

The Impact of Diversification on Efficiency: Analysis of The Indonesian Banking Industry

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The objective of this research is to examine the Indonesian banking industry diversification strategy towards efficiency from 2014 – 2018. The present study aims to measure banks' effectiveness as financial intermediaries with income diversification, loan diversification, and technology diversification as dependent variables, with return on assets, non-performing loan ratio, loan to deposit ratio, and bank size as control variables. To measure the firms' efficiency, this research uses a non-parametric measurement called data envelopment analysis input-oriented method. Two models are being used: constant return to scale (CRS) and variable return to scale (VRS). For measuring diversification, this research will use the Hirschman-Herfindahl Index to find the relationship between firms' efficiency, firm diversification strategy, and the control variables. This research will use panel data regression. Finally, the result of this research is Indonesian banking efficiency has not increased every year, and only loan diversification seems to affect efficiency significantly. This research suggests that firms should consider diversifying their loan distribution to get a maximum performance efficiency result.

Key words: *Efficiency, Diversification, Data Enveloping Analysis, Intermediation Approach, Hirschman-Herfindahl Index, Return on Assets, Non-Performing Loan, Loan to Deposit Ratio, Assets Size.*

Introduction

ASEAN Economic Community (MEA) 2015 and the integration of ASEAN financial services in 2020 have made competition in Indonesian banking industries tougher. With the opening of the MEA and the coming of ASEAN financial integration, foreign banks can operate more freely in Indonesia. This situation, compounding with how banks compete to offer the same product as each other, has made financial performance assessment more crucial than ever. Financial statement analysis is a potent tool. It is essential to obtain information relating to the

financial position of companies and the results achieved in connection with the election of company strategy to be implemented. By doing a report analysis of company finance, the company leader can know the situation as well as the financial development of the company with the results that have been achieved in the past, and currently.

One of the most common ways to assess the performance of the banks is the CAMELS framework (Capital, Quality Assets, Management, Earnings, Liquidity, and Sensitivity). In Indonesia, the determination of CAMEL as an indicator of bank health assessment is contained in Bank Regulation Indonesia No. 6/10/PBI/2004 12th April 2004 concerning Level Assessment System Health of a Commercial Bank, which is already an improvement from the scoring system previously. In addition to the CAMELS method, performance banking can be measured by seeing banks' management efficiency. The more efficient a bank the more it will be indicating the health of the bank. The aim of measuring effectiveness is to see firms' ability to produce maximum output with a minimum set of inputs. When efficiency measuring is done, the bank is faced with how it is to create conditions to optimise the output level to a certain input level, or to minimise the input level with a certain level of output (Hadad, 2003; Muharam, 2007; Sutawijaya & Lestari, 2009). To compete in the industry, banks are required to operate efficiently, so that they can reach maximum profit and productivity and maintain financial health.

For this reason, it is necessary to measure banks' performance, so firm efficiency and profitability level is known. The wide acceptance of data envelopment analysis as a measurement tool for measuring the efficiency of the banking industry can be attributed to the specific strengths of this approach (Charnes, Cooper, & Rhoades, 1978; Farrell, 1957). The main advantages of using data envelopment analysis are the fact that the data may not necessarily assume any functional form. Since the method compares one bank against another (and combination of banks), the units of the inputs and outputs can be varied, and it will not affect efficiency measurement. It implies that changing the units of measurement (e.g., measuring labour quantity in person-hours instead of person-days) does not change the value of the efficiency measures. Thus, the application of data envelopment analysis techniques has provided several efficiency measures such as technical allocative and scale efficiency, which related to cost and profit efficiency differentials among banks (El Moussawi & Obeid, 2011; Hassan, Mohamad, & Bader, 2009; Kamaruddin, 2008).

According to research by Elsas, Hackethal, & Holzhauser (2010), the diversification rate of big banks around the world increased by 30% from 1996 to 2003. This phenomenon raised an interesting question of whether diversification trends in the banking industry can attract shareholders while adding value creation for the banks. Compared to other sectors, banks have certain advantages in creating value when using diversification. As specific economics of scope, banks tend to have a long contractual relationship with their customers. Thus, the bank has more opportunities to get information from its customers that can be used for further growth

in the firm. Another reason why diversification can increase the value of banks, according to Elsas, Hackethal, and Holzhauser, is the advantage of increasing technology. Due to technology, the Indonesian banking industry is improving massively in the last 20 years – and it also forces banks to change how they run their business. Banks are required to keep on innovating their products and services to gain a competitive advantage against their competitor. The impact of technology and industrial 4.0 can be seen from how banks start to shift the traditional way of making a profit to incorporate fee-based income. In addition to increasing profitability, the goal of business diversification strategy is to reduce risk levels. Aligned with Indonesian Central Bank law, banks in Indonesia need to diversify credit to control the risk of default. Bank studies on credit diversification have shown mixed results. For example, Ramly (2017), in his research, found that the benefits of credit diversification depend on the level of credit risk.

On the other hand, a study by Karim et al. (2010) shows that diversification reduces risk, reduces cost efficiency, and increases profit efficiency. Because their function is so essential, banks are highly government regulated institutions to ensure they are safe and operating correctly. The issue arises on how banks can operate efficiently while maintaining the obligation to expand the scope of their businesses via diversification.

Literature Review

Efficiency

There are several approaches to how one defines efficiency. One of the well-known approaches to efficiency available is based on the study by Farrell (1957). Farrell proposed that the efficiency of a firm could be distinguished between technical and allocative efficiency. Allocative efficiency is the degree to which a company's resources are being distributed to the utilisation with the highest expected value. A firm is technically efficient if it is using the lowest possible input to produce an output (Golany & Storbeck, 1999; Portela, 2014). These two types of efficiency are then combined into an overall economic efficiency, which can be examined from the perspective of input or output-based models (Kocisova, 2014). One cannot focus on technical efficiency or allocative efficiency only. To achieve maximum benefit level, a company must produce maximum output with a certain number of inputs (technical efficiency) and produce output with the right combination with a certain price level (allocative efficiency).

One way of measuring efficiency is Data Envelopment Analysis (DEA). First introduced by Charnes, Cooper, & Rhoades (1978), DEA describes an application of mathematical programming to observe data to locate the frontier, which can then be used to evaluate efficiency. The concept of DEA is similar to the concept of technical efficiency in the theory of production. However, the main difference is that the DEA production frontier is generated

from the actual data from the evaluated firm instead of determined by some equation. Therefore, the DEA's efficiency score for a specific firm is relative to the other firms under consideration. This feature differentiates DEA from the parametric approaches, which require a particular functional form. DEA also assumes that all firms face the same unspecified technology, which defines their production possibility set (Tahir, 2009). The main objective of DEA is to determine which firms are operating on their efficient frontier and which firms are not. If the firm's input-output combination lies inside the frontier, the firm is efficient; and the firm is considered inefficient when the input-output combination lies outside the frontier. There are two well-known models in DEA: Constant Return to Scale, CRS Model, and Variable Return to Scale, VRS Model.

To be able to calculate banks' efficiency, input and output need to be selected to measure banks' activities, although there is no consensus regarding inputs and outputs that have to be used in the analysis of the efficiency regarding bank activity (Berger & Humphrey, 1991; Drake, 2001; Pasiouras, 2008). Five conventional approaches are used: the production approach, the intermediations approach, the assets approach, the user-cost approach, and the value-added approach. The intermediation approach is probably the most popular when measuring a bank's efficiency. The intermediation approach viewed banks as financial intermediaries, who accumulate deposits and purchase funds and then intermediated these funds (Allen & Santomero, 2001; Gurley & Shaw, 1956; Sealey, 1977). In selecting variables, researches about efficiency normally include assets and costs in inputs, while loans are typically counted as outputs. This approach recognises the bank's vital function that collects funds in the form of deposits and lends them out as loans to gain profit.

Diversification

Why should firms pursue diversification? To answer this, Alhassan (2015) suggests viewing firm diversification from two angles: managerial point of view and perspective point of view. The managerial point of view seeks to understand what influences managerial action in choosing diversification as a strategic move, and the perspective point of view tries to justify the expected result from the diversification activity. Therefore, a good theory of diversification must satisfy both the perspective and managerial point of view. The motives behind corporate diversification are also numerous. According to research by Montgomery (1994), there are three theoretical motivations behind why firms practise diversification: the search for market power, to solve agency problems; and the application of resource bundles to attain a competitive advantage. I refer back to diversification angles above; the search of the market and application of resource bundle is an authoritative point of view explaining firm diversification based on profit maximisation. On the other hand, agency theory is managerial and, as a basis for achieving diversification, emphasises managerial self-interest.

According to Robertho & Wibowo (2018), market power is the capability of firms to impact the market by the strategy that they have created. If the firms have weak market power, they have less room to influence the industry and achieve their targets. Vice versa, strong market power firms can easily influence the industry and achieve a more favourable target. Knowing this, it is clear that market power also reflects the level of competition between firms. To acquire market power, the firm can use profit subsidisation to support predatory pricing, practise mutual forbearance between competitors and reciprocal buying on the small competitor. From the market power theory, one can see that to enhance financial performance, the firm will diversify. Agency Theory hypothesis is a condition where the owner and managers have a different interest, which increases agency cost. This cost can be incentives, monitoring, and maximisation or reduction of welfare due to divergence between agents and welfare-maximising expected by owners. Referring to this theory, and managers often use corporate assets for their interests instead of the owners'. While the managers are concerned with unsystematic risk by trying to invest to maximise profit instead of increasing cash payment to the shareholder, owners tend to worry about systematic risk. Managers use diversification strategy as a tool to maximise profit.

Managers are likely to undertake low benefit diversification to increase their business territory's size and reduce the risk to the firm that will benefit their position with free cash flows. The Agency view emphasises the benefits accruing to managers at the expense of the stockholders as a result of the managers' decisions. Accordingly, the view explains why managers pursue diversification and predict a negative impact of diversification on firm performance. The Resources Based View approach assumes that by nature, every firm will try to have a sustainable competitive advantage towards others. This theory is based on the work by Penrose (1959) and continued by Rubin (1973). The approach by Penrose and Rubin is using Porter Five Forces to see which firm's resources can bring the most return over a specified period. The theory not only suggests to firms to improve financial performance but also encourages diversification by exploiting firms' competitive resources when entering a new market. With the resources, a firm can create entry barriers, thus providing cost and benefit to the firm—diversification based on this theory focusses on sharing competencies and resource allocation to enhance the firm's performance. There are many studies related to banks adopting diversification. However, common bank diversification is income diversification, credit (loan) diversification, asset diversification, international diversification, and geographical diversification.

Income diversification plays a big part in banks' sustainability (Busch & Kick, 2009). According to research by DeYoung & Rice (2004), banks are shifting from the traditional way of making money to fee-based income such as investment, mutual funds, and insurance. By spreading its activity towards multiple products and economic environments, banks can lower the cost of monitoring and reduce their expected cost during financial distress (Boot & Schmeits, 2000). The main objective for loan diversification is minimising exposure to any

single borrower and reducing the risk of multiple borrowers defaulting in a specific industry or geographic region simultaneously. The risk of a sudden decline in one sector or the economy of a particular region cannot be ignored, as the recent financial crisis proved that shocks could arise without giving enough time for lenders to hedge or neutralise these positions. With the rapid development of information technology, the banking industry is required to be able to keep up with developments, and one of them is Internet banking. By providing Internet banking services, it is expected it will be one of the main attractions for consumers in terms of convenience and security in transactions. In Indonesia alone, many commercial banks have been actively implementing Internet banking. Even though in the short term the company incurs some investment costs, they hope that in the long run, the company can carry out cost efficiency and increase the effectiveness of the performance of the company (Carlson, 2000; Day, 2000). Further, his study on Internet banking concluded that internet banking offered by the banks tested did not have an independent impact on bank profitability.

Impact of Diversification on Efficiency

There are several researches in the banking industry regarding efficiency and diversification. Du, Worthington & Zelenyuk (2016) investigated the impact on earning and asset diversification towards efficiency from 2006 to 2011 in China and found that Chinese banking efficiency increases when they diversified their earning assets from loans towards other earning assets. They also found that the ratio of deposits and reduction of non-earning assets have a positive impact on efficiency. Elyasiani & Wang (2012) uncovered impressive results regarding diversification on bank holdings towards efficiency. First, they found that activity diversification is shown to be negatively associated with technical efficiency. Secondly, the changes in diversification are found to not affect the total factor productivity but to be negatively related to technical efficiency. Using Luxemburg bank data during the financial crisis, Curi, Lozano-Vivas, & Zelenyuk (2015) found that banks who diversified in assets, funding, and income are more efficient and have more advantages during a financial crisis. Research by Alhassan (2015) in the Ghanaian banking industry examined the effect of bank income diversification on efficiency from 2003 to 2011. He uses the Herfindahl–Hirschman Index to measure diversification and stochastic frontier analysis to measure efficiency. Results suggest that less efficient large banks can improve to achieve efficiency gains through diversification into fee-based income.

Methods

Briefly, this research will try to establish the impact of income diversification, loan diversification, and technology diversification towards two efficiency models (Constant Return to Scale and Variable Return to Scale Model). Because one cannot neglect the importance of other variables that may affect efficiency, the Return on Assets, Non-Performing Loan (Gross),

Loan to Deposit Ratio and Company Size are added as control variables. The model of this research is shown in Figure 1.

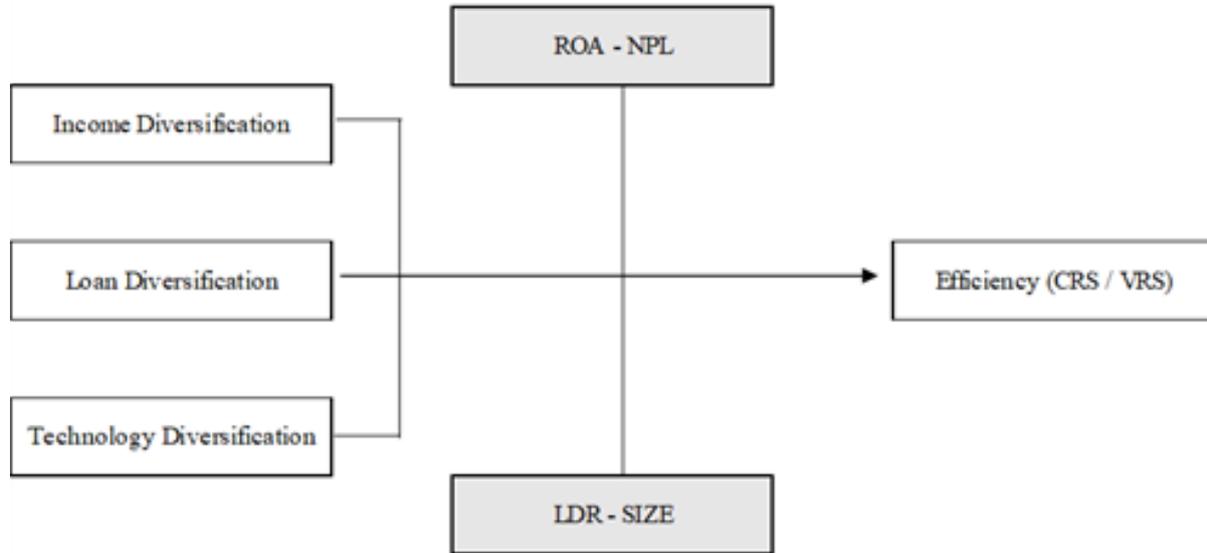


Figure 1. Research Model

Unit Measurement

As previously mentioned, to find the firm's efficiency, this research will use data envelopment analysis with a constant return to scale model and variable return to scale model. The approach is the intermediation to mimic the bank as financial intermediaries. Input and output are the key components in getting efficiency of the firm using Data Envelopment Analysis. Thus, this research will use *Total Fixed Assets, Number of Employees, and Total Deposit* as input and *Total Loans and Non-Interest Income* as output. This research assigns IN as a bank's income diversification. Traditionally, a bank's main source of income is the amount of interest that the bank charges to the borrower (interest income). But since banks try to expand their way of acquiring profit, fee-based income such as administration fees and forex gain have been playing an essential role as a bank source of income. Thus, in measuring income diversification, this research will use variable interest income and non-interest income.

$$IN = \left(\frac{\text{Interest Income}}{\text{Total Income}} \right)^2 + \left(\frac{\text{Non-Interest Income}}{\text{Total Income}} \right)^2 \quad (1)$$

Depending on the company's strategy and resources, banks usually have a focus on distributing the funds that they have as loans. From observation, there are three main sectors that banks try to target: retail (regular consumer for mortgage financing, for example), small-medium enterprise, or corporation. Often it is found that banks with many branches might focus on the retail consumer, while banks with few branches might focus on corporate funding. Thus, to measure loan diversification of banks (LN), this research looks at the banks' loan proportion.

$$LN = \left(\frac{\text{Loan to Retail}}{\text{Total Loan}} \right)^2 + \left(\frac{\text{Loan to SME}}{\text{Total Loan}} \right)^2 + \left(\frac{\text{Loan to Corporation}}{\text{Total Loan}} \right)^2 \quad (2)$$

Banking is probably one of the industries most affected by technology advancement. Like in other sectors, new technology they are implementing does not come cheap. It requires massive investment in IT infrastructure, hardware, software, workforce, and IT securities. To measure whether banks pay attention to the demands of technology (IT), this research will use the availability of Internet banking and mobile banking platforms.

$$IT = \text{Internet Banking} + \text{Mobile Banking} \quad (3)$$

Finally, this research use *Return on Assets (ROA)*, *Non-Performing Loan (NPL)*, *Loan to Deposit Ratio (LDR)*, and *Bank Size (SZ)* as control variables.

Results and Discussion

Efficiency Result

Using the Constant Return to Scale Model, the efficiency of the Indonesian banking industry is reduced from 0.88 to 0.75. The big improvement of efficiency in 2016 and 2017 was not followed in 2018. From 32 Banks, only 7 Banks are the most efficient in 2018 if being measured by the CRS Model: Bank Rakyat Indonesia Agro Niaga, Bank Central Asia, Bank Negara Indonesia, Bank Nusa Parahayangan, Bank QNB Indonesia, Bank Maybank Indonesia, and Bank Woori Saudara Indonesia. Bank National Nobu and Bank Pembangunan Jawa Timur are the most inefficient banks in the sample with an efficiency score of 0.48. Using the Variable Return to Scale Model, the efficiency of the Indonesian banking industry is reduced from 0.92 to 0.84. 12 out of 32 Banks managed to score highest on the efficiency scale, but it does not hinder the fact that the performance of the Indonesian Banking Industry is regressing if being compared to 2014. Using Variable Return to Scale Model, the efficiency score shows that Bank Arta Graha International is the most inefficient firm with a score of 0.51.

Diversification Result

For income diversification measurement, the average score of diversifications is 0.74 on the average within the industry. It translates that the Indonesian banking industry is still reliant on interest income as the primary source of profit. A good sign from the data, if we look closely, is the non-interest income of each firm on the average increases yearly, which translates to the increasing popularity of fee-based income. For loan diversification measurement, the average score of diversifications is 0.44 within the industry. This translates that Indonesian distribution of loans within the sector is not varied. This might be due to each firm having its market share,

and it is unable to focus on several markets. As an example, Firm A resources enable them to become the market leader on loan to retail, but not in SME or Corporate Loans. If you look closely, it is clear to see that the banking industry is riding the advantage of Indonesian status as the 4th most populated country on earth because retail is where the most loans are distributed. The amount is increasing daily. For technological diversification, the average score of diversifications is 0.58 within the industry. It shows that Indonesian usage of technology to reach its customers is still minimal. If we take a look closely, some of the banks in Indonesia have just implemented Internet banking, and some haven't even adopted the usage of mobile banking. This can be understood as IT infrastructure requires a big capital injection and maintenance, and firms might take the view that it is preferable to invest the capital in the central core of the business.

Regression Result

The CRS Efficiency model has an R2 coefficient of 0.758605. It means that this model can explain the relationship between efficiency and diversification by 76%. Other factors can explain the rest of the 24%. To find how the independent variable simultaneously affects the dependent variable is commonly known as the F-Test. The testing shows that we can see that the F-Test result is very significant (< 5%). In terms of T-Test, the CRS Efficiency model shows that LN (Loan Diversification) has a significant impact on the bank's efficiency.

Table 1. CRS Regression

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|--------|
| C | 1.642825 | 0.990267 | 1.658973 | 0.1005 |
| IN | 0.110747 | 0.310509 | 0.356663 | 0.7222 |
| LN | -0.444244 | 0.254558 | -1.745157 | 0.0841 |
| IT | 0.035418 | 0.105152 | 0.336826 | 0.7370 |
| ROA | 1.826989 | 1.099752 | 1.661273 | 0.0800 |
| NPL | 1.000262 | 1.412966 | 0.707917 | 0.4808 |
| LDR | 0.415502 | 0.204455 | 2.032243 | 0.0450 |
| SZ | -6.890482 | 4.779610 | -1.441641 | 0.1528 |

The CRS Efficiency Model T-Test produces an equation with a constant of 1.642. It means that if the variable in this equation is zero, then the CRS efficiency score will be 1.642. The coefficient 0.110 on income diversification (IN) means that when the IN increases by 1 unit, then the efficiency score will increase by 0.110. 0.444 coefficient on loan diversification means that if the rest of the variable is zero and variable LN increases by 1 unit, then the efficiency score will decrease by 0.444 points. The technology diversification (IT) has a coefficient of 0.035 coefficient that has the effect of reducing inefficiency by 0.035 points when the technology diversification increases by 1 unit. The T-Test equation result is as follow:

$$EFFCRS = 1.642 + 0.110IN - 0.444LN + 0.035IT + 1.826ROA + 1.000NPL + 0.415LDR - 6.890SZ + EI \quad (4)$$

The VRS Efficiency model has an R2 coefficient of 0.690122, which translates as this model can explain the relationship between efficiency and diversification by 69%. Other factors can explain the other 31%. The F-Test of the model also shown that Income Diversification, Loan Diversification, Technological Diversification, ROA, NPL, LDR, and Size simultaneously affect VRS Model Efficiency significantly. Similarly to the CRS Model, the VRS Model regression shows that only LN (Loan Diversification) has an impact on the bank's efficiency. Not only that, but Return on Assets and Loan to Deposit Ratio also have a significant effect on efficiency.

Table 2. VRS Efficiency

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|--------|
| C | 1.829304 | 0.970630 | 1.884657 | 0.0626 |
| IN | -0.054855 | 0.304352 | -0.180237 | 0.8574 |
| LN | -0.450155 | 0.244874 | -1.838316 | 0.0691 |
| IT | -0.099375 | 0.103067 | -0.964176 | 0.3375 |
| ROA | 1.547905 | 1.077944 | 1.435979 | 0.0944 |
| NPL | 0.812509 | 1.384947 | 0.586671 | 0.5588 |
| LDR | 0.311310 | 0.200401 | 1.553438 | 0.0737 |
| SZ | -5.650043 | 4.684830 | -1.206030 | 0.2309 |

The VRS Efficiency Model T-Test produced an equation that has a constant of 1.829. It means that if the variable in this equation is zero, then the CRS efficiency score will increase by 1.829 points. The coefficient -0.054 on income diversification (IN) means that when the IN increases by 1 unit, then the efficiency will go down by 0.054 points. A coefficient of 0.45 on loan diversification means that if the rest of the variable is zero and variable LN increases by 1 unit, then the efficiency score will decrease by 0.450 points. The technology diversification (IT) has a -0.099 coefficient that translates to reduce inefficiency by 0.099 when the technology diversification increases by 1 unit. The VRS Efficiency Model equation is as follow:

$$EFFVRS = 1.829 - 0.054IN - 0.450LN - 0.099IT + 1.547ROA - 0.812NPL + 0.311LDR - 5.650SZ + EI \quad (5)$$

Conclusion

The banking industry's role as an intermediary institution plays an essential role in driving the national economy. The increased pressure from regulators, competitors, and demand to bring profit to its shareholders, forces them to be efficient in running the operation while also finding some ways to get multiple sources of income, reduce credit risk by diversifying their loans, and



taking advantage of technology. It raises an interesting topic: can efficiency, profitability and diversification be achieved under a heavily regulated environment? Thus, this research examines Indonesian banking efficiency and its relations to the diversification strategy from 2014 – 2018 using the non-parametric method of Data Envelopment Analysis. There are a couple of Data Envelopment Analysis models that are being employed (constant return to scale and variable return to scale) and intermediation approaches to oversee banks as intermediaries' entities.

Additionally, this research also uses panel data regression to find the relationship between a bank's efficiency in income diversification, loan diversification, and technology strategy of banks. Control variables to represent profitability, credit quality, and bank's market share (asset size). The result of this research shows that Income Diversification, Technology Diversification, Non-Performing Loan, Loan Deposit Ratio, and Asset Size does not affect the bank's efficiency. On the other hand, Loan Diversification and Return on Assets affect a bank's efficiency significantly.

REFERENCES

- Alhassan, A. L. (2015). Income Diversification and Bank Efficiency in an Emerging Market. *Managerial Finance*, 41. <https://doi.org/10.1108/MF-12-2014-0304>
- Allen, F., & Santomero, A. M. (2001). What do financial intermediaries do? *Journal of Banking & Finance*, 25(2), 271-294. [https://doi.org/10.1016/S0378-4266\(99\)00129-6](https://doi.org/10.1016/S0378-4266(99)00129-6)
- Berger, A. N., & Humphrey, D. B. (1991). The Dominance of Inefficiencies Over Scale and Product Mix Economies In Banking. *Journal of Monetary Economics*, 28, 117-48. [https://doi.org/10.1016/0304-3932\(91\)90027-L](https://doi.org/10.1016/0304-3932(91)90027-L)
- Boot, A. W., & Schmeits, A. (2000). Market discipline and incentive problems in conglomerate firms with applications to banking. *Journal of financial intermediation*, 9(3), 240-273. <https://doi.org/10.1006/jfin.2000.0287>
- Busch, R., & Kick, T. K. (2009). Income diversification in the German banking industry.
- Carlson, T. (2000). One CU's Secret: Lack of Technology. *The Credit Union Journal*.
- Charnes, A., Cooper, W.W., & Rhoades, E. (1978). Measuring The Efficiency of Decision Making Units. *European Journal of Operational Research*, 6, 429-444. [https://doi.org/10.1016/0377-2217\(78\)90138-8](https://doi.org/10.1016/0377-2217(78)90138-8)
- Curi, C., Lozano-Vivas, A., & Zelenyuk, V. (2015). Foreign Bank Diversification and Efficiency Prior to and During the Financial Crisis: Does One Business Model Fit All? *Journal of Banking & Finance*. <https://doi.org/10.1016/j.jbankfin.2015.04.019>
- Day, K. (2000). Web-Only Banks Start to Get Real. *Washington Post*.
- DeYoung, R., & Roland, K. P. (2001). Product Mix and Earnings Volatility at Commercial Banks: Evidence from a Degree of Total Leverage Model. *Journal of Financial Intermediation*, 10, 54-58. <https://doi.org/10.1006/jfin.2000.0305>
- Drake, L. (2001). Efficiency and productivity change in UK banking. *Applied Financial Economics*, 11(5), 557-571. <https://doi.org/10.1080/096031001752236825>
- Du, K., Worthington, A., Zelenyuk, V. (2016). Asset Diversification and Efficiency: Evidence from the Chinese Banking Sector. *29th Australasian Finance and Banking Conference*. <https://doi.org/10.2139/ssrn.2825787>
- El Moussawi, C., & Obeid, H. (2011). Evaluating the productive efficiency of Islamic banking in GCC: A non-parametric approach. *International Management Review*, 7(1), 10-21.
- Elsas, R., Hackethal, A., & Holzhäuser, M. (2010). The anatomy of bank diversification. *Journal of Banking and Finance*, 34, 1274-1287. <https://doi.org/10.1016/j.jbankfin.2009.11.024>
- Elyasiani, E., & Wang, Y. (2012). Bank Holding Company Diversification and Production Efficiency. *Applied Financial Economics*, 22, 1409-1428. <https://doi.org/10.1080/09603107.2012.657351>



- Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society: Series A (General)*, 120(3), 253-281. <https://doi.org/10.2307/2343100>
- Golany, B., & Storbeck, J. (1999). A data envelopment analysis of the operation efficiency of bank branches. *Interfaces*, 29(3), 14–26. <https://doi.org/10.1287/inte.29.3.14>
- Gurley, J. G., & Shaw, E. S. (1956). Financial intermediaries and the saving-investment process. *The Journal of Finance*, 11(2), 257-276. <https://doi.org/10.2307/2976705>
- Hadad, M. D. (2003). Analisis Efisiensi Industri Perbankan Indonesia: Penggunaan Metode Non Parametrik Data Envelopment Analysis (DEA). *Buletin Ekonomi Moneter dan Perbankan*.
- Hassan, T., Mohamad, S., & Bader, M. K. I. (2009). Efficiency of conventional versus Islamic banks: evidence from the Middle East. *International Journal of Islamic and middle eastern finance and management*. <https://doi.org/10.1108/17538390910946267>
- Kamaruddin, B. H. (2008). Assessing Production Efficiency of Islamic Banks and Conventional Bank Islamic Windows in Malaysia. *International Journal of Business and Management Research*, 1(1), 31–48.
- Karim, M.Z., Chan, S., & Hassan, S. (2010). Bank Efficiency and Non-Performing Loans: Evidence from Malaysia and Singapore. *Prague Economic Papers*. <https://doi.org/10.18267/j.pep.367>
- Kocisova, K. (2014). Application of Data Envelopment Analysis to Measure Cost, Revenue and Profit Efficiency.
- Montgomery, C. A. (1994). Corporate Diversification. *Journal of economic perspectives*, 8(3), 163-178. <https://doi.org/10.1257/jep.8.3.163>
- Muharam, H. (2007). Analisis Perbandingan Efisiensi Bank Syariah di Indonesia Dengan Metode Data Envelopment Analysis (periode Tahun 2005). *Jurnal Ekonomi dan Bisnis Islam*, 2(3), 80-166.
- Pasiouras, F. (2008). International evidence on the impact of regulations and supervision on banks' technical efficiency: an application of two-stage data envelopment analysis. *Review of Quantitative Finance and Accounting*, 30(2), 187-223. <https://doi.org/10.1007/s11156-007-0046-7>
- Penrose, E. (1959). The theory of the growth of the firm. *John Wiley & Sons, New York*.
- Portela, M. C. A. S. (2014). Value and quantity data in economic and technical efficiency measurement. *Economics Letters*, 124(1), 108-112. <https://doi.org/10.1016/j.econlet.2014.04.023>



- Ramly, R., & Abdul, H. (2017). Pemodelan Efisiensi Bank di Indonesia: Perbandingan Antara Bank Syariah dan Bank Konvensional. *Journal Bisnis dan Menejemen*, 7. <https://doi.org/10.15408/ess.v7i2.4989>
- Robertho, V., & Wibowo, B. (2018). Market Power, Types of Ownership and Bank Income Diversification: Cases of Asian Countries. *Jurnal Dinamika Manajemen*, 9(1), 12-22. <https://doi.org/10.15294/jdm.v9i1.14648>
- Rubin, P. H. (1973). The economic theory of the criminal firm. *The economics of crime and punishment*, 155-166.
- Sealey, C. L. (1977). Inputs, Outputs, and a Theory of Production and Cost at Depository Financial Institution. *Journal of Finance*, 32. <https://doi.org/10.1111/j.1540-6261.1977.tb03324.x>
- Sutawijaya, A., & Lestari, E. P. (2009). Efisiensi Teknik Perbankan Indonesia pascakrisis ekonomi: Sebuah studi empiris penerapan model DEA. <https://doi.org/10.23917/jep.v10i1.808>
- Tahir, Abu, B., & Haron. (2009). Evaluating Efficiency of Malaysian Banking Using Data Envelopment Analysis. *International Journal of Business and Management*. <https://doi.org/10.5539/ijbm.v4n8p96>