regional banks will compete for the market in the same region. Third is the problem of efficiency. When a regional bank opens a UUS, all the facilities and infrastructure in the UUS still depend on the parent bank. However, if a spin-off is carried out, the UUS switching to the BUS must bear the facilities and infrastructure (Sutan Emir Hidayat et al., 2020). The conversion trend is expected to continue due to Law No. 21 of 2008 concerning Sharia Banking, which requires conventional banks that have UUS: 1) where the minimum assets are 50% of the total assets of the parent bank or 2) the age of the UUS reaches 15 years as of 2008. Then, the holding company bank must separate itself from the UUS. Based on Law No. 21 of 2008 concerning Sharia Banking, all UUS will switch to BUS no later than 2023.

Increasing the number of BUS must be followed by increasing the quality of bank performance. The way to measure bank performance is by analyzing productivity and efficiency. According to Berger and Humphrey, the initial task in evaluating a financial institution's performance is to separate the production units that perform well from those that perform poorly. This evaluation can be done using a parametric or non-parametric approach (Berger & Humphrey, 1997). The researcher used a parametric approach in this study. Productivity is an important aspect of measuring a company's success because, in addition to affecting production costs, it also affects motivation, employee satisfaction, and consumer confidence. Productivity can also be an indicator of competitive ability and an aspect that is taken into account in the decision-making process. Efficiency is a comparison between output and input. An efficient condition for a company is when it can produce maximum output with the available input. Efficiency is critical because it has an impact on profitability (Juliza Hidayati, 2005). Efficiency is a source of growth and the root of banking health problems (Muharam, 2007). Efficiency gives investors confidence to invest their funds; for customers, efficiency shows the bank's ability to provide profits at a low cost, while for the government, an efficient bank will provide additional taxes, so efficiency and productivity must be a concern for banks (Suseno, 2008). In a study conducted by Fonseka and Farooque in Pakistan, they found that conventional banks perform more efficiently than Islamic banks (Fonseka & Farooque, 2024). According to Ariff and Can findings, joint-stock banks appear to be more cost—and profit-efficient than state-owned banks, while medium-sized banks are significantly more efficient than small and large banks (Ariff & Can, 2008).

This study aims to analyze the productivity and efficiency of NTB Sharia Bank before and after conversion. So that it can be known whether NTB Bank gets optimal productivity and efficiency when running a conventional system or after changing the system to sharia.

METHOD

The research approach used in this study is quantitative, and the type of research is comparative causal research. The research sample is the annual report of Bank NTB Syariah for the period of three years before the conversion and five years after the conversion, namely 2015, 2016, 2017, 2019, 2020, 2021, 2022, and 2023. The selection of the research period was due to data limitations because the data used was the annual report of NTB Syariah Bank, which was taken directly from the official website of NTB Syariah Bank. In this study, the data available before the conversion was 2015, 2016, and 2017. The data after the conversion was 2019, 2020, 2021, 2022,

and 2023. Data from 2018 was not included because this year NTB Syariah Bank made the conversion, and data from 2024 was not available when this study was conducted.

The researcher used documentation as the data collection technique. Measuring productivity and efficiency in financial institutions, both banks and non-banks, requires input and output variables. There are three approaches to determining input and output variables, namely: 1) Production approach, 2) Intermediation approach, and 3) asset approach. The approach used is the intermediation approach because the bank's main task is as an intermediary institution. Efficiency measurement uses the assumption of Variable return to scale (VRS). VRS assumes that there is no linear relationship between input and output. It is usually used to measure efficiency when the scale of production is considered important and varied.

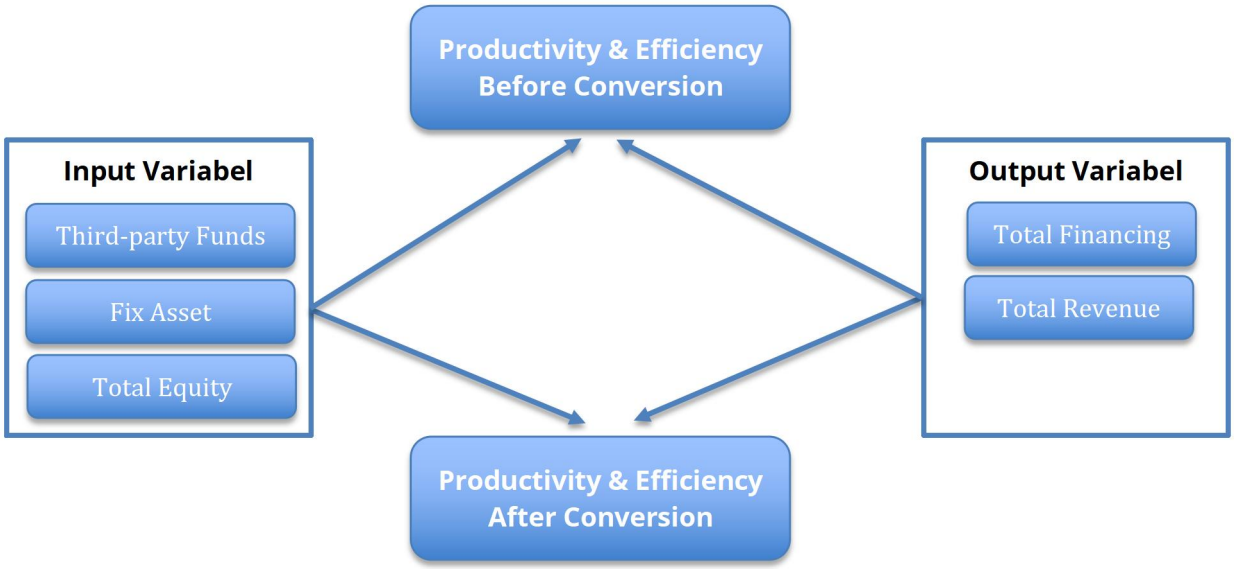
Table 1. Variable Input and Output

Input	Output
1). Third party fund	1). Total Financing
2). Total Asset	2). Total Revenue
3). Total Equity	

Source: primary data processed, 2024

In this study, data analysis techniques for measuring efficiency and productivity use non-parametric analysis techniques. According to Casu et.al, the use of parametric and non-parametric approaches generally does not produce different calculation results (Casu et al., 2004). Bank NTB Syariah's productivity is measured using the Malmquist Productivity Index (MPI) with the software DEAP. MPI pertama kali diperkenalkan oleh Caves, Christensi, dan Diewert dalam papernya meredifinisi total factor productivity menggunakan Malmquist input dan output distance function, hasilnya kemudian disebut sebagai MPI (Coelli et al., 2005). Bank NTB Syariah's efficiency is measured using the Data Envelope Analysis (DEA) technique with the software MaxDEA.

Figure 1. Conceptual Model of Research



Source: primary data processed, 2024

RESULTS AND DISCUSSION

RESULTS

Productivity

Productivity measurement using the Malmquist Productivity Index (MPI). The model used to analyze the productivity of NTB Syariah Bank before and after the conversion is the Banker, Charnes and Cooper (BCC) model or the Variable Return to Scale (VRS). MPI measurement results in assessing productivity refer to the following statements: 1) If the MPI measurement results have a value lower than 1 (1 < MPI), then there is a decrease in productivity; 2) if the MPI measurement results have a value higher than 1 (MPI> 1), then there is an increase in productivity, and 3) if the MPI measurement results have a value equal to 1 (MPI = 1), then there is no change in performance or productivity.

Table 2. Productivity Before Conversion

Period	EFFCH	TECHCH	PECH	SECH	TFPCH
2015-2016	1.000	0.916	1.000	1.000	0.916
2016-2017	1.000	0.887	1.000	1.000	0.887
Mean	1.000	0.901	1.000	1.000	0.901

Source: primary data processed, 2024

The results of measuring the productivity of NTB Syariah Bank before the conversion generally showed a decrease in the productivity of NTB Syariah Bank before the conversion, as seen from the TFPCH value or total productivity factor on average of 0.901 or 90.1%. In 2015-2016, it was worth 0.916 or 91.6% and in 2016-2017, it was worth 0.887 or 88.7%. Based on the measurement results, there was a decrease in productivity of 8.4% in the period 2015-2016 and a decrease in productivity of 11.3% in the period 2016-2017. Then, if reviewed in more detail, the cause of the decrease in productivity of NTB Syariah Bank before the conversion was a factor of technological change (TECHCH), where the TECHCH value in the period 2015-2016 was 0.916 or decreased by 8.4% and in the period 2016-2017 was 0.887 or decreased by 11.3%.

Table 3. Productivity After Conversion

Period	EFFCH	TECHCH	PECH	SECH	TFPCH
2019-2020	1.000	0.960	1.000	1.000	0.960
2020-2021	1.000	1.073	1.000	1.000	1.073
2021-2022	1.000	1.029	1.000	1.000	1.029
2022-2023	1.000	1.039	1.000	1.000	1.039
Mean	1.000	1.024	1.000	1.000	1.024

Source: primary data processed, 2024

The results of the measurement of Bank NTB Syariah's productivity after the conversion generally showed an increase in the productivity of Bank NTB Syariah after the conversion, as seen from the TFPCH value or total productivity factor on average of 1,024 or 102.4%. In the 2019-2020 period, the TFPCH value was 0.960 or 96%, which means that there was a decrease in productivity of 4% in the 2019-2020 period. If reviewed in more detail, the cause of the decrease in the productivity of Bank NTB Syariah in the 2019-2020 period was the factor of technological change (TECHCH), where the TECHCH value in the 2019-2020 period was 0.960 or decreased by 4%. In the 2020-2021 period, the TFPCH value was 1,073 or 107.3%, which means that in the 2020-2021 period, there was an increase in productivity of 7.3%. This increase in productivity is due to the technological change factor (TECHC), which has a value of 1.073. Then, in the 2021-2022 period, the TFPCH value is 1.029

or 102.9%, which means that in the 2021-2022 period, there was an increase in productivity of 2.9%. This increase in productivity is due to the technological change factor (TECHC), which has a value of 1.029. Then, in the 2022-2023 period, the TFPCH value is 1.039 or 103.9%, which means that in the 2021-2022 period, there was an increase in productivity of 3.9%. This increase in productivity is due to the technological change factor (TECHC), which has a value of 1.039.

Efficiency

Measuring the level of efficiency using the Data Envelopment Analysis (DEA) method. In its implementation, the use of DEA specifically measures the efficiency of an economic activity unit by using many inputs and outputs (Lestari, 2015). This study analyzes efficiency using the Variable Return to Scale (VRS) approach.

Table 4. Efficiency Before Conversion

Year	Score	Interpretation
2015	1.00	Efficient
2016	1.00	Efficient
2017	0.96	Inefficient

Source: primary data processed, 2024

The table shows that 2015 and 2016 had scores of 1, which indicates efficiency, and 2017 had scores of 0.96, which indicates inefficiency. Therefore, the input and output variables need to be improved in 2017. To make improvements in the efficiency by adjusting the actual value with the projected value. Here is a comparison of the actual value and the projected value in 2017:

Table 4. Score Actual and Projection Before Conversion

Year	Variable	Actual	Projection	*To Gain*	*Achieved*
2017	Third party fund	7190684000000	6505363366463	10%	90%
	Equity	1273169000000	1273169000000	0%	100%
	Total Asset	8864392000000	8704777935407	2%	98%
	Total Financing	5397842000000	6340614683123	-17%	83%
	Total Revenue	992650000000	1037665394049	-5%	95%

Source: primary data processed, 2024

In the input variable, third-party funds have an actual value of Rp7.190 trillion, while the projection is Rp6.505 trillion. Then, total assets have an actual value of Rp8.864 trillion, while the projection is Rp8.704 trillion. Furthermore, in the output variable, the financing variable has an actual value of Rp5.397 trillion, while the projection is Rp6.340 trillion. Then, the income variable has an actual value of Rp992 billion, while the projection is Rp1.037 trillion.

Table 5. Efficiency After Conversion

Year	Score	Interpretation
2019	0.93	Inefficient
2020	0.89	Inefficient
2021	0.95	Inefficient
2022	0.99	Inefficient
2023	1.00	Efficient

Source: primary data processed, 2024

The table shows that 2019 has a score of 0.93, 2020 has a score of 0.89, 2021 has a score of 0.95, 2022 has a score of 0.99, and 2023 has a score of 1. So, only in 2023 is indicated as efficient. While 2019, 2020, 2021, and 2022 are indicated as inefficient. Therefore, improvements need to be made in 2019, 2020, 2021, and 2022 so that the company's performance can achieve efficiency. To make improvements in the efficiency by adjusting the actual value with the projected value. Here is a comparison of the actual value and the projected value in 2019, 2020, 2021, and 2022:

Table 6. Score Actual and Projection After Conversion

Year	Variable	Actual	Projection	*To Gain*	*Achieved*
2019	Third party fund	6816359000000	6457039699479	5%	95%
	Equity	1400359000000	1268282152806	9%	91%
	Total Asset	8640305000000	8640305000000	0%	100%
	Total Financing	5582098000000	6297370736389	-13%	87%
	Total Revenue	966509000000	1033813606730	-7%	83%
2020	Third party fund	7408916000000	7408916000000	0%	100%
	Equity	1397091000000	1364542935949	2%	98%
	Total Asset	10419759000000	9910288489802	5%	95%
	Total Financing	6410884000000	7149187053353	-12%	88%
	Total Revenue	932287000000	1109685850949	-19%	81%
2021	Third party fund	8143058000000	8143058000000	0%	100%
	Equity	1455370000000	1438784813619	1%	99%
	Total Asset	11215180000000	10889773133612	3%	97%
	Total Financing	7406836000000	7806157012824	-5%	95%
	Total Revenue	1062962000000	1168202909399	-10%	90%
2022	Third party fund	9780184000000	9285667985802	5%	95%
	Equity	1554334000000	1554334000000	0%	100%
	Total Asset	13001641000000	12414231528517	5%	95%
	Total Financing	8725028000000	8828657341175	-1%	99%
	Total Revenue	1224900000000	1259278171849	-3%	97%

Source: primary data processed, 2024

In 2019, the input variable, third-party funds, had an actual value of IDR 6.816 trillion, while the projection was IDR 6.457 trillion. Then, equity had an actual value of IDR1.400 trillion, while the projection was IDR 1.268 trillion. Furthermore, in the output variable, the financing variable had an actual value of IDR 5.582 trillion, while the projection was IDR 6.297 trillion. Then, the revenue variable had an actual value of IDR 966 billion, while the projection was IDR 1.033 trillion. In 2020, the input variable, equity, had an actual value of IDR 1.397 trillion, while the projection was IDR 1.364 trillion. Then, total assets had an actual value of IDR 10.419 trillion, while the projection was IDR 9.910 trillion. Furthermore, in the output variable, the financing variable had an actual value of IDR 6.410 trillion, while the projection was IDR 7.149 trillion. Then, the revenue variable has an actual value of IDR 932 billion, while the projection is IDR 1.109 trillion.

In 2021, the input variable, equity, has an actual value of IDR 1.455 trillion, while the projection is IDR 1.438 trillion. Then, the total assets have an actual value of IDR 11.215 trillion, while the projection is IDR 10.889 trillion. Furthermore, in the output variable, the financing variable has an actual value of IDR 7.406 trillion, while the projection is IDR 7.806 trillion. Then, the revenue variable has an actual value of IDR 1.062 trillion, while the projection is IDR 1.168 trillion. In 2022, the input

variable, third-party funds, have an actual value of IDR 9.780 trillion, while the projection is IDR 9.285 trillion. Then, the total assets have an actual value of IDR 13.001 trillion, while the projection is IDR 12.414 trillion. Next, in the output variable, the financing variable has an actual value of Rp8.725 trillion, while the projection is Rp8.828 trillion. Then, the revenue variable has an actual value of Rp1.224 trillion, while the projection is Rp1.259 trillion.

DISCUSSION

Productivity

Based on the results of the calculation of the productivity level of NTB Syariah Bank before conversion, the results generally show a decrease in productivity. The factor that caused the decrease in productivity of NTB Syariah Bank before conversion was technological change (TECHCH). The decrease in TECHCH shows that before converting, NTB Syariah Bank had not been optimal in utilizing information technology (IT) or had not been maximal in developing technology in various operational activities. The results of this study are the same as the results of research conducted by Munteanu who found in the study that there was a decrease in bank productivity in Romania in the period 2006-2011 (Munteanu et al., 2013).

Based on the results of the calculation of the productivity level of NTB Syariah Bank, after conversion, the results generally show an increase in productivity. The factor that causes the increase in productivity of NTB Syariah Bank after converting is technological change (TECHCH). The increase in TECHCH shows that after conversion, NTB Syariah Bank has been able to optimize and utilize information technology (IT). In other words, NTB Syariah Bank has been able to maximize the development of technology for its various operational activities. The results of this study are in accordance with Hadad's findings, where in his research, he found that the level of bank productivity tends to be stable. Then, the most influential factor in making changes to banking productivity in Indonesia, which functions as an intermediary institution, is technological change (Hadad et al., 2011).

Efficiency

Based on the results of the calculation of the efficiency of Bank NTB Syariah before the conversion, it showed perfect efficiency in 2015 and 2016 and inefficiency in 2017. The cause of the inefficiency of Bank NTB Syariah in 2017 was the high input but the output is low. Bank NTB Syariah can do improvement of efficiency in this output aspect by increasing the amount of financing. The amount of increase in the amount of financing that must be done is IDR 943 billion; with the addition of this amount of financing, it is also expected to be able to increase the amount of revenue. This is because the amount of income obtained by Bank NTB Syariah has not been in accordance with the projection from the DEA calculation. The shortfall in the amount of Bank NTB Syariah's revenue from the projection value in 2017 is IDR 45 billion. In addition to increasing the amount of financing, improvements can be made based on the input aspect by Bank NTB Syariah by increasing efficiency in 2017 by reducing the amount of assets. This can be seen from the total assets that exceed the projection of the DEA calculation results, where there are more than IDR 159 billion of total assets that should be reduced.

Based on the results of the efficiency calculation of NTB Syariah Bank after the conversion, it showed efficient results in 2023, but inefficient in 2019, 2020, 2021, and 2022. In 2019, efficiency improvements in the output aspect can be carried out by Bank NTB Syariah by increasing the amount of financing disbursed. The amount of additional financing is IDR 715 billion. With this additional financing amount, it is expected to increase the amount of revenue. In addition, based on the DEA calculation, the amount of revenue received by Bank NTB Syariah in 2019 was still less than the projection. The amount of shortfall in the amount of revenue of Bank NTB Syariah in 2019

reached IDR 67 billion. While in the input aspect in 2019, Bank NTB Syariah did not need to make improvements. In 2020, efficiency improvements in the output aspect can be carried out by Bank NTB Syariah by increasing the amount of financing disbursed. The amount of additional financing is IDR 738 billion. With this additional financing amount, it is expected also to increase the amount of revenue. In addition, based on the DEA calculation, the amount of revenue received by Bank NTB Syariah in 2020 was still less than the projection. The amount of shortfall in Bank NTB Syariah's revenue in 2020 reached IDR 177 billion. In addition to improvements in the output aspect, improvements in the input aspect also need to be made by Bank NTB Syariah in 2020. Improvements can be made by reducing the amount of assets. In 2020, the total amount of assets owned by Bank NTB Syariah exceeded the projection of the DEA calculation results. The amount of asset reduction that can be made reaches IDR 509 billion, and the excess amount of assets can be allocated to other aspects, such as increasing the financing disbursed.

In 2021, improvements in efficiency in the output aspect can be made by Bank NTB Syariah by increasing the amount of financing disbursed. The amount of additional financing is IDR 399 billion, with the addition of the amount of financing expected to be able to increase the amount of revenue. In addition, based on the DEA calculation, the amount of revenue received by Bank NTB Syariah in 2021 is still less than the projection. The amount of the shortfall in Bank NTB Syariah's revenue in 2021 reached IDR 105 billion. In addition to improvements in the output aspect, improvements in the input aspect also need to be made by Bank NTB Syariah in 2021. Improvements can be made by reducing the amount of assets. Because in 2021 the total amount of assets owned by Bank NTB Syariah exceeded the projection of the DEA calculation results. The amount of asset reduction that can be made reaches IDR 325 billion, and the excess amount of assets can be allocated to other aspects, such as increasing the financing disbursed. In 2022, improvements in efficiency in the output aspect can be made by Bank NTB Syariah by increasing the amount of financing disbursed. The amount of additional financing is IDR 103 billion; with this additional amount of financing, it is hoped that it will also be able to increase the amount of revenue. In addition, based on the DEA calculation, the amount of revenue received by Bank NTB Syariah in 2021 is still less than the projection. The amount of shortfall in the amount of revenue of Bank NTB Syariah in 2021 reached IDR 34 billion. In addition to improvements in the output aspect, improvements in the input aspect also need to be made by Bank NTB Syariah in 2021. Improvements can be made by reducing the amount of assets. Because in 2021 the total amount of assets owned by Bank NTB Syariah exceeded the projection of the DEA calculation results. The amount of asset reduction that can be made reaches IDR 587 billion; the excess amount of assets can be allocated to other aspects such as increasing the financing disbursed and various other more productive aspects.

The results of this study are in accordance with those conducted by Norfitriani (Norfitriani, 2016), her research found that the level of efficiency of Islamic banks before and after the spin-off showed consistent results classified as efficient each year. However, the results of this study are different from the research conducted by Sunarsih (Sunarsih, 2017), the results of her research on the level of efficiency of Islamic banks showed fluctuating results. There are Islamic banks in certain years that are classified as efficient, but in other years they are classified as less efficient. The difference in results is due to differences in research objects; Sunarsih researched 11 Islamic banks, while this study only focuses on one Islamic bank. The results of Drake and Howcroft's research suggest that the primary cause of inefficiency in banks in England is the excessive use of stationery and the underutilization of technology, such as Automatic Teller Machines (ATMs) (Drake & Howcroft, 2002).

CONCLUSION

Based on the results of direct and indirect testing, the conclusions of this study include:

1. Before the conversion, Bank NTB Syariah's productivity level decreased by 9.9%, referring to the TFPCH score of 0.901 or 90.1%. In the 2015-2016 period, it decreased by 8.4%, and in the 2016-2017 period, it decreased by 11.3%.
2. After the conversion, Bank NTB Syariah's productivity level increased by 2.4%, which is referred to by the TFPCH score of 1.024 or 102.4%. In the 2019-2020 period, it decreased by 4%, increased by 7.3% in the 2020-2021 period, increased by 2.9% in the 2021-2022 period, and increased by 3.9% in the 2022-2023 period.
3. Bank NTB Syariah's efficiency level before the conversion was classified as efficient. In 2015 and 2016, it achieved a perfect efficiency level with a score of 1, while in 2017, the efficiency score was 0.96.
4. Bank NTB Syariah's efficiency level after the conversion is classified as efficient. In 2023, it achieved a perfect efficiency level with a score of 1. In 2019, the efficiency score was 0.93; in 2020, it was 0.89; in 2021, it was 0.95; and in 2022, it was 0.99.

Recommendation for government:

The ability of Bank NTB Syariah to adopt and maximize advances in information technology (IT) in all its operational activities greatly contributes to bank productivity. Therefore, Bank NTB Syariah must continue to develop and adopt various technologies in order to continue to experience productivity. Then, to overcome the problem of efficiency, Bank must make improvements in the input and output aspects. In the input aspect, it is better to reduce the number of assets; this study found that the number of assets experienced a very large amount from the DEA measurement projection. The excess amount of assets can be allocated to other aspects that can increase bank income. Then, in the output aspect, it is better to increase the amount of financing distributed. Transferring or allocating assets and increasing financing are expected to increase the income of Bank NTB Syariah. The findings in this study are that Bank NTB Syariah's income in several periods is still below the DEA measurement projection.

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