Examining the Implementation of Green Banking and Intellectual Capital on Bank’s Profitability in Indonesia

Brigitta Catherine Wongso 1*, Stevan Helsa1†, and Rosinta Ria Panggabean 1‡

1Accounting Department, School of Accounting, Bina Nusantara University, Jakarta 11480, Indonesia

Abstract. The aim of this study was to examine the implementation of green banking operations and intellectual capital (IC) on bank’s profitability in Indonesia. Quantitative approach and panel data regression analysis were employed in this study. The bank’s profitability was measured by return on assets (ROA). Green banking operations were reflected through the combinations of bank’s e-channel transactions and the measurement of intellectual capital components were from Modified Value-Added Intellectual Coefficient (MVAIC™). A purposive sampling method was applied concerning the disclosure of e-channel’s transactions. The samples were taken from annual reports and/or sustainability reports of 14 banking sub-sector companies that listed on the Indonesia Stock Exchange (IDX) for the year 2012-2021 with a total observation of 107 samples. The results state that the total transactions via e-channel had a significant influence over ROA. However, the relationship is negative. MVAIC™ components of human capital efficiency (HCE) and capital employed efficiency (CEE) had a positive and significant impact on ROA. The other two components, structural capital efficiency (SCE) and relational capital efficiency (RCE) did not have a substantial influence over ROA.

1 Introduction

Profitability means the earnings generated from business activities within a specific timeframe. Profitability is particularly relevant for this as it can affect the company’s overall value. Higher profitability can lead to an increase in stock prices, which in turn can enhance the company’s worth. Measuring the level of profitability is critical as the main objective of a business is to optimize the value of its shareholders’ investments [1]. Bank profitability can be measured using Return on Assets (ROA). ROA is widely employed to measure bank profitability as it measures how effective a firm can leverage its assets to generate earnings [2]. ROA indicates the organization’s capability to exploit its assets efficiently to generate earnings. It is widely considered an essential financial indicator for investors, providing an overview of operating results and asset turnover ratio as a measure of productivity for the company.

There appear several factors that contribute to the profitability of banks. There has been an increase in global awareness during the past few years and concern about the impact of human activities on the environment and society, driven by the recognition of the existential threat posed by climate change. In response, many industries, including the banking sector, have started to focus on sustainability as a core principle. As a critical intermediary between investors and borrowers, banks have a crucial role to play in promoting sustainable economic development. The adoption of sustainable practices by banks can result in improved risk management, increased operational efficiency, enhanced brand reputation, and access to a wider range of funding sources. As such, sustainability is becoming an increasingly important consideration for banks looking to remain competitive and relevant in today’s rapidly changing business landscape, and to fulfill their responsibility to the communities and the environment in which they operate.

The implementation of green banking (GB), for example, has been carried out and the related activities are regularly disclosed in sustainability reports. GB has received significant attention in current green finance literature, largely in response to the growing concern surrounding the issue of global climate change [3]. GB aims to incorporate eco-friendly measures in the provision of banking services by advocating for the adoption of digital transactions, which in turn minimizes the carbon footprint associated with its operations. In specific, the approach to green banking involves the extensive utilization of technology, thereby reducing the reliance on paper-based transactions [4]. Green banking initiatives have been adopted in a variety of financial...
operations, including internet banking, mobile banking, and green loans [5].

In addition to the implementation of green banking, the introduction of Industry 4.0, which transforms the way we generate value, organizations and individuals are required to reconsider what they expect or demand from internet-connected gadgets [6]. Industry 4.0 is defined as enhanced management and organization of the whole value chain for product life cycles, with a focus on satisfying the constantly changing and individualized needs of customers. Industry 4.0 is a concept that includes, among other things, the use of big data, technology, cyber security, and the Internet of Things (IoT) [7]. These technologies are commonly classified as intangible assets or intellectual capital (IC). The emergence of a knowledge-based economy compels firms to depend not only on tangible assets such as physical and financial resources, but also on intangible assets to enhance productivity and maintain a competitive edge [8]. As banks would be categorized as a knowledge intensive sector, the enhancement of intellectual capital is considered a crucial factor in enabling banks to attain a competitive advantage [9].

Past research has shed light on the connection between green banking practices and the profitability of banks. Previous study concluded that the financial results of Egyptian banks in relation to the use of online banking for green banking practices after its implementation significantly affects bank’s profitability [10]. Another study found that the number of bank cards issued, automated teller machines (ATMs), and point of sale (POS) increased bank profitability in 23 countries from 2002 to 2016 [11]. Then, [12] discovered a substantial and positive connection between Value-Added Intellectual Coefficient (VAIC) and banks' return on assets (ROA). In detail, VAIC components that consist of SCE (Structural Capital Efficiency), CEE (Capital Employed Efficiency), and HCE (Human Capital Efficiency) have a considerable and favorable effect on the performance of banks. Furthermore, study by [13] examined the link between intellectual capital (IC) and bank profitability during COVID-19, utilizing samples from 34 Chinese and 39 Pakistani banks. Using return on asset (ROA) and return on equity (ROE) as measurements for profitability and VAIC for IC, it resulted in a positive effect on bank’s profitability in China and Pakistan throughout the pandemic.

This research seeks to examine the relationship between the application of green banking, intellectual capital, and the financial performance of banks in Indonesia. Few studies have been conducted on green banking implementations; however, they did not accurately reflect the most recent banking facilities offered by Indonesian banks. In addition, numerous prior research examined the impact of intellectual capital on a firm's profitability using measurement solely on HCE, SCE, and CEE under Pulic VAIC Model [14] separated intellectual capital into three categories: human capital, structural capital, and customer capital. To address this gap, this research attempts to investigate the impact of intellectual capital components on profitability using a modified VAIC model [15].

2 Literature review and Hypothesis development

2.1 Resources-based theory

The recent development of the resource-based theory studied by [16] acknowledges the role of stakeholders such as employees, customers, suppliers, debtholders and shareholders who provide access to crucial and specialized resources that, when combined, have the potential to generate economic profit and sustain long-term competitive advantage. These resources are valuable, rare, inimitable, and non substitutable. Furthermore, [17] observed that the rarity pertains to resource bundles. It can be implied that the greater rareness of a firm’s combination of resource capability, the more advantageous the firm’s successful exploitation of the combinations, resulting in either a cost advantage or differentiation advantage. There are several non-financial statement items such as knowledge, intellectual property, information, systems, and business processes that have important influences in creating a value to the company. The banking industry is considered as a knowledge-based enterprise [18]. They have different approaches to generating income such as using relationship selling and secured money infrastructure to gain trust from customers. The intellectual factors are tied to the nature of the banking sectors. Therefore, intellectual capital owned in banking sector can be explained by resource-based theory to generate their sources of income [19].

2.2. Legitimacy theory

Legitimacy theory posits that companies disclose information related to their social responsibility to create a positive image of themselves as socially responsible entities [20]. This is done to legitimize their actions and gain the approval of their stakeholder groups. According to this theory, there is a social contract between businesses and society, wherein companies are allowed to exist and have rights in exchange for fulfilling societal expectations regarding their operations. Therefore, for a company to survive, it must ensure that its actions align with societal values and norms. If a company fails to meet these expectations, it creates a breach of contract, and a legitimacy gap arises. According to [20], banking companies require a direct connection with end-users to initiate a business relationship. Therefore, banking companies must establish a stronger relationship with their customers to ensure their legitimacy in the market. Banks are now prioritizing green initiatives as a core objective to reduce their carbon footprint in both banking activities and financial products, thereby fulfilling their environmental responsibility. To support environmental protection, environmentalists have created policies to safeguard the environment. Banks must contribute to environmental sustainability by promoting paperless and internet banking and adhering strictly to non-materialization, non-carbonization, and non-mobilization practices in their operations, as
outlined by [21] considering that one of the most important types of legitimizing communicative practices was related to monitoring and controlling the environment through image and reputation activities [22]. Hence, it is encouraged that banks produce and publicize their green banking performance in order to meet the demand of and to establish legitimation from the public.

2.3 Green banking

The topic of Green Banking has received significant attention in current green finance literature, largely in response to the growing concern surrounding the issue of global climate change [5]. Green banking aims to incorporate eco-friendly measures in the provision of banking services by advocating for the adoption of digital transactions, which in turn minimizes the carbon footprint associated with its operations. In specific, the approach to green banking involves the use of extensive utilization of technology, thereby reducing the reliance on paper-based transactions [4]. Green banking initiatives have been adopted in a variety of financial operations, including internet banking, mobile banking, and green loans [5]. According to [23], their research shows that green banking by corporate social responsibility disclosure has a strong and beneficial impact on the bank's profits. Then, a study by [24] found that the implementation of green banking initiatives has resulted in enhanced competitiveness for banks as there were improvements in operational efficiency, cost savings, financial efficiency, and product enhancement. While, in this study we are focusing on green banking strategy through paperless banking. Paperless banking means carrying out financial transactions through electronic channels. Electronic banking is the channel that enables customers to conduct financial transactions with banks through the use of electronic devices such as tablets or smartphones [25]. According to a 2019 poll by Deloitte [26], the proportion of banking customers in Indonesia who are digitally active has increased 2.5 times since 2014 and currently makes up 32% of the country's banked population. Given that, the significance of this expansion has increased. Without physically visiting a bank, users of internet banking may check their account balances and make payments. Accordingly, we generate the following hypotheses from the above:

\( H_1 \): Frequency transactions using e-channels affect the ROA of banks.

2.4 Intellectual capital

Intellectual capital (IC) is seen as a strategic asset as organizations can attain a competitive edge through effective utilization based on resourced based theory [27]. Moreover, IC refers to the advanced skills and abilities possessed by an organization’s employees. This valuable resource can be applied as a competitive advantage in the pursuit of innovative and improved processes, which are essential for the organization’s survival and resilience in an ever-volving work environment [28]. Regarding the categorization of intellectual components, various academics hold different views. For instance, [29] has categorized intellectual capital into three distinct categories that consist of human capital, structural capital, and customer capital. Process capital and protection capital are also included in the research conducted by [30]. Furthermore, [31] used innovation capital as part of IC components. IC in financial institutions certainly plays a major role. A survey was conducted among executives of Indian banks, which revealed that there was a reasonable level of awareness regarding IC. This awareness was found to be equally distributed across three sub-categories, namely external capital, human capital, and internal capital. Nevertheless, the level of engagement with external funding was relatively high [32]. More importantly, [33] in his study argument, the business model of Islamic banks was heavily based on intangible sources which were utilized to generate value in the form of stability, profitability, and financial inclusion.

Moreover, the subsequent extant literature endeavored to observe the influence of intellectual capital on the profitability of banks. According to a study conducted by [34], the financial success of Indonesia’s Islamic commercial banks for the coming year may be predicted by the IC growth rate. Then, research found by [35] concluded that the productivity and profitability of Indian banks were significantly improved by the enhanced efficiency of IC. In detail, the authors assert that human capital was a crucial element of intellectual capital and played a significant role in enhancing the profitability and productivity of the banking industry in India. In contrast, [36] proposed that although human capital efficiency slightly reduces bank profitability today, it produces favorable results for future profitability. Additionally, another study found that capital employed efficiency serves as the primary determinant of bank profitability in Thailand from 1997 to 2016. [37] revealed a correlation between the efficiency of structural capital and ROA. According to [38], SCE and RCE are the primary value drivers for achieving outstanding results in Islamic banks. Based on the existing studies, the following hypotheses were proposed:

\( H_2 \): Human capital efficiency affects the ROA of banks.

\( H_3 \): Structural capital efficiency affects the ROA of banks.

\( H_4 \): Relational capital efficiency affects the ROA of banks.

\( H_5 \): Capital employed efficiency affects the ROA of banks.

3 Research methodology

3.1 Sample

This study was conducted within the scope of publicly traded banks on IDX during the years 2012 and 2021. The study applied financial data sourced from the Osiris database. The annual and sustainability reports of the companies were used to extract data on the frequency of
transactions carried out through e-channels, specifically internet banking and mobile banking/SMS banking. The researchers employed the purposive sampling method, using specific criteria that involved the disclosure of the frequency of transactions conducted through internet banking and mobile/SMS banking. The study included a total of 107 samples, although the sample consisted of 46 banks that were listed on the IDX which only 14 banks that disclosed their e-channel transactions reported in the last 10 years shown in table 9 Appendix.

3.2 Research model

The research employed financial ratios, in particular ROA, as an independent variable. In their study, [5] employed the number of ATM transactions as a variable to indicate the implementation of environmentally sustainable banking practices. However, this research utilized the frequency of transactions conducted through electronic channels such as internet banking and mobile banking or SMS banking. The expansion of digital channels, like websites, banking applications, and mobile banking, may be linked to the improvement of technology as well as the changing needs of consumers. The pandemic caused by the Covid-19 virus has further exacerbated this tendency [39]. Furthermore, [40] employed the measure of internet banking volume as an independent proxy to examine the correlation between the intensity of internet banking and bank performance.

There exist numerous methods for computing Intellectual Capital (IC). The formulation to quantitatively account for IC was first proposed by [41] and is known as the Value-Added Intellectual Capital Coefficient (VAIC). The original Pulic’s VAIC model was later modified by [15] by incorporating relational capital as the final component of IC. Thus, MVAIC consisted of 4 components, human capital efficiency (HCE), structural capital efficiency (SCE), relational capital efficiency (RCE), and lastly capital employed efficiency (CEE). The initial step involves the computation of Value Added (VA) using the equation suggested by [14].

\[ VA = OP + EC + D + A \]  

The variable OP denotes operating profits, while EC signifies expenses that are associated with employees. Additionally, variable D represents depreciation, and A denotes amortization.

Regarding HCE, the formula can be expressed as follows:

\[ HCE = \frac{VA}{HC} \]  

The term "HC" refers to the expenses associated with employees.

Concerning SCE, the formula can be expressed as follows:

\[ SCE = \frac{SC}{VA} \]  

The calculation of SC involves the subtraction of HC from VA.

The RCE is calculated in the way described below:

\[ RCE = \frac{RC}{VA} \]  

The variable RC encompasses marketing costs, advertising expenses, and promotional expenditures.

The CEE is expressed in the following manner:

\[ CEE = \frac{VA}{CE} \]  

The variable CE represents the amount of capital invested in a business, ascertained by the recorded value of the company’s total assets less its liabilities (or total equity). The following is the regression model:

\[ Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \epsilon \]  

Where:

- \( Y \): return on assets
- \( X_1 \): frequency of transactions via e-channels
- \( X_2 \): human capital efficiency
- \( X_3 \): structural capital efficiency
- \( X_4 \): relational capital efficiency
- \( X_5 \): capital employed efficiency

Figure 1 shows the framework used in this study.

Fig. 1 Research Framework

The research utilized the panel data methodology using EViews 12. The dataset is comprised of both time series (2012-2021) and cross-sectional data (14 banks in Indonesia). The lack of adequate information pertaining to indicators of green banking necessitated the use of imbalanced data. Several tests were employed to ascertain the appropriate estimation technique, namely Chow Test, Hausman Test, Lagrange Multiplier (LM) - Bruesch-Pagan Test. Subsequently, the descriptive statistics were carried out, followed by a series of classical assumption tests, to examine the normality, multicollinearity, and heteroscedasticity. Finally, the results of the panel data regression were presented.

4 Result and discussion

The following are the results of the descriptive statistics as shown in Table 1

Table 1 Descriptive Statistics
### 3.3 Regression model test

#### Table 2 Chow test

<table>
<thead>
<tr>
<th>Effects Test</th>
<th>Statistic</th>
<th>d.f.</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross-section F</td>
<td>10.733701</td>
<td>(13,88)</td>
<td>0.0000</td>
</tr>
<tr>
<td>Cross-section Chi-square</td>
<td>101.647963</td>
<td>13</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Source: The output generated by EViews version 12.

The Chow Test was used to determine whether to employ the common effect model (CEM) or fixed effect model (FEM). The FEM is selected when the cross-section F probability value falls below the 5% significance level ($\alpha = 0.05$). Table 2 shows that the p-value associated with cross-section F is 0.0000. As a result, the FEM was deemed to be the suitable model as its significance level was less than 0.05.

#### Table 3 Hausman test

<table>
<thead>
<tr>
<th>Test Summary</th>
<th>Chi-Sq. Statistic</th>
<th>Chi-Sq. d.f</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross-section random</td>
<td>22.883335</td>
<td>5</td>
<td>0.0004</td>
</tr>
</tbody>
</table>

Source: The output generated by EViews version 12.

Subsequently, to differentiate between the fixed effect model (FEM) and random effect model (REM), Hausman Test was utilized. According to the findings presented in Table 3, it can be observed that the p-value for the cross-section random variable is 0.0004. The statistical significance level of 0.0004 is less than the predetermined significance level of 0.05 suggesting that the FEM was the appropriate choice. If FEM is confirmed by both the Chow and Hausman tests, then the utilization of the Lagrange Multiplier (LM) - Bruesch-Pagan Test is superfluous. Conclusively, the FEM method is suitable to be used in this study.

### 3.4 Classical assumption test

#### Fig. 2 Normality Test (Jarque-Bera) results

The results of the Jarque-Bera test for normality showed that the independent variables had a normal distribution, as shown in Figure 2. The Jarque-Bera value, which was less than 2, was 0.208998. In addition, the probability value was calculated to be 0.90, and the test's level of significance was set at 0.05 ($0.90 > 0.05$).

#### Table 4 Multicollinearity test

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.432414</td>
<td>0.324619</td>
<td>1.332066</td>
<td>0.1863</td>
</tr>
<tr>
<td>$X_1$</td>
<td>-0.014890</td>
<td>0.034000</td>
<td>-0.437949</td>
<td>0.6625</td>
</tr>
<tr>
<td>$X_2$</td>
<td>-0.016114</td>
<td>0.029969</td>
<td>-0.537671</td>
<td>0.5922</td>
</tr>
<tr>
<td>$X_3$</td>
<td>-0.012713</td>
<td>0.119420</td>
<td>-0.106454</td>
<td>0.9155</td>
</tr>
<tr>
<td>$X_4$</td>
<td>0.975039</td>
<td>0.273494</td>
<td>3.499692</td>
<td>0.0366</td>
</tr>
<tr>
<td>$X_5$</td>
<td>-0.410157</td>
<td>0.273494</td>
<td>-1.509692</td>
<td>0.1373</td>
</tr>
</tbody>
</table>

Source: The output generated by EViews version 12.

The results are the results of the multicollinearity test conducted using EViews 12. If the correlation values resulted in less 0.80, multicollinearity would not be present. The results indicate multicollinearity problem did not exist, as the highest correlation value observed was 0.6616, which was less than the acceptable value of 0.80.

#### Table 5 Heteroscedasticity test

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
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<td>0.273494</td>
<td>-1.509692</td>
<td>0.1373</td>
</tr>
</tbody>
</table>

The Glesjer Test was used to perform a heteroscedasticity test (reflected as Resabs). Given that the correlation values resulted in less 0.80, multicollinearity would not be present. The results indicate multicollinearity problem did not exist, as the highest correlation value observed was 0.6616, which was less than the acceptable value of 0.80.

### 3.5 Hypothesis test

3.5.1 Coefficient determination test

The adjusted R-Squared was determined to be 96.54% through the coefficient of determination test. The study indicates that the dependent variable, namely ROA, may...
be accounted for by independent variables such as frequency of transactions via e-channels, human capital efficiency, structural capital efficiency, relational capital efficiency, and capital employed efficiency. This research seems to have ignored certain variables that may have exerted a 3.46% influence.

**Table 6 R-squared and adjusted R-squared**

<table>
<thead>
<tr>
<th></th>
<th>R-squared</th>
<th>Adjusted R-squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source: The output generated by EViews version 12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.5.2 Statistical F-test

**Table 7 F-statistic and Prob (F-statistic)**

<table>
<thead>
<tr>
<th>F-statistic</th>
<th>Prob (F-statistic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source: The output generated by EViews version 12</td>
<td></td>
</tr>
</tbody>
</table>

The statistical analysis of ROA using the F-test yielded a probability value (Prob) of 0.000, using a significance level of 0.05. The null hypotheses should be rejected if the value is lower than 0.05. Thus, the utilization of the regression model is feasible. Moreover, it indicates that the ROA was simultaneously affected by independent variables.

3.5.3 Statistical T-test

**Table 8 T-test**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source: The output generated by EViews version 12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.6 Discussion

3.6.1 The influence of frequency of transactions via e-channels on ROA

The regression results show that for the years 2012 to 2021, ROA in listed Indonesian banks is significantly affected by the number of transactions made via e-channels (internet banking, mobile banking, SMS banking). The coefficient of determination of FTE was observed to be -0.1785, indicating a negative relationship. This implies that a 1% increase in the volume of digital banking transactions would result in a corresponding decrease of 0.17% in the ROA. The findings of the study align with the legitimacy theory, which asserts that the adoption of green banking practices can impact profitability. This indicates that banking institutions are under perceived pressure to integrate environmental considerations into their banking practices, as evidenced by the emergence of technologies aimed at mitigating carbon emissions. [41]

argue that legitimacy theory centers on the congruence between a company's actions or systems and the values or social norms of society. Stated differently, it is imperative for the company to rationalize all its actions to conform to societal norms and secure societal approval.

3.6.2 The influence of HCE on ROA

Table 8 reveals that the HCE demonstrated a link that is statistically significant with the dependent variable. The statistical analysis revealed that the p-value for HCE was 0.000, indicating a high level of significance which was found to be below the predetermined significance level of 0.05. Additionally, the coefficient value was 0.8932. Therefore, HCE had a positive and significant relationship towards ROA.

The findings of this study provide validation for the resource-based theory, which proposes that HCE as part of MVAIC has an impact on profitability. The theory of resource-based emphasizes the utilization of intangible resources as a means for companies to achieve long-term competitive advantage. The intangible assets discussed here pertain to the contributions made by employees towards the advancement of company operations, through their skills, general and specialized knowledge, and decision-making abilities, resulting in increased efficiency. Investing in employee training and education can enhance their competencies and job satisfaction, thereby resulting in increased productivity and ultimately, enhanced profitability [42].

3.6.3 The influence of SCE on ROA

Table 8 shows that the influence of SCE on the ROA of banks registered on IDX was not statistically significant throughout a decade-long period from 2012 to 2021. The statistical analysis of SCE resulted in a p-value of 0.3805, which suggests that it surpassed 0.05. Consequently, H_0 is supported. The concept of structural capital encompasses a range of organizational elements, including systems, procedures, programs, tools, and innovations such as patents, copyrights, and trademarks. These elements serve to support and enhance the productivity of human capital and fixed assets within an organization. As per resource-based theory, these kinds of assets are likely to have a significant impact on the creation of value for the organization, particularly in the banking industry, which is widely regarded as being the most knowledge-intensive sector. The findings of the study, however, did not provide evidence to support the claim that the efficacy of structural capital has an impact on the profitability of banks. [43] proposed an argument indicating that there could potentially exist trade-offs among the various components of intellectual capital, thereby rendering the utilization of multiple forms of intellectual capital to be productive. Furthermore, it should be noted that the formula for calculating structural capital is contingent upon the value of human capital, as expressed by the equation SC = VA-HC. Thus, it can be inferred that as the contribution of human
capital in value creation increases, the contribution of structural capital in value creation decreases [44].

3.6.4 The influence of RCE on ROA

The regression results in Table 8 present that RCE had no relationship towards ROA for publicly listed banks in Indonesia over the period that extended from 2012 to 2021. The results indicate that the p-value for RCE was 0.5595, which surpasses the established significance level of 0.05, indicating that there is no relationship between the variables. In conclusion, it is acceptable not to reject the $H_0$. The theory of resource-based perspective states that the existence of relational or customer capital can contribute to the enhancement of a firm's brand image, leading to an increase in profitability. Relational capital refers to a resource that is specific to the market and is associated with the external relationships established with channel partners and customers [45]. On the contrary, the study found that the RCE did not make any significant contribution to the bank's return on assets (ROA). Yet the findings of the present study are consistent with the research conducted by [46], which indicated a positive yet insignificant relationship between relational capital efficiency and the return on assets (ROA) of financial institutions in Malaysia. Furthermore, it is evident that the impact of RCE on the overall intellectual capital performance comprehensive efficacy was merely 1%. The impact of promotional expenditures in driving revenue and profitability appears to be limited, as consumers have numerous opportunities to avoid or disregard advertising and it is proved that societal promotions are better to enhance customer engagement [47].

3.6.5 The influence of CEE on ROA

Table 8 findings show a significant relationship between CEE and ROA since the statistical analysis produced a p-value of 0.0000, which was lower than the threshold of 0.05 for significance. Furthermore, the connection was favorable due to CEE's positive coefficient value of 3.58. The alternative hypothesis is thus considered to be valid. The relationship can be explained using the resource-based theory. The theory suggests that companies can attain competitive advantage if they are able to utilize their unique and potential resources, especially in banking sector where they provide financial services to customers. This study correlates with the study in Ethiopia that CEE has a positive impact on ROA within private banking institutions [48].

4 Conclusion

The objective of this study is to examine the influence of green banking and intellectual capital on the ROA of Indonesian banks that are publicly listed on the IDX over a period of ten years, from 2012 to 2021. The study reveals that the frequency of transactions conducted through e-channels, namely internet banking and mobile banking/SMS banking, as a green banking factor, has a significant negative impact on ROA. The MVAICTM identified that the HCE and CEE exhibited a significant positive influence on the ROA. However, the impact of SCE and RCE on ROA was not significant.

When conducting the study, the authors encountered challenges in gathering data pertaining to the frequency of transactions conducted through e-channels. This was due to the limited amount of disclosure provided by the majority of Indonesian banks, which consequently resulted in a reduction in the quantity of data available for examination. Based on the core capital groupings (KBMI) established by OJK, it seems only banks falling under KBMI 2.3, and 4 disclose their digital operations.

Several recommendations can be applied for further research: 1) expand the scope of the research to other countries aside from Indonesia, such as Malaysia as both countries are located in ASEAN region and classified as middle income countries according to World Bank [49], 2) incorporate additional variables pertaining to IC to comprehensively capture its impact on firms. For instance, [31] have proposed the inclusion of innovation capital as an additional IC variable.

References

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34. S. Wahyuni, P. Pujiharto, B.C. Pratama, S.N. Azizah, AJAR (2023)
49. World Bank, (2023)
### Appendix

**Table 9. List of samples**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banks that are listed on IDX as of 2022</td>
<td>46</td>
</tr>
<tr>
<td>Observation years</td>
<td>10</td>
</tr>
<tr>
<td>Total observation</td>
<td>460</td>
</tr>
<tr>
<td>Banks that did not report the frequency of transactions via e-channels (internet banking, mobile/SMS banking) in annual report/sustainability report</td>
<td>(353)</td>
</tr>
<tr>
<td>Total samples</td>
<td>107</td>
</tr>
</tbody>
</table>