Efficiency, Technology And Manpower In Banking Industry

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Abstract

This study analyze the correlation of technology and efficiency and how it affect the turnover of the employee. The commercial banks in Indonesia is the subject to be analyzed. The study also analyze the impact of foreign shareholdings on technology adoption of the acquired local banks. The non-parametric DEA efficiency is utilized to measure bank efficiency and the ratio of IT-related cost to total bank operational cost is used as proxy of digital technology. The panel data regression model used banks efficiency scores based result of DEA analysis and ratio of IT related cost as dependent variables. Duration of the study is 2011-2021 with cross-section samples of all banks used in the DEA analysis. The sample used in this study is totally 29 Banks purposively selected based on the aggressiveness in utilizing digital banking technology which is assumed due to foreign shareholdings. It is concluded that higher digitalization tends to increase efficiency but decrease number of employee demand /recruited. It is also found that higher portion of foreign shareholdings significantly increase magnitude of technology adoption in its acquired local banks. Results of this study will be used as reference for policy maker in shaping the future of efficiency and human resources of banking industry in Indonesia.

JEL Classifications: G21, L22, O33

Keywords: Bank Efficiency, Bank Competition, Digital Banking, DEA

INTRODUCTION

According to Lipton et al. (2016), in the future, there will be a banking system with digital technology that not only performs the basic functions of banks as financial intermediary institutions and financial service providers, but also beyond just as financial advisors to their customers and can interact real time through the mobile device used by its customers. The major strategic issue for the banking industry in Indonesia for the last 10 years is the advancement of digital technology. Both in terms of opportunities for the development of bank businesses and in the aspects of threats to the bank's business existence issues (Dermine, 2016; Marinč, 2013).

From the perspective of banking sector authorities and public policy, the penetration of digital banking technology can cause problems related to the impact on bank efficiency and human resources planning in the banking system. On the other hand, it has positives impact in the form of increased competition and expanding potential market which can ultimately boost bank's efficiency and productivity in the financial industry. Financial services that are integrated with sectors outside the financial sector can be a threat as well as an opportunity in terms of efficiency and employment of the banks. This future scenario condition certainly has broad implications for the long term policy of the financial system in the economy.

According to McKinsey & Company research on digital banking in Asia (McKinsey & company, 2014), the full time equivalent (FTE) approach reveals that 30 top processes in banking use 50 percent of their cost, 20 percent of processes in banking services can be digitized and potentially can increase efficiency of 15-20 percent of the total banking costs. McKinsey (2016) also stated that consumer adoption for digital banking experienced a significant increase.

Furthermore, the Bank for International Settlements, predicts five scenarios that will be faced by banks related to the implementation of digital banking technology in the future. The first scenario is the emergence of a better bank, the incumbent bank is modernizing and digitizing. In this scenario, incumbent banks digitize and modernize themselves to maintain customer relationships and core banking services, utilizing technology that makes it possible to change their current business model. The second scenario is the emergence of new banks, the replacement of incumbents by challenging banks including foreign banks as a consequence of the emergence of new banks that have used digital technology. The third scenario is a fragmented financial industry between banks and financial service companies that utilize financial technology. The fourth scenario is that the role of banks is irrelevant because the role of banks as intermediary institutions has been completely replaced by technology. The latest scenario of incumbent banks being commodity service providers and submitting direct customer relations to otherfinancial service providers, such as financial technology and big tech companies. (BIS Quarterly Review December, 2017).   Financial Technology Company and big tech customers use front-end platform to offer a range of financial services from a diverse group of providers.

The other important aspects to be included in the study of impact of digital technology on banking efficiency and employee demand is the factor of increase in foreign shareholdings in Indonesian banking industry as those foreign shareholders will gradually transfer new technology originated from their originated countries and adopted to its acquired local banks. The foreign shareholdings in Indonesia's banking industry has been increased from 23.02% in 2007 to 35.29% in 2017 and the figure is higher in 2020 which approximately reach 38%.

Percentages of Foreign Shareholdings in Indonesia's Banking Industry 2009-2019

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Percentage of Foreign Shareholdin	23.02	26.02	26.88	27.33	27.33	27.0	27.00	28.73	34.03	34.39	35.29

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Source: Data processed based on Indonesian Banking Directory 2019

The phenomenon of the increasing share of foreign shareholdings in Indonesian banking industry and the unclear effects or impacts it causes are the basis for conducting research to examine whether the concentration of foreign shareholdings affecting the level of adoption of technology, the banks efficiency and its employee demand.

Apart from various future scenarios that will be faced by the banking industry, with the rapid penetration in the implementation of digital technology, economic theory explains that technological advances lead to increased productivity and drive the efficiency of the company. More efficient and productive a company will increase its capacity to compete and dominate the market. The empirical finding shows that most banks in Indonesia banking sector have made adoption of digital banking technology as a major strategy that is being implemented (Price Waterhouse and Coopers, 2018). Economic theory predicts banks need to keep their market share to compete in an oligopolistic market or industry. They should expand or at least maintain their market share to stay competitive in the market or lose their market power. Technology adoption through digitalization can widen a bank's market without requiring the opening off additional branches or sinking costs into the inputs. Thus technology adoption can efficiently change the way banks use inputs, especially with regard to labor utilization (Dachs, 2018). Regarding the increase of technology adoption from the Indonesia Financial Service Authority (OJK) (2018) reveal that the number of banks and branches decreases from 2013 to 2017. The number of commercial banks decreased from 120 to 115 in 2017. Moreover the number of commercial bank branches also decreased, especially during the 2015-2017 period, declining from 32,949 in 2015 to 32,285 in 2017. This decline may affect employee demand in the Indonesian banking sectors. Small size Bank such as Mayora Bank reduce its employee from 742 in 2018 to 730 in 2019. Previous studies have advanced various conclusions regarding the effect of technology adoption as a substitute for employee, especially in large banks. Large banks such as Bank Danamon employee decrease from 22,832 in 2016 to 16,811 in 2017, whereas Bank Mandiri employee increase from 30,034 in 206 to 30,464 in 2017 for its permanent employee but its temporary/contract base employee decrease from 8,694 in 2016 to 7704 in 2017 and both permanent and contract employee totally 39,065 in 2020, BNI employee is 24,270 in 2016 and increase to 24,641 whereas for contract/temporary employee decrease from 3914 in 2016 to 2,568 in 2017. The routinizationhypothesis developed by Autor et.al.(2003), along with a finding from Evangelista and Savona (2003), showed that the jobs based on routine tasks could be replaced by technology. Dintrans et.al (2016) also projected that front office and low middle back office positions will be replaced by technology in the future. Contrarily, Furukawa et.al (2000), Bresnashan et.al. (2002) and Ibrahim et al. (2015) found that technology adoption complemented labor. Given that, the findings regarding the relationship between technology adoption and labor demand are inconclusive, it is important to investigate this relationship in the banking sector. Furthermore, research investigating the effect of technology adoption on labor demand in the Indonesian economy is also rare. Our research provides one fruitful way to fill this gap. The in

depth understanding of the impact of technology on labor demand also has policy implications which is beneficial for OJK and other related policy makers in formulation of regulation related to demand and supply for worker especially in banking sector.

This research investigates level of employment during the rapid implementation of digital banking technology and digital banking effect on banks efficiency due to increase in foreign shareholdings in banking industry in Indonesia through acquisitions and merger with local banks. To the best of our knowledge, there is no publish study on analyzing the impacts of technology adoption or digital technology on both efficiency and employee demand in the Indonesia's banking industry. Specifically, there is no publish study to analyze the impact of foreign shareholdings on adoption of digital technology of the acquired local banks in Indonesia. Therefore the research on analyzing the effect of digital banking technology on both efficiency and employment and the impact of foreign shareholding on technology adoption in acquired local banks is still scanty.

The next part of this research framework will review the theoretical and empirical literature and develop hypothesis why banks should adopt the digital banking technology. The last part shows the empirical model and explains the empirical models and data to be used in the research. The aims of this research is to contribute basic references for regulators in designing policy specifically in terms of improving efficiency and employment within the banking industry.

LITERATURE REVIEW

Digitalization of Commercial Banking Services

In the simplest sense, a bank is an institution that in its operations aims to lend funds to borrowers and receive funds from the lenders in the economy (Freixas X. & Rochet, J. C, 2008). The roles of the bank is not only as an intermediary institution between depositors and borrowers but also have an important role in the allocation of capital in the economy This definition describes the main activities of banks to pool funds from society and channeling them in the form of loans. According to Merton (1993), "A well-developed smoothly functioning financial system facilitates the efficient life-cycle allocation of household consumption and the efficient allocation of physical capital to its most productive use in the business sector."

All of bank operational activities lead to banking service role that generates fees based income, and intermediation services that generate interest income. In relation to the role of the bank in its operations, the role of technology is important to accelerate and streamline the services provided by banks. In carrying out its roles, banks will face competition in various banking output markets, both in the provision of the payment system and liquidity services (funding) and borrower monitoring services (lending). According to Lipton et.al. (2016), banking activity is mostly technological and mathematical in nature. That means most of the operational roles in banks can be transformed into forms of technology-based digital services. The banking system from the front end to the back end of the process can executed by utilizing technology and replacing the role of worker. Consequently, the role of technological advances and the

implementation of digital banking is an opportunity for banks to improve competitiveness in the banking industry through increasing bank operational efficiency.

The study in Thailand shows a statistically significant and positive coefficient on the asset share of hybrid banks or banks with foreign shareholdings, which, ceteris paribus, indicates that increases in foreign bank present have tended to make adoption of internet banking more likely. The foreign ownership dummy variable is also statistically significant and its coefficient enters with the expected positive sign, indicating that hybrid banks or foreign shareholdings banks tended to adopt internet banking or digital technology faster (Herberholz, 2006). It is concluded also that foreign banks may indeed increase the quality and availability of financial services by directly introducing new technology.

The more aggressive a bank on digital banking technology implementation, themore efficient is that bank relative to other banks. Based on the explanations that have been conveyed, then in terms of digital banking implementation by individual banks in Indonesia, this can be presumed to be a bank strategy to maintain and expand their market share. Furthermore, the transmission of the impact of digital banking on the market share of an individual bank is through increasing the efficiency of a bank in carrying out business activities, both in collecting and managing public funds (liquidity and funding) and in channeling funds (lending). forms of technology-based digital services.

Digital Banking product and services are one of the bank's strategies to increase and maintain its market share in the current era of digital competition. Based on digital banking surveys conducted by PWC in 2018, 66 percent of respondents stated that digital banking strategy is part of the company's strategy. Further still the same survey, only 12 percent of respondents said that digital banking is part of the company's information technology development strategy, and 16 percent as part of their product or customer strategy. The survey results indicate that digital banking in Indonesia has become a mainstream strategy and not a specific strategy in the field of information technology or in the field of banking service product development.

Employee Recruited in Banking Sector
Regarding the effect of technology adoption on employee recruited in the banking sector, the results of empirical studies are still inconclusive. For example, Craig (1997) investigated the impact of technological change on employee demand in the US banks. The research used a time trend as a proxy for technological change, finding that technology might substitute for the labor in the large banks. Evangelista and Savona (2003) investigated the effect of innovation on employment in the service sectors in Italy, including in the banking sector. Technological progress had a negative impact on the absorption of labor in the banking sector. Moreover, Bessen (2015) investigated the effect of ATMs on labor demand in the US banks. The research found that the introduction of ATMs reduced employee demand, but this reduction was offset by a large increase in the number of branches. Contrarily, Ibrahim et al. (2015) investigated the impact of ICTs on labor demand in the Nigerian banking industry. They concluded that ICTs did not act as a substitute for labor. Ritzberger-Grunwald et al. (2016) also investigated the impact of information technology (IT) usage in the Austrian banking sector, finding that IT usage in banks

increased the demand for high-skilled labor. Moreover, McKendrick (1992) investigated the impact of IT on the performance of Indonesian commercial banks. This research concluded that the impact of IT on productivity was limited because of the shortage of personnel skilled in IT, insufficient management capabilities and inadequate telecommunications infrastructure. The paper suggested that the use of IT complemented labor with higher skill.

Previous research still shows inconclusive results with respect to the relationship between employee demand and technology adoption. Similar research has not been conducted in the Indonesian economy. Thus, investigating the relationship between employee demand and technology adoption in the Indonesian banking sector is a relevant area of study.

Measuring Bank Efficiency

Based on the ability of the DEA method to generate efficiency score, bank efficiency in the banking industry can be analyzed from various perspectives, among others banks as financial intermediary institutions, banks as companies or production units and banks as individual actors in the banking industry. The intermediation model views banks as intermediaries that receive inputs in the form of deposits and investments to lend and output in the form of loans, mortgages, and investments. In 1997, Athanassopoulos (1997) published a DEA research that used an intermediation model to examine 68 bank branches in Greece using interest and non-interest expenses as inputs and non-interest income and total customers as output.

The production model commonly called the output approach considers the bank as the production units that convert inputs such as employees, resources, and capital into outputs, such as the amount of the deposit or loan amount. DEA researches that use the production model includes research by Soteriou and Stavrinides (1997); Sherman and Ladino (1995); Oral and Yolalan (1990). The profitability model which is also similar to the production model considers banks as production units that convert inputs into outputs. However, the type of input and output used is different from the production model. Oral and Yolalan (1990) conducted a study that measured the performance of 20 banks in Turkey with a profitability model. The input they use is operating expenses and interest expenses, while the output used is interest and non-interest income.Merton (1993), perspective on financial services put forward bank function as the payment system provider and financial resources allocation in the economy. This perspective leads to bank market outreach approach, as a company in the banking industry, banks can also assess its output from the availability and their ability to provide services (market outreach) to customers. A bank in an oligopolistic market must be able to maintain and expand its market share so that the number of customer proxies by the number of banks accounts and the number of banking services can be used as an output indicator. In addition, the input indicators used in this market analysis are the service and bank operational infrastructures, such as the number of branch offices, information technology infrastructure, and banks marketing costs. There are several literature reviews related to the efficiency of the banking and financial industry. Berger and Mester (2003) reviewed the literature on the efficiency of financial institutions and opportunities for improving efficiency. Berger et al. (1993) analyzed 130 studies related to the application of frontier analysis on the efficiency of financial institutions in 21 countries. Fethi, et al. (2010) conducted a survey of 196

studies related to operational research and artificial intelligence techniques used to evaluate bank performance.

Application of DEA analysis is also carried out using different performance indicators. In general, there are three main points of view in analyzing the efficiency of bank performance using the DEA method, namely the efficiency of banks as financial transaction service providers for their customers, the role of banks as financial intermediary institutions and bank efficiency to generate profits. Berger et al. (1993) suggested that the production point of view would be more appropriate to be used to analyze the efficiency level of bank branches, and intermediation efficiency is more suitable to be used to compare the efficiency level between banks. The results of a study conducted by Fethi et al. (2010) also support the findings expressed by Berger et al. (1993).Berger & Humphrey (1997) conclude that production approach is better used to evaluate branch of the financial institution instead of the whole institutions. Whereas according to Allen and Santomero, 1998, intermediate approach is more focusing on less important function and product of the financial institutions as this approach does not include the risk transfer and complex banking instruments/products in the market. Loan loss provision has been generally accepted as risk proxy in estimation of efficiencies of banks (Sun and Chang, 2011).Inprofitability approach, three inputs will be used such as deposits expense, fixed asset expense includingloan loss provision and personnel expenses, whereas for outputs the item are loan interest income, other productive assets income (marketable securities, bonds, fund placement in other banks) and other non interest income.

DATA AND METHODOLOGY

Data Envelopment Analysis Method
We adopt a parametric approach, the Data Envelopment Approach (DEA) , to estimate the efficiency of the local banks acquired by foreign shareholders. We further incorporate the percentage of foreign shareholdings of the local banks to examine its influence on efficiency. We also adopt the profitability approach to determine the input and output vectors for estimating efficiency instead of intermediation or production approach due to the; First, Drake et al, 2009 conclude that profitability approach will give more comprehensive analysis because different interest rate factor and risk transfer factor has been included in the analysis. Whereas other approach does not incorporate the different interest rate factor completely and lack of including the risk transfer. Data will be processed using the DEAP 2.0 and EViews 10.0. Efficiency scores during period of study will be regressed against several internal factors independent variables such as total assets, strength of capital measured by Capitla Asset Ratio conducted a survey of 196 studies related to operational research and artificial intelligence techniques used to evaluate bank performance

Efficiency is calculated as ratio of output on input as below,x and y represent input and output, i and j represent certain input and output. So, xi is input –ith and yj is output -jth at Decision Making (DMU). Total input represent by I and total output represent by J, where I,J > 0. Mathematical equation presented as below, (Ramanathan., 2003).

$$\text{Virtual Input} = \sum_{t=1}^{j} ut\ xt$$

ui is weighted of input xi during accumulation process,

$$\text{Virtual Output} = \sum_{t=1}^{j} yvj$$

vj is weighted of input y_i during accumulation process,

$$\text{Efficiency} = \frac{\text{Virtual Output}}{\text{Virtual Input}} = \frac{\sum_{j=1}^{J} yvj}{\sum_{i=1}^{I} ut\ xt}$$

Using the results of the DEA decomposition, it can be known and analyzed the transmission of the impact of the implementation of digital banking technology on the changes in the efficiency of each bank and the average changes in the efficiency of the banking industry in Indonesia.

Data and Sample Selection
The sample used in this study is all commercial banks that at least having 50% foreign shareholdings, but not including Islamic commercial banks and rural credit banks (BPR). Furthermore, based on the availability of data needed to conduct DEA analysis, we used 29 banks as samples. The period of analysis for this study is from 2010 to 2020. The selection of this period is based on the rapid progress of digital banking technology adoption in Indonesia banking industry specifically occurred during the last ten years. The data sources that we use in this study are commercial bank annual report data published by banks in its website, and also secondary data originated from the official publication such as the Indonesian Central Bank and Indonesian Central Agency on Statistics (BPS).

Our data set covers twenty-nine domestic commercial banks acquired by foreign shareholders, which yields a sample of 319 observations. Our sample starts from 2010 that is, the years in which many local banks were acquired by foreign shareholders after the issuance of government regulation to ease the maximum limit or cap of foreign shareholding in the local/domestic bank to 99% in 1999. This ensures that all the domestic commercial banks are banks acquired by

foreign shareholders as before 2010 most of the local banks is still owned by domestic shareholders, therefore, this is a balanced panel because we try to maintain as many banks as possible in this study to derive a better representation of how digital technology affect efficiencies as a result of technology adopted by the banks originated from the foreign shareholders. We also filter the sample to include only banks with at least 10 years data so as to obtain a smoother and better estimation of the efficiencies. The data, are extracted from various banks' financial statements downloaded from Directory of Indonesian Banking sourced from Bank Indonesia, the central bank of Indonesia Data on the macroeconomic variables is obtained from the Indonesia's Central Bureau of Statistics.

The Digital Banking Technology Adoption Effect on Bank's Efficiency and Employee Recruited: Panel Data Regression Model

We develop a panel data regression model and uses banks efficiency scores using DEA and number of employee recruited as dependent variables. The time period is 2011-2021 with cross-section samples of 29banks used in the DEA analysis. The regression model of the panel data is as follows:

$$EFF_{i,t} = Bo_{it} + B1SIZE_{it} + B2CAR_{it} + B3ROA_{it} + B4Br_{it} + B5PDB_{it} + B6DIG_{it} + E_{it} \quad (8)$$

$$EMP_{it}, = Bo_{it} + B1SIZE_{it} + B2CAR_{it} + B3ROA_{it} + B4Br_{it} + B5PDB_{it} + B6DIG_{it} + E_{it} \quad (9)$$

$$DIG_{it} = Bo_{it} + B1SIZE_{it} + B2CAR_{it} + B3PDB_{it} + E_{it} \quad (10)$$

Where EFF is bank i efficiency score in year t, ε is error term. Bank characteristics variables and macroeconomic variables are of control variables which in the empirical studies of bank efficiency determinants have been known to have a significant effect. Following the previous empirical study these variables consisted of bank characteristics variables and external conditions of the bank (Repkova, 2015; Girardone et.al, 2004; Soteriou and Yiannos, 1997; Košak and Zajc, 2006) as follows:

a. **SIZE**, Bank size/asset, using the total assets of the bank as the indicator

b.**CAR**, level of capitalization, is the ratio of equity to total assets

c.**ROA**, return on assets ratio is a proxy for bank profitability

d.**Branch**, Number of branch offices,

e.**GDP**, real Gross Domestic Product

f.**DIG**, is the ratio of information technology cost to total operational costs, developedfrom secondary data obtained from Indonesian bank supervision authority (OJK).

g.**EMPit**, number of employee of the bank i in year t.

h.**FSHit,** portion of foreign shareholding of the bank i, in year t.

Equation (8) is the general form of our empirical model specification in order to investigate the effect of DBTA on each type of banks efficiency scores. As mentioned in Berger and Mester (2003) and Deyoung et al. (2003), technology adoption could reduce unit cost and some services

of banks have evolved into low cost and high volume business dominated by high technology banks. The investment on the digital technology not only could raise bank's operational cost but also increase their revenue, the gap between increases in total revenue to rising total operational cost is positive. Their finding implies the non-linearity effect of technology adoption on bank scale efficiency. This study also estimates the quadratic specification in addition to the linear model specification to take into account the non-linear effect of DBTA on bank relative efficiency.

RESULTS & DISCUSSION

Table below shows the efficiency of banks 2011-21 in the Indonesian banking industry.

Table 1. The efficiency of local banks acquired by foreign shareholders 2011-2021

BANK	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
AMAR	0.51	0.538	0.538	1	1	0.352	1	1	0.588	1	1
OKE	0.414	0.558	0.558	0.361	0.36	0.125	0.544	0.544	0.394	0.44	0.875
JTRUST	0.63	0.567	0.567	1	1	0.443	0.671	0.671	0.351	0.528	0.843
MAYBANKSYAR	0.362	0.537	0.537	1	1	0.447	1	1	1	0.516	1
METRO/SHINHAN	0.864	0.774	0.774	0.521	0.521	0.115	0.582	0.582	0.474	0.484	0.806
WINDU/CCB	0.588	0.529	0.529	0.543	0.543	0.369	0.693	0.693	0.534	0.559	0.645
SMBC	0.706	0.771	0.771	1	1	1	1	1	1	1	1
MIZUHO	1	0.871	0.871	1	1	0.904	1	1	0.985	0.861	1
ANZ	1	1	1	0.58	0.58	0.816	1	1	1	1	1
COMMONWEALTH	1	1	1	0.353	0.353	0.655	0.497	0.497	0.561	0.477	0.777
DBS	0.712	0.524	0.524	0.546	0.546	0.483	0.844	0.844	0.643	1	0.94
ICBC	0.596	0.509	0.509	0.695	0.695	0.422	0.966	0.966	0.692	1	1
OCBC	0.702	0.601	0.601	0.564	0.564	0.417	0.719	0.719	1	0.792	0.946
KEB/HANA	1	1	1	1	1	1	1	1	1	0.925	0.853
RABO	0.577	0.563	0.563	0.425	0.425	0.169	0.543	0.543	0.454	0.538	0.569
UOB	1	1	1	0.614	0.614	0.547	0.745	0.745	0.924	0.94	0.986
BNP	0.588	0.527	0.527	0.846	0.846	0.255	0.679	0.679	0.544	0.525	0.552
BOII	0.572	0.654	0.654	0.873	0.873	0.434	1.00	1.00	0.687	1.00	0.787
WOORI	1	1	1	1	1	0.965	1	1	0.936	0.675	0.886
BNPPARIBAS	0.639	1	1	0.913	0.913	0.579	0.903	0.903	0.644	1	1
EKONOMI	0.654	0.654	0.654	0.543	0.543	1	0.675	0.675	0.532	0.53	1
CIMB	0.617	0.552	0.552	0.611	0.611	0.406	0.795	0.795	0.646	0.74	0.961
QNBKESAWAN	0.581	0.478	0.478	0.474	0.474	0.147	0.417	0.417	0.588	0.727	0.586
MUAMALAT	0.611	0.918	0.918	0.476	0.476	0.202	0.738	0.738	0.547	0.546	0.76
BII/MAYBANK	0.549	0.513	0.513	0.529	0.529	0.325	0.684	0.684	0.728	0.711	0.795
CTBC	0.806	0.88	0.88	1	1	1	1	1	1	1	1
SBII	0.601	0.572	0.572	0.668	0.668	0.491	0.941	0.941	0.705	0.925	0.941

| RESONA | 0.704 | 0.738 | 0.738 | 0.768 | 0.768 | 0.518 | 1 | 1 | 0.817 | 0.908 | 0.791 |
| DANAMON | 0.804 | 0.696 | 0.696 | 0.615 | 0.615 | 0.354 | 0.544 | 0.544 | 0.661 | 0.7 | 0.922 |

Source: Calculated by using DEAP 2.0 based on Indonesian Banking Directory

The average efficiency of local bank acquired by foreign shareholders during 2010-2020 is 0.728 and the most efficient banks originated from Taiwan (CTBC), South Korea (Hana, Woori) and Japan (SMBC) with average of efficiency almost 1.000,   whereas the most inefficient is banks originated from Middle East such as Muamalat and QNB Kesawan which average efficiency less than 0.6.   The study by Barry, 2013 also found that banks originatedfrom South Korea is very efficient.   In general,   the average efficiency of local banks acquired by foreign shareholders is still not efficient (0.728) and only 24.45% of all local bank acquired by foreign shareholders is efficient (1.000). Knowing the nature of the banks business, the implication of the efficiencies results depicted in the table abovementioned shows that business expansion is the sources of small banks increasing level of efficiency, on the other hand for the larger banks technical and managerial advancement is the sources of the increase on their operational efficiency.

The descriptive statistic data abovementioned, indicated by the maximum values, shows that several observations value is exceeding far beyond the average value thus the Ordinary Least Square regression become invalid due to a violation of classical assumptions such as heteroscedasticity, multicollinearity, and autocorrelation resulted from the extreme observations value. As we need to use the observations considering the importance of the data for our study, another alternative method is applied to overcome the violations of the assumption abovementioned which is by using Generalized Least Square.

The effect of digitization on efficiencies is tested by using General Least Square (GLS) as using the Ordinary Least Square (OLS) will produce the regression coefficients which having violations of classical assumption such as heteroscedasticity and autocorrelation. Except for multicollinearity, the regression model is still violating the classical assumptions so cannot be used as an efficient estimator (BLUE). Thus, the data should be processed using other regression techniques namely Generalized Least Square (GLS) or Weighted Least Square (WLS) as it is transformed using the weighting techniques (Wooldridge, 2010)

GLS is a least square techniques designed to overcome heteroscedasticity which is able to preserve the efficiency of the estimator without losing its unbiased and consistency characteristics. GLS is able to minimize residual square which has been weighted (weighted least square) so it can fulfill the standard assumptions of the least square (OLS) resulting in the BLUE results estimations (Gujarati dan Porter, 2012).If the efficiency estimator is more important than unbiased and consistency under the condition of heteroscedasticity, the Estimated Generalized Least Square(EGLS) is more appropriate to be used instead of OLS.   Therefore the EGLS method is used to eliminate the heteroscedasticity and autocorrelation (Gujarati, 2009).   The method in which the residual is replaced by moment estimator is also applied here. This method is a variant namely Panel Corrected Standard Error (PCSE) (Beck and Katz, 1995). This method allows cross-sectional correlation and heteroscedasticity across panels.

Table 2. Estimation Results using EGLS

	EFF	t-statistic	Probability
C	0.306742**	2.443	0.0618
DIG	0.150263***	3.279	0.0062
Branch	-0.633812**	-2.030	0.0332
EMP	-0.010868***	-3.421	0.0054
ROA	0.050183***	6.379	0.0001
ln SIZE	0.057563***	2.977	0.0068
CAR	0.000614	1.488	0.1374
GDP	-0.050278***	-3.375	0.0007
R square	0.786023		
Adjusted RSq.	0.750217		
F statistic	9.2224		
Prob.(Fstat.)	0.00000		
DurbinWStat.	1.5074		

***significant at α< or = 1%, ** significant at α>1% or <5%, and * significant at α>5% or <10%
Source: Calculated by using E Views 10

Digital Banking Technology Adoption Impact on Banks Efficiency
Table 2 abovementioned is the estimation results from the panel data regression model for analyzing the impact of digital banking technology adoption to banks relative efficiency score in Indonesia during the period of 2011 to 2021. All data already pass the OLS heteroscedasticity, autocorrelation and multicollinearity test. In relation to the possibility of non-linearity impact from the banking digital indicators, we also use quadratic model specifications. Based on the estimation results we can describe some main findings of this research on the impact of digital banking on banks relative efficiency in Indonesia.

DIG statistically has a significant impact on Indonesia bankstechnical efficiency (CRS DEA). For the bank's technical efficiency, the impact of digital banking is positive and significant as the increase in digitization will increase the efficiency of the banks and this research finds there is no indication of the non-linear effect of digital banking technology adoption to banks technical efficiency. Based on our analysis, the effect of DIG on banks technical efficiency has the inverted U shape. This finding indicates that at the low ratio of information technology related cost to total operational cost will have a positive effect on banks performance, but this positive effect could turn to be negative when this ratio is too high. Banks that are too aggressive in implementing and adopting digital banking technology tend to have lower performance efficiency score during the analysis period.

Banks faces trade-off between expanding their capacity and ability to improve their efficiency, too low investment in digital banking technology could cause lowering their funding and liquidity efficiency, otherwise when they invest too high in digital banking technology could harm their performance efficiency. From the banking regulator perspective the digital banking technology

would improve banks intermediation function efficiency, but from individual bank perspectives, they have to balance the positive effect of digital banking technology adoption on their funding and liquidity efficiency versus the negative effect to bank financial performance efficiency.The improvement of banks efficiency could also be originated from their ability to improve their productivity, their business process and also because of the economics of scale effect of their business expansion.

Digital Banking Technology Adoption Impact on Employee Recruited

Table 3. Estimation Results using EGLS

	EMP	t-statistic	Probability
C	0.376732**	2.743	0.0518
DIG	0.310265***	3.678	0.0062
Branch	-0.633712**	-2.450	0.0642
ROA	0.035183***	4.687	0.0705
ln SIZE	-0.16563***	6.778	0.0063
CAR	0.000614	1.687	0.1568
GDP	0.050275***	3.474	0.0075
R square	0.680121		
Adjusted RSq.	0.630214		
F statistic	10.2232		
Prob.(Fstat.)	0.00000		
Durbin WStat.	1.9684		

***significant at α< or = 1%, ** significant at α>1% or <5%, and * significant at α>5% or <10%
Source: Calculated by using E Views 10.

Using the same empirical model and control variables, we also estimate the impact of digital banking on employee recruited.

Table 3 abovementioned is the estimation results from the panel data regression model for analyzing the impact of digital banking technology adoption to the number of banks's recruited employee in Indonesia during the period of 2011 to 2021. All data has already passed the OLS heteroscedasticity, autocorrelation and multicollinearity test. In relation to the possibility of non-linearity impact from the banking digital indicators, we also use quadratic model specifications. Based on the estimation results we can describe some main findings of this research on the impact of digital banking on the number of employee absorbed by the banks in Indonesia.

The estimation result shows a significant and negative impact of digital banking on employee recruited. For the bank's employee recruited, the impact of digital banking is negative and significant, higher level of digitization (DIG) tend to decrease the number of employee recruited. Bank seemingly faces trade-off between increasing digitization and reducing number of employee but this can be overcome by rotating the employee within the banks as well as to other non banking financial institutions.

Banks also faces trade-off between expanding their capacity and ability to improve their efficiency, too low investment in digital banking technology could cause lowering their funding and liquidity efficiency, otherwise when they invest too high in digital banking technology could harm their performance efficiency. From the banking regulator perspective the digital banking technology would improve banks intermediation function efficiency, but from individual bank perspectives, they have to balance the positive effect of digital banking technology adoption on their funding and liquidity efficiency versus the negative effect to bank financial performance efficiency.Instead, the improvement of banks efficiency could be from their ability to improve their productivity and their business process or because of the economics of scale effect of their business expansion.The Hausman test suggested that the fixed effect model is used, instead of the random effect model, for each model of employee demand.

Foreign Shareholdings Impact on Level of Technology Adopted by Banks.

Table 4. Estimation of Impact of Foreign Shareholdings on Level of Technology Adopted by Banks 2011-2021

	DIG	t-statistic	Probability
C	0.376782**	2.943	0.0912
FSH	0.440267***	3.977	0.0041
ln SIZE	0.036563***	2.875	0.0048
CAR	0.15714	1.597	0.0368
GDP	0.030265***	3.248	0.0425
R square	0.882131		
Adjusted RSq.	0.820315		
F statistic	11.4432		
Prob.(Fstat.)	0.00000		
Durbin WStat.	1.9671		

The estimation result shows a significant and positive impact of foreign shareholdings on technology adoption or digital banking by local banks acquired or merged by the foreign shareholders. The higher the portion of foreign shareholdings, the higher the level of technological adoption by its acquired local banks. This results is also the same as the results of study on adoption of technology in Thailand banking industry. By disregarding other factors suchas customer demand for digital banking services, etc, it is evidenced that foreign shareholdings is identical with higher technological adoption. In terms of size, magnitude of banks equity it is also shows tendency that lager and higher equity banks tend to be more advance in using technology its banking services.

CONCLUSION AND POLICY IMPLICATION
The main purpose of the research is to investigate the correlation between technology and banking industry efficiency andhow it affect employee recruited and also how foreign

shareholdings affect technology adopted by the banks. This research found a significant impact of digital technology on banks efficiency, but the sign of the impact depends on the perspectives of level of digitization of the banks. Lower digitization bank tend to increase bank efficiency moderately whereas higher digitization banks which IT cost has significant amount in comparison to the bank total operation cost tend to increase efficiency higher with significant amount. There is also a positive significant impact of digital technology using the capital expenditure on technology on employee recruited. Lower level digitization banks tend to recruit more employee vis a vis the higher digitization banks.   This findings implies the trade-off between the cost of IT and bank's efficiency as well as employee recruited. Although applying digital technology reduces employee demand, technology can improve banking efficiency, which is also a prolong issue in Indonesia banking industry. Thus while technology adoption may increase efficiency, it may also decrease employee demand. As the employee is complement to digital technology, up-skilling in banking personnel is a must to adjust their skills with new technology as well as to enable them to be rotated to other areas in the bank which technology cannot replace the humanworks.   Reskilling banking personnel to perform well in other roles in related financial sectors (such as financial technology, insurance and capital markets) is also required to enable employee to be rotated to work in the non-banking financial institutions. In the time being, policymakers should support academic institutions to enable its graduates adaptable to new technological advancements. This research also found that there is a significant impact of foreign shareholdings on adoption of technology or digital banking on it acquired local banks. Higher portion of foreign shareholdings tend to increase uses of technology or digital banking services on its local banks acquired. Therefore higher foreign shareholdings provides betters performance for banking industry in Indonesia in terms of efficiency and digital banking services.

For future research it is advised to obtain only the number of employee recruited on each year not the total employee of the banks as total employee of the banks is not reflecting the accurate number of employee recruited but also including the number of resigned and retired employee. This is to ensure more accurate results whether increase in IT cost is always reduce employee recruited or maybe it will increase number of employee recruited. It is also advised to separate the foreign shareholdings based on countries of origin as those from developed countries may possibly have more advanced technology vis-a-vis the developing countries. As a caveat of this research, we only use very simple digital banking indicator, measured by the ratio of the bank's IT-related cost over their total operational cost. We also do not specify the employee based on areas of works such as marketing, business, operations, administrative, general work, etc. We also encourage future research to more precisely define the digital banking terminology and develop more precise measurements of a bank's digital banking level indicators and comparable across countries. And last but not least we need to grouped the banks based on its equity size as this research cannot verified whether the higher digitization of the larger bank is always decreasing the number of its employee demand or recruited.

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