Exploration of Competitive Intensity, ESG, and Operational Performance in the Banking Industry

Ting-Kun Liu[1]

Abstract

Based on previous literature on the impact of ESG (Environmental, Social, and Governance) on corporate operations, it is evident that the effects of corporate ESG investments on operational performance are not easily reflected in performance-related variables or indicators. Jung and Yoo (2023) also pointed out that in a competitive market, companies might overlook the implementation of ESG, resulting in an insignificant relationship between ESG and performance. Therefore, this study, from this perspective, constructs a panel data set of Taiwan's financial industry from 2010 to 2023 to explore the influence of competition level, ESG, and banking industry operational efficiency. In addition to including multiple performance variables, the study also considers various ESG ratings and scoring systems, and CommonWealth Magazine's Sustainable Citizen Award. The sample is divided into pre-pandemic and post-pandemic sub-samples to further examine the differences in influencing factors across these periods.

Keywords: *Competition, ESG, Banking Industry, Operational Performance, Panel Data Model*

INTRODUCTION

The acronym ESG was first introduced in the United Nations' 2005 report "Who Cares Wins," which highlighted that companies should incorporate "Environmental," "Social," and "Governance" considerations into their operational evaluation standards. In response to climate change, the depletion of environmental resources, and the outbreak of COVID-19 in 2019, there has been a growing emphasis on protecting nature and ensuring sustainable resource development. Consequently, the concepts of environmental, social, and governance factors have gained importance, with governments, corporations, and investors increasingly focusing on the opportunities and risks associated with ESG (Environmental, Social, and Governance).

In recent years, Taiwan's financial industry has launched ESG funds. Since July 2021, the scale of ESG domestic and foreign funds complying with Financial Supervisory Commission (FSC) regulations has rapidly increased from less than NT$200 billion to NT$438.9 billion, representing a growth rate of nearly 120%. The top three funds in the 2023 "Taiwan ESG Sustainable Fund Rankings" are Schroder's "Global Energy Transition Fund," BlackRock's "Next Generation Transportation Fund," and Fubon's "Taiwan Corporate Governance 100 ETF Fund," with returns of 74.3%, 72.8%, and 72.7%, respectively. In 2021, the Taiwanese government announced the goal of achieving "net-zero emissions" by 2050 and officially released the "2050 Net-Zero Emissions Pathway Blueprint" in March 2022. This blueprint outlines four major transitions: "energy transition," "industrial transition," "lifestyle transition," and "social transition," along with two fundamental bases, "technology research and development" and "climate legislation." These are supplemented by twelve key strategies to formulate action plans for expected growth in crucial areas of energy, industry, and lifestyle transition policies (National Development Council, Executive Yuan), aiming to achieve economic growth while ensuring environmental sustainability and enhancing social welfare.

For enterprises, focusing on ESG can reduce management risks, increase market transparency, develop innovative business opportunities, attract sustainable talent, comply with regulatory oversight, and contribute to fulfilling social responsibility. Furthermore, banks that sign the Equator Principles incorporate environmental protection, corporate integrity, and social responsibility into their credit assessment criteria for borrowers. If a company fails to meet these standards, the bank can tighten its financing limits or even blacklist the company. This approach can attract more companies to commit to ESG and sustainable development. For investors,

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[1] Associate Professor, Department of Finance, Chaoyang University of Technology, 168, Jifeng E. Rd., Wufeng District, Taichung, 41349, Taiwan. Tel: 886-4-23323000 ext. 4881, E-mail: tkliu@cyut.edu.tw. ORCID: https://orcid.org/0000-0002-2656-1071

ESG can help them more easily assess a company's long-term value and risk, making companies that actively engage in ESG development a priority consideration. Taiwanese banks have also begun to focus on and engage in ESG matters. ESG investing considers a company's performance in environmental, social, and governance areas, as well as its impact on society and the environment. For example, Taishin Bank participates in ESG-related activities and initiatives; CTBC Bank is making efforts in sustainable finance and ESG investment; Taiwan SME Bank is involved in ESG-related activities and has expressed its commitment to sustainable finance; and Yuanta Commercial Bank has launched ESG-related financial products. These banks engage in ESG activities through the launch of ESG-related financial products, participation in social responsibility projects, and the publication of ESG reports.

Previous research examining the relationship between ESG and corporate performance has revealed inconsistent findings. For example, Lee et al. (2022) found in their study on the impact of ESG and board characteristics on the financial performance of Taiwan's financial holding companies that sustainable environmental development and social welfare within ESG have a significant impact on financial performance, but corporate governance does not. Buallay et al. (2023) reported a negative correlation between ESG and performance indicators such as Return on Assets (ROA), Return on Equity (ROE), and firm value (Tobin's Q). Zahid et al. (2023) used Tobin's Q to measure the impact of ESG performance on the financial performance of the banking sector before and after the COVID-19 pandemic, finding that environmental sustainability negatively affected financial performance during the COVID-19 period. Additionally, Jung and Yoo (2023) indicated that in a competitive market, companies might overlook the implementation of ESG, leading to an insignificant relationship between ESG and performance.

Given the investment in ESG by Taiwan's banking industry and insights from previous literature, this study focuses on the banking sector, incorporating the perspective of market competition. Using empirical panel data from Taiwan's banking industry spanning from 2010 to 2023, this research examines the impact of competition intensity and ESG on the operational efficiency of banks. In addition to including various performance variables, the study also considers multiple ESG rating and evaluation systems. The sample is divided into pre-pandemic and post-pandemic sub-samples to further investigate the differences in influencing factors before and after the pandemic.

The thereafter structure of this article includes: Section 2. literature review, we mainly discuss the research related to ESG and corporate performance, Section 3. research method, this part explains the data source, variable definition, empirical model and research method, Section 4. empirical results and analysis, and Section 5. conclusions and recommendations.

LITERATURE REVIEW ON ESG RELATED ISSUES

Review of Literature on ESG-Related Issues in Taiwanese Enterprises

Lee et al. (2011) found that companies that win CSR awards experience significant positive impacts on both financial and non-financial performance due to their CSR investments. Hong et al. (2013) observed that companies with closer relationships with stakeholders are more likely to engage in related social responsibility activities; furthermore, higher levels of environmental disclosure correlate with better CSR performance. Lee et al. (2022) demonstrated that sustainable environmental development and social welfare components of ESG significantly impact corporate financial performance. Yang and Hu (2023) discovered that increasing information transparency can enhance CSR performance and credit ratings, and better social responsibility performance helps companies achieve higher credit ratings. According to Liu (2024), from a risk management perspective, better ESG performance reduces financial distress and enhances the stability of bank operations, especially notable in financial holding companies.

Conversely, the literature also shows that ESG investments do not directly translate into performance improvements: Lin et al. (2006) mentioned that enhancing social responsibility performance benefits corporate revenue growth and operating income return rate in the short term, but it does not have an immediate effect on financial performance metrics like ROA and ROE. Lin et al. (2012) pointed out a significant negative relationship between environmental disclosure and financial performance. Liu (2024) found that banks with

comprehensive ESG disclosures face higher financial risks, implying that engaging in ESG activities can affect corporate profitability.

Overall, the reviewed literature indicates that the impact of ESG on Taiwanese companies' performance varies when different measurement methods are used. Companies with higher overall ESG scores and those awarded for ESG performance tend to show better operational results. However, there are inconsistencies in the performance of the three ESG pillars across various rating agencies. Thus, this study will employ multiple ESG rating scores and use diverse perspectives to explore the relationship between ESG and bank performance.

Review of Literature on ESG-Related Issues in Other Countries' Enterprises

Velte (2017) showed that ESG investments positively impact ROA, with governance having the most substantial effect on financial performance compared to environmental and social aspects. Escrig-Olmedo et al. (2019) found that incorporating new standards into ESG rating assessments provides more accurate and robust performance measurement models to address global challenges. However, they also noted that ESG rating agencies have not fully integrated sustainability principles into their evaluation processes. Alareeni and Allam (2020) indicated that ESG disclosures positively influence company performance indicators. Brando et al. (2021) observed that discrepancies in environmental scores positively correlate with stock returns, and companies with higher ESG rating discrepancies have a risk premium. Ahmad et al. (2021) demonstrated a significant positive impact of ESG on financial performance, with high ESG companies generally showing better financial results.

Engelhardt et al. (2021) found that during the COVID-19 crisis, companies with high CSR had better financial performance, mainly driven by their environmental and social scores. Chiaramontea et al. (2022) indicated that overall ESG scores and their subcomponents reduce bank vulnerability during financial crises, with this stabilizing effect being more pronounced in banks with higher ESG ratings. Zhou et al. (2023) emphasized that improvements in listed companies' ESG performance can increase company value, with financial performance showing a significant mediating effect. Operational capability is identified as a crucial mediating factor in the impact of ESG performance on company value. Azhari et al. (2023) reported a positive correlation between profitability, independent board members, and ESG disclosure during and before the COVID-19 pandemic.

Other scholars, however, have presented less optimistic views. Velte (2017) found no impact of ESG performance on Tobin's Q. Alareeni and Allam (2020) discovered a negative relationship between environmental and CSR disclosures and ROA and ROE when evaluating the three ESG components separately. Yuen et al. (2022) noted that adopting ESG standards might increase banking costs and reduce profitability. Jung and Yoo (2023) showed that the more competitors in the market, the weaker the impact of ESG performance on corporate performance, suggesting that companies might be unable to invest in ESG activities when market competition is intense. They recommended that governments provide policy support to encourage corporate participation in ESG activities or offer more incentives for ESG activities in highly competitive industries. Buallay et al. (2023) found negative correlations between ESG and operational performance (ROA), financial performance (ROE), and market performance (Tobin's Q).

Zahid et al. (2023) revealed that environmental sustainability negatively affected financial performance during the COVID-19 period, suggesting that the banking sector neglected environmental sustainability practices during the pandemic. Gutiérrez-Ponce and Wibowo (2023) pointed out significant negative impacts of all ESG performance indicators (ROA, ROE, and Tobin's Q), indicating that ESG activities incur substantial costs in the short term, leading to reduced returns. Mao et al. (2024) found a negative correlation between ESG performance and earnings management, with companies engaged in ESG practices exhibiting higher levels of earnings management when ESG rating discrepancies are high, and vice versa.

In summary, the international literature shows more evidence of a negative relationship between ESG and company performance, with some scholars suggesting a U-shaped relationship where long-term ESG investments benefit bank performance. Additionally, some scholars have observed that market competition affects the focus on ESG investments, leading to ESG activities being overlooked. Therefore, this study will consider market competition levels to explore whether the competitive intensity influences bank performance.

METHODOLOGY

This section is structured into four components. The initial segment pertains to the selection of samples and data sources, followed by the definition of variables. The subsequent part outlines the methodology employed, culminating in the presentation of the empirical model.

Sample Selection and Sources

This study focuses on the banking industry in Taiwan, utilizing data from the Taiwan Economic Journal (TEJ) database. The sample includes 24 banks, comprising financial holding banks and domestic banks, spanning the period from 2016 to 2023, covering eight years of data. The ESG data for this study is sourced from the TESG Sustainability Development Indicators in the TEJ database, the S&P Global ESG database, the ESG Investor Relations Platform, and the "CommonWealth Magazine Sustainability Awards" survey.

Definition of Variables

First, in exploring the impact of ESG investments and competition levels on the operational efficiency of Taiwan's financial industry, this paper references the empirical findings of Zhou et al. (2023), which demonstrate a significant positive relationship between a company's ESG performance and its market value (Tobin's Q). Accordingly, market value is included as a performance variable. Conversely, Buallay et al. (2023) examined the sustainability reporting and performance of banks and financial services across seven regions, finding a negative correlation between ESG performance and both return on assets (ROA) and return on equity (ROE). Jung and Yoo (2023) investigated how ESG activities influence firm performance and the moderating role of competitive market environments, concluding that intense market competition negatively impacts ESG performance.

Although the existing literature presents inconsistent results regarding the linear causal relationship between ESG investments and firm performance, the effects on ROA and ROE are consistently significant. Therefore, this study employs ROA, ROE, and Tobin's Q as the dependent variables representing traditional financial performance indicators. Additionally, the Herfindahl-Hirschman Index (HHI) and the Four-firm concentration ratio (CR4) are used as proxy variables to measure the level of market competition.

Dependent Variables

Return on Assets (ROA): This is calculated as net income after tax divided by average total assets, and it is used to measure the operational efficiency of banks. Return on Equity (ROE): This is calculated as net income after tax divided by average shareholders' equity, and it is used to measure the financial performance of banks. Tobin's Q: This is calculated as the market value of a company divided by the replacement cost of its assets. It is used to measure the market performance of banks. (The market value of a company is calculated as the number of outstanding shares multiplied by the market price.)

Independent Variables

ESG Overall Scores and E, S, G Dimension Scores

The ESG overall scores and the scores for the Environmental (E), Social (S), and Governance (G) dimensions are derived from three ESG rating agencies: the S&P Global ESG Database, the TESG scores from the Taiwan Economic Journal (TEJ), and the CommonWealth Magazine's "Top 100 Sustainable Citizens Award." These scores are used to construct the ESG overall scores, E, S, G dimension scores, and ESG dummy variables.

S&P Global ESG Score (ESG$_1$)

Sourced from the S&P Global ESG ratings available on the ESG Investor Relations Platform (range: 0-100, with 100 being the highest).

S&P Global Environmental Dimension Score (E$_1$)

Sourced from the S&P Global ESG ratings available on the ESG Investor Relations Platform (range: 0-100, with 100 being the highest).

S&P Global Social Dimension Score (S₁)

Sourced from the S&P Global ESG ratings available on the ESG Investor Relations Platform (range: 0-100, with 100 being the highest).

S&P Global Governance Dimension Score (G₁)

Sourced from the S&P Global ESG ratings available on the ESG Investor Relations Platform (range: 0-100, with 100 being the highest).

TESG Score (ESG₂)

Selected from the TESG sustainability development indicator scores in the Taiwan Economic Journal (TEJ) database (grades range from A+ to C- across 7 levels).

TESG Environmental Dimension Score (E₂)

Selected from the TESG sustainability development indicator environmental dimension scores in the Taiwan Economic Journal (TEJ) database (range: 0-100). This score measures various environmental issues and disclosure practices of banks.

TESG Social Dimension Score (S₂)

Selected from the TESG sustainability development indicator social dimension scores in the Taiwan Economic Journal (TEJ) database (range: 0-100). This score measures various social issues and disclosure practices of banks.

TESG Governance Dimension Score (G₂)

Selected from the TESG sustainability development indicator governance dimension scores in the Taiwan Economic Journal (TEJ) database (range: 0-100). This score measures various governance issues and disclosure practices of banks.

CommonWealth Magazine - Top 100 Sustainable Citizens Award (ESGDV)

Sourced from the list of the top 100 enterprises with superior ESG performance as selected by CommonWealth Magazine. For the financial sector, a score of 1 is assigned if the bank is awarded, and 0 if not.

Market Competition Variables

Herfindahl-Hirschman Index (HHI)

The market share of all firms within an industry is represented by the sum of the squared market shares of all banks (calculated based on net operating income) in the country. Specifically, HHI= $\text{HHI} = \sum_{i=1}^{n}(x_i/X)^2 \times 10{,}000 = \sum_{i=1}^{n} S_i^2 \times 10{,}000$, where x_i is the market share of firm, X is the total market share, n is the total number of firms in the market, and S_i is the market share of firm i. A higher HHI indicates a more concentrated market, while a lower HHI, approaching zero, indicates a more dispersed and competitive market.

Four-Firm Concentration Ratio (CR₄)

The formula is: $CR_n = \sum_{i=1}^{n} S_i$, where n is the total number of firms in the market, and S_i is the market share of firm i. CR₄ refers to the percentage of total industry output accounted for by the largest four firms within an industry. The higher the CR₄, the higher the concentration and the more monopolistic the market; conversely, a lower CR₄ indicates a more competitive market.

Other control variables

Company Size (SIZE)

Defined as the natural logarithm of total assets, serving as a measure of enterprise scale. Generally, larger companies tend to possess greater resources and market share, which can enhance production efficiency, reduce costs, and potentially boost competitiveness and market position.

Company Age (AGE)

Calculated as the current year minus the year of company establishment in calendar years. As a company's tenure increases, its management team accumulates extensive industry knowledge and experience. Coupled with long-term accumulation of resources and operational capabilities, this enhances market competitiveness, improves operational efficiency, and fosters growth potential.

Real GDP Growth Rate (GDP)

The GDP growth rate is a measure of the rate at which a country's Gross Domestic Product (GDP) increases or decreases over a specific period. The formula to calculate the GDP growth rate is:

GDP Growth Rate= (Previous GDP-Current GDP/Previous GDP)×100%A positive GDP growth rate indicates economic expansion, reflecting higher productivity, increased economic activity, and improved economic conditions in the region. Conversely, a negative rate suggests economic contraction or recession.

Description of Research Methods

Panel Data Model

This study employs a panel data model that combines both time series and cross-sectional analysis. While ordinary least squares estimation (OLS) is widely used for measuring time series and cross-sectional data, it overlooks the heterogeneity among the data being processed, potentially leading to biased results. The panel data model conducts regression analysis that incorporates both time series and cross-sectional dimensions, offering richer and more versatile characteristics suitable for complex or individual-level data. Equation (1) is the basic regression formula for the panel data model:

$$Y_{i,t} = \alpha_i + \sum_{k=1}^{K} \beta_k X_{k,i,t} + e_{i,t} \tag{1}$$

where $Y_{i,t}$ is the ith influencing variable, which is the dependent variable in period t,

$X_{i,t}$ represents the explanatory variable, $u_{i,t}$ is the error term, β_k is the regression coefficients, which have fixed constant values for each other in a long period of time, and α_i is the intercept of the regression, and is fixed in the long run.

The panel data model can be divided into two types: the fixed effects model and the random effects model. The main difference between the two lies in the definition of the intercept term. If there is a correlation between the intercept term and the explanatory variables, it is called a fixed effects model. If there is no correlation between the intercept term and the explanatory variables, it is called a random effects model.

Fixed Effect Model

The characteristics of the fixed effects model include considering both cross-sectional and time-series data simultaneously, allowing for differences between companies. Each company's unique characteristics are represented by a fixed intercept term, which does not change over time. This model assumes that these differences originate from the population itself, implying low similarity within the population. Therefore, it does not rely on sampling but uses the entire population to observe differences between all companies. As a result, each regression equation in the model has a unique and fixed intercept term. When conducting empirical analysis using the panel data model, it is typically assumed that the fixed intercept term is α_i, with dummy

variables included to measure the impact of unobserved variables on the model. The model is represented by Equation (2) as follows:

$$Y_{i,t} = \sum_{j=1}^{N} \alpha_i D_{j,t} + \sum_{k=1}^{K} \beta_k X_{k,i,t} + e_{i,t} \tag{2}$$

$$D_{j,t} = \begin{cases} 1, \text{when } j = 1 \\ 0, \text{when } j \neq 1 \end{cases}$$

where α_i represents the coefficient of the intercept term, $D_{i,t}$ is a dummy variable, if $j=i$, then $D_{i,t}=1$; otherwise, $j \neq i$, then $D_{i,t}=0$.

Random Effect Model

The random effects model is also applicable to data that combines cross-sectional and time series dimensions. It assumes small differences and high similarity within the population, thus using random sampling instead of the entire population. This model emphasizes the overall relationship in the data rather than differences between individual companies. Consequently, it assumes the model's intercept term is randomly generated and does not change over time. The model is as shown in Equation (3):

$$y_{it} = \alpha_i + \sum_{k=1}^{K} \beta_k X_{ikt} + \varepsilon_{it}$$
$$= (\alpha + \mu_i) + \sum_{k=1}^{K} \beta_k X_{ikt} + \varepsilon_{it} \tag{3}$$

α_i is a fixed unknown parameter, which represents the average number of individual effects on variable variables. ε_{it} is an independent random variable with the same probability distribution, and X_{ikt} the observation of the kth explanatory variable for the ith sample in period t.

Empirical Models

Model 1 represents the panel data model that explains the variations in ROA, as shown in Equation (4) below.

$$ROA_{it} = \alpha_0 + \alpha_1 ESG_{1it} + \alpha_2 E_{1it} + \alpha_3 S_{1it} + \alpha_4 G_{1it} + \alpha_5 ESG_{2it} + \alpha_6 E2_{it}$$
$$+ \alpha_7 S_{2it} + \alpha_8 G_{2it} \alpha_9 SIZE_{it} + \alpha_{10} AGE_{it} + \alpha_{11} GDP_{it} + \alpha_{12} HHI_{it}$$
$$+ \alpha_{13} CR_{4it} + \varepsilon_{it} \tag{4}$$

Model 2 is the panel data model that examines the variables influencing ROE, as shown in Equation (5) below.

$$ROE_{it} = \beta_0 + \beta_1 ESG_{1it} + \beta_2 E_{1it} + \beta_3 S_{1it} + \beta_4 G1_{it} + \beta_5 ESG_{2it} + \beta_6 E_{2it} + \beta_7 S_{2it} + \beta_8 G_{2it}$$
$$+ \beta_9 SIZE_{it} + \beta_{10} AGE_{it} + \beta_{11} GDP_{it} + \beta_{12} HHI_{it} + \beta_{13} CR_{4it}$$

$$+ \theta_{it} \tag{5}$$

Model 3 represents the panel data model that determines the factors influencing Tobin's Q, as shown in Equation (6 below.

$$Tobin's\ Q_{it} = \gamma_0 + \gamma_1 ESG_{1it} + \gamma_2 E1_{it} + \gamma_3 S_{1it} + \gamma_4 G_{1it} + \gamma_5 ESG_{2it} + \gamma_6 E_{2it}$$
$$+ \gamma_7 S_{2it} + \gamma_8 G_{2it} + \gamma_9 SIZE_{it} + \gamma_{10} AGE_{it} + \gamma_{11} GDP_{it}$$

$$+ \gamma_{12} HHI_{it} + \gamma_{13} CR_{4it} + \mu_{it} \tag{6}$$

where i represents the ith financial company (i=1, …, N) and t represents the tth quarter. For other related variables, please refer to the previous definitions.

EMPIRICAL RESULTS

Descriptive Statistical Analysis

This study covers the sample period from 2016 to 2023, comprising 8 years of annual data. This section is divided into the full sample, pre-pandemic sample, and post-pandemic sample, presenting the basic statistics of

the panel data model for each. The statistics include the mean, standard deviation, minimum value, and maximum value for each variable under study. Based on the descriptive statistics, natural logarithms of the numerical values are utilized for data analysis to reduce potential biases in the final estimates. For detailed descriptive statistics, please refer to Table 1.

Table 1: Descriptive Statistics of Variables for the Full Sample

Variable	Code	Mean	Standard Deviation	Minimum	Maximum
Return on assets	ROA	0.791	0.376	-0.130	2.530
Return on equity	ROE	7.623	2.787	-2.420	16.76
Market value	Tobin'S Q	0.105	0.033	0.040	0.250
S&P Global ESG Score	ESG_1	41.000	35.257	0.000	89.000
S&P Environmental Score	E_1	19.990	32.239	0.000	98.000
S&P Social Score	S_1	23.313	36.256	0.000	94.000
S&P Governance Score	$G1$	21.141	33.665	0.000	89.000
TESG score	ESG_2	62.131	7.322	45.89	79.220
TESG Environmental Score	E_2	64.841	14.063	30.200	87.530
TESG Social Score	S_2	65.462	12.567	35.680	86.310
TESG Governance Score	G_2	59.433	9.120	34.820	76.380
ESG dummy variables	ESGDV	0.375	0.485	0.000	1.000
company size	SIZE	21.229	1.153	19.000	23.000
company age	AGE	33.458	20.246	12.000	73.000
Real GDP growth rate	GDP	3.169	1.441	1.420	6.620
Herfindahl-Hirschman Index	HHI	60.201	151.878	0.228	824.280
Four-firm Concentration Ratio	CR_4	0.637	0.072	0.4955	0.738

Note 1: The sample period is from 216 to 2023, with a total sample size of 192.

Optimal Panel Data Empirical Models Selected

These models examine the determinants influencing Return on Assets (ROA), Return on Equity (ROE), and Tobin's Q (market value of equity). The selection process involves employing F-tests, LM-tests, and Hausman tests to determine the most suitable empirical models for the full sample, pre-pandemic sample, and post-pandemic sample (Hausman,1978). Firstly, F-tests and LM-tests are used to assess the significance of both fixed effects and random effects models. Significant results prompt further evaluation using the Hausman test to choose between fixed effects and random effects models based on estimation outcomes.

Ultimately, the study finds that for the full sample, except for the Tobin's Q model which uses a fixed effects model, the others employ OLS models. In the pre-pandemic sample, all models except for Tobin's Q use random effects models. However, in the post-pandemic sample, only the Tobin's Q model uses an OLS model, with the rest employing fixed effects models. For detailed testing and model selection results, please refer to Table 2.

Table 2: Optimal Model Selection Test Results for Each Empirical Model

ROA model	Full Sample	Pre-pandemic	Post-pandemic
F-test	12.72*** (0.0000)	12.92*** (0.0000)	4.861*** (0.0000)
LM-test	143.45*** (0.0000)	61.66*** (0.0000)	14.01*** (0.0000)
Hausman-test	--	7.68 (0.6603)	30.98*** (0.0034)
Applicable models	OLS	Random-effects	Fixed-effects
ROE model	**Full Sample**	**Pre-pandemic**	**Post-pandemic**
F-test	4.76*** (0.0000)	4.88*** (0.0000)	2.64*** (0.0018)
LM-test	32.79*** (0.0000)	24.55*** (0.0000)	3.30* (0.0693)
Hausman-test	--	9.55 (0.481)	25.40* (0.0204)
Applicable models	OLS	Random-effects	Fixed-effects
Tobin's Q model	**Full Sample**	**Pre-pandemic**	**Post-pandemic**
F-test	10.31*** (0.0000)	4.86*** (0.0000)	8.73*** (0.0000)
LM-test	122.90*** (0.0000)	14.01*** (0.0002)	22.98*** (0.0000)

Hausman-test	23.17* (0.0397)	30.98*** (0.0034)	--
Applicable models	Fixed-effects	Fixed-effects	OLS

Empirical Results of Model 1

According to Table 3, the panel data empirical results of ESG and other control variables on ROA are presented. In the full sample, the empirical findings indicate a significant positive impact of real GDP growth rate on ROA, reaching a 1% significance level. This suggests potential influences from increased investment opportunities and market expansion, driven by economic efficiency factors. Additionally, the study results show a significant positive effect of HHI on ROA, achieving a 5% significance level. Higher HHI values indicate greater market concentration in the financial industry, possibly promoting long-term planning effectiveness and contributing to ROA enhancement. Furthermore, the research reveals a positive impact of CR4 on ROA at a 1% significance level. This indicates that firms leading in market share and strengthening their competitive capabilities with increased scale contribute to overall industry concentration and improve firm performance. For detailed panel data empirical results affecting the ROA model in the full sample, please refer to Table 3.

Table 3: Empirical Results of ROA Model for the Full Sample

Variable	Code	Coefficient	P-value
Constant term	CON	0.105	0.033
S&P Global ESG Score	ESG_1	41.000	35.257
S&P Environmental Score	E_1	19.990	32.239
S&P Social Score	S_1	23.313	36.256
S&P Governance Score	$G1$	21.141	33.665
TESG score	ESG_2	62.131	7.322
TESG Environmental Score	E_2	64.841	14.063
TESG Social Score	S_2	65.462	12.567
TESG Governance Score	G_2	59.433	9.120
ESG dummy variables	$ESGDV$	0.375	0.485
company size	$SIZE$	21.229	1.153
company age	AGE	33.458	20.246
Real GDP growth rate	GDP	3.169	1.441
Herfindahl-Hirschman Index	HHI	60.201	151.878
Four-firm Concentration Ratio	CR_4	0.637	0.072
within R-squared = 0.433			

Note 1: The sample period is from 216 to 2023, with a total sample size of 192.

Note 2: ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

In this study, we further divide the sample into periods before and after the pandemic. Please refer to Tables 4 for empirical results. According to Table 4, in the pre-pandemic sample, the ESG dummy variable shows a positive impact on ROA at a significant level of 5%. This suggests that banks recognized for their ESG efforts exhibit higher ROA, consistent with Engelhardt et al. (2021), Chiaramontea et al. (2022), Zhou et al. (2023), Azhari et al. (2023) and Liu (2024), who found that ESG investments contribute positively to corporate financial performance. For detailed empirical results influencing pre-pandemic ROA models using panel data, please see Table 4.

As shown in Table 4, in the post-pandemic sample, the ESG dummy variable exhibits a negative impact on ROA at a significant level of 10%. This indicates that even with ESG initiatives post-pandemic, there is no improvement in bank performance. It is speculated that this may be due to firms reallocating resources, efforts, and costs toward mitigating the pandemic's impact, rather than focusing solely on ESG activities. Conversely, increased industry concentration and competition appear to enhance operational performance in the banking sector.

Table 4: Empirical Results of ROA Model Before and After the Pandemic

Variable	Code	Pre-pandemic Coefficient	P-value	Post-pandemic Coefficient	P-value
Constant term	CON	1.050	1.361	-4.625	0.112
S&P Global ESG Score	ESG_1	6.78e-5	0.953	-0.003	0.231
S&P Environmental Score	E_1	---	---	0.003	0.612
S&P Social Score	S_1	---	---	-4.052e-4	0.957
S&P Governance Score	$G1$	---	---	3.22e-5	0.997

TESG score	ESG_2	-0.003	0.815	0.055	0.678
TESG Environmental Score	E_2	-0.003	0.248	-0.012	0.497
TESG Social Score	S_2	3.697e-4	0.949	-0.025	0.660
TESG Governance Score	G_2	-0.002	0.826	-0.029	0.636
ESG dummy variables	$ESGDV$	0.135	0.038*	-0.201	0.089*
company size	$SIZE$	-0.003	0.967	0.215	0.108
company age	AGE	0.005	0.203	---	---
Real GDP growth rate	GDP	0.014	0.770	0.030	0.231
Herfindahl-Hirschman Index	HHI	-1.536e-4	0.737	0.001	0.013**
Four-firm Concentration Ratio	CR_4	0.123	0.745	2.384	0.011**
within R-squared			0.1370		0.6315

Note : ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

Empirical Results of Model 2

According to the empirical data presented in Table 5, the S&P Global ESG Environmental Score positively influences ROE in the full sample, with a significance level of 10%. This suggests that higher ESG Environmental Scores are associated with higher ROE, likely because companies that prioritize environmental issues and effectively manage environmental risks drive ROE growth. Additionally, the real GDP growth rate positively impacts ROE, achieving a 1% significance level, indicating that economic expansion and increased investment opportunities are positively correlated with ROE. Increased industry concentration and competition also positively contribute to the performance of banks.

Table 5: Empirical Results of ROE Model for the Full Sample

Variable	Code	Coefficient	P-value
Constant term	CON	-1.642	0.880
S&P Global ESG Score	ESG_1	0.003	0.690
S&P Environmental Score	E_1	0.676	0.042*
S&P Social Score	S_1	-0.018	0.630
S&P Governance Score	$G1$	-0.048	0.262
TESG score	ESG_2	-0.035	0.781
TESG Environmental Score	E_2	-0.001	0.964
TESG Social Score	S_2	0.001	0.981
TESG Governance Score	G_2	-0.023	0.708
ESG dummy variables	$ESGDV$	0.827	0.059*
company size	$SIZE$	0.246	0.612
company age	AGE	---	---
Real GDP growth rate	GDP	0.371	0.004***
Herfindahl-Hirschman Index	HHI	0.014	0.000***
Four-firm Concentration Ratio	CR_4	-1.642	0.880
within R-squared = 0.4466			

Note : ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

For the sub-sample empirical results before and after the pandemic, please refer to Table 6. The table shows that in the pre-pandemic sample, company size positively influences ROE, with a significance level of 5%. This indicates that larger companies are better able to increase market share, thereby enhancing ROE. Additionally, the results show that the company's establishment years have a positive impact on ROE, with a significance level of 1%. This suggests that longer-established companies may have built a solid customer base and possess a strong brand image and reputation, thus increasing ROE.

In the post-pandemic sample, the real GDP growth rate positively influences ROE, with a significance level of 10%. This indicates that, after the pandemic, the overall environment needs economic growth momentum to promote the increase of corporate ROE. Furthermore, the Herfindahl-Hirschman Index (HHI) has a positive impact on ROE, with a significance level of 1%. This signifies that higher industry concentration in the banking sector, achieved through increased monopolistic power, contributes to higher ROE. It also implies that competition within the banking industry has only intensified after the pandemic.

Table 6: Empirical Results of ROE Model Before and After the Pandemic

		Pre-pandemic		Post-pandemic	
Variable	Code	Coefficient	P-value	Coefficient	P-value
Constant term	CON	-8.715	0.311	-21.625	0.389

Variable	Code				
S&P Global ESG Score	ESG_1	0.011	0.250	-0.012	0.624
S&P Environmental Score	E_1	--	--	0.045	0.315
S&P Social Score	S_1	---	---	0.017	0.793
S&P Governance Score	$G1$	---	---	-0.047	0.516
TESG score	ESG_2	-0.125	0.264	1.410	0.225
TESG Environmental Score	E_2	0.001	0.951	-0.229	0.124
TESG Social Score	S_2	0.030	0.516	-0.630	0.197
TESG Governance Score	G_2	0.043	0.439	-0.679	0.206
ESG dummy variables	$ESGDV$	1.019	0.049**	-1.259	0.218
company size	$SIZE$	0.786	0.042**	1.315	0.257
company age	AGE	0.058	0.002***	---	---
Real GDP growth rate	GDP	-0.126	0.757	0.390	0.078*
Herfindahl-Hirschman Index	HHI	0.002	0.450	0.016	0.003***
Four-firm Concentration Ratio	CR_4	1.423	0.652	12.714	0.111
within R-squared			0.1460		0.6341

Note : ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

Empirical Results of Model 3

As shown in Table 7, in the full sample, the S&P Global ESG score has a negative impact on Tobin's Q, with a significance level of 10%. This indicates that increasing ESG investment in the short term raises company costs, thereby reducing profitability and leading to a negative effect on Tobin's Q. Additionally, the results show that CR₄ has a negative impact on Tobin's Q, with a significance level of 5%. As industry concentration increases, creating a situation where larger banks dominate, smaller banks are less willing to engage in ESG investments, thus lowering Tobin's Q.

Table 7: Empirical Results of Tobin's Q Model for the Full Sample

Variable	Code	Coefficient	P-value
Constant term	CON	0.036	0.776
S&P Global ESG Score	ESG_1	-1.824e-4	0.051*
S&P Environmental Score	E_1	5.90e-6	0.988
S&P Social Score	S_1	9.56e-7	0.988
S&P Governance Score	$G1$	-.9.04e-5	0.856
TESG score	ESG_2	4.19e-5	0.977
TESG Environmental Score	E_2	1.06e-5	0.968
TESG Social Score	S_2	5.3e-5	0.933
TESG Governance Score	G_2	-5.015e-4	0.478
ESG dummy variables	$ESGDV$	0.001	0.820
company size	$SIZE$	0.006	0.224
company age	AGE	---	---
Real GDP growth rate	GDP	0.002	0.149
Herfindahl-Hirschman Index	HHI	-1.56e-7	0.997
Four-firm Concentration Ratio	CR_4	-0.081	0.030**
within R-squared = 0.0760			

Note : ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

Table 8 presents the empirical results before and after the pandemic. In the pre-pandemic sample, the TESG social dimension score negatively impacts Tobin's Q, with a significance level of 10%. This indicates that social risks such as labor issues and social relations problems in the banking industry affect the market value of enterprises and Tobin's Q. The study also shows that the HHI negatively impacts Tobin's Q, with a significance level of 10%, indicating an inverse relationship between high market concentration and firms' market value or investment activities.

As shown in Table 8, in the post-pandemic sample, the TESG social dimension score and the TESG governance dimension score both positively impact Tobin's Q, with significance levels of 5% and 10%, respectively. This suggests that banking industry investments in corporate social responsibility and strengthened corporate governance help improve company value. The S&P Global ESG social dimension score and the TESG score both negatively impact Tobin's Q, with a significance level of 5% each. This may be due to the unstable socio-economic conditions during the pandemic, leading to increased issues such as unemployment and reduced income, affecting companies' investment willingness. Additionally, high market concentration presents an inverse interactive relationship with firms' market value, consistent with pre-pandemic and full-sample empirical results.

Table 8: Empirical Results of Tobin's Q Model Before and After the Pandemic

		Pre-pandemic		Post-pandemic	
Variable	Code	Coefficient	P-value	Coefficient	P-value
Constant term	CON	0.547	0.022**	-0.856	0.001***
S&P Global ESG Score	ESG_1	-2.054e-4	0.131	-1.623e-4	0.477
S&P Environmental Score	E_1	---	---	4.862e-4	0.247
S&P Social Score	S_1	---	---	-0.001	0.028**
S&P Governance Score	$G1$	---	---	8.147e-4	0.231
TESG score	ESG_2	0.002	0.258	-0.023	0.039**
TESG Environmental Score	E_2	-2.38e-4	0.486	0.002	0.103
TESG Social Score	S_2	-0.001	0.064*	0.010	0.031**
TESG Governance Score	G_2	-9.467e-4	0.295	0.009	0.067*
ESG dummy variables	$ESGDV$	-0.004	0.572	-0.001	0.909
company size	$SIZE$	-0.018	0.112	0.053	0.000***
company age	AGE	---	---	---	---
Real GDP growth rate	GDP	0.009	0.127	0.003	0.157
Herfindahl-Hirschman Index	HHI	-1.958e-4	0.027**	6.46e-5	0.182
Four-firm Concentration Ratio	CR_4	-0.053	0.221	-0.169	0.026**
within R-squared			0.2412		0.4429

Note : ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

Analysis of Industry Concentration of the Top Four Firms (CR₄)

This study first ranks the market shares from 2016 to 2023 and sums the top four market shares to derive the industry concentration (CR4) for each year. According to the trend graph in Figure 3, the CR4 values for 2016 and 2017 were 73.80% and 72.17%, respectively, before the COVID-19 pandemic. During and after the pandemic, a declining trend in CR4 values can be observed. Additionally, according to the industry structure analysis in Table 9, the period from 2016 to 2021 can be classified as highly oligopolistic, with intense competition among firms, leading to collusion and ultimately forced price increases. In contrast, the industry structure for 2022 and 2023 is classified as low oligopoly. This indicates that after the impact of the pandemic, firms in the banking industry have been striving to strengthen and consolidate their positions, thus intensifying competitive pressure. Consequently, some firms have deviated from their ESG investments and focus, indirectly affecting the relationship between ESG and performance. The trend of CR₄ from 2016 to 2023, please refer to Figure 1.

Table 9: Classification of Industry Structures

| Market Type	Main Characteristics
Monopoly	One firm holds 100% of the market share with no close competitors.
Oligopoly	
Leading Firm	One firm holds 50% to 100% of the market share with no close competitors.
Tight Oligopoly	The top 4 firms hold 60% to 100% of the market share, making it easy to collude on prices.
Loose Oligopoly	The top 4 firms hold about 40% to 60% of the market share, making collusion less likely.
Monopolistic Competition	Many effective competing firms exist, with the top 4 firms holding less than 40% of the market share.
Perfect Competition	More than 50 competing firms, each holding a market share of less than 3%.
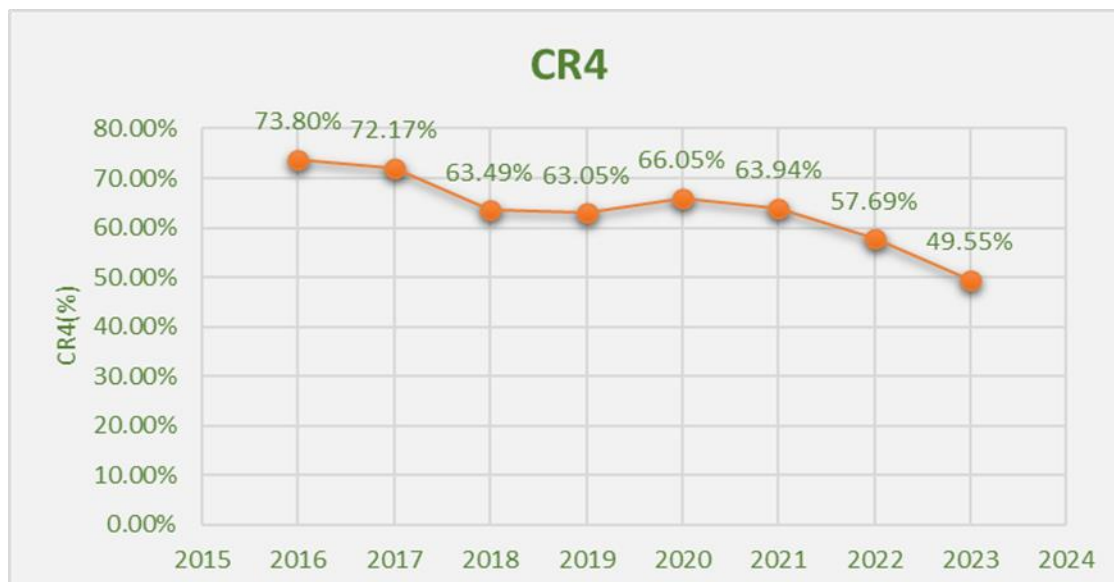
Figure 1: Time Trend of CR$_4$ from 2016 to 2023

CONCLUSION

Based on the empirical model results of ROA, it is observed that real GDP growth rate exhibits significant positive effects only in certain parts of the entire sample, suggesting increased investment opportunities and economic efficiency factors contributing to this trend. Additionally, HHI shows significant positive effects on both the entire sample and the post-pandemic sample. A higher HHI indicates greater market concentration, fostering intense competition among large banks and thereby contributing positively to ROA. Conversely, the results for the ESG dummy variable differ before and after the pandemic: before the pandemic, the ESG dummy variable positively impacts ROA, consistent with Lin (2023), suggesting that banks receiving awards tend to achieve higher ROA by focusing on ESG investments. However, post-pandemic, the ESG dummy variable negatively impacts ROA, possibly due to increased post-pandemic trauma necessitating higher ESG costs, thereby reducing ROA. This implies that competitive environments and pandemic impacts indeed affect the focus and investment in ESG, indirectly impacting performance outcomes.

The empirical model results of ROE indicate that S&P Global ESG environmental scores positively influence ROE, likely because companies focus on environmental issues and effectively manage environmental risks, thereby driving ROE growth. This finding aligns with the research of Ho (2024), suggesting a significant positive impact of ESG rating levels on ROE, attributable to companies emphasizing environmental issues and effectively managing environmental risks to enhance ROE. Furthermore, real GDP growth rate positively influences ROE, indicating expansionary economic conditions and increased investment opportunities, thereby correlating positively with ROE. Company size also significantly affects ROE positively, indicating that larger companies are more capable of increasing market share, thereby enhancing ROE. Moreover, company tenure positively impacts ROE, suggesting that longer establishment periods may establish a stable customer base and possess a strong brand image and corporate reputation, thereby increasing ROE. In the post-pandemic sample, real GDP growth rate continues to positively influence ROE, reflecting beneficial effects on ROE from economic growth. The ROE model also demonstrates that higher industry concentration contributes to ROE through increased competition and innovation activities among large banks.

The empirical model results of Tobin's Q show that across the entire sample, S&P Global ESG scores negatively influence Tobin's Q, reaching a significant level of 10%. This suggests that increasing ESG investments in the short term increases company costs, thereby reducing profitability and resulting in a negative impact on Tobin's Q. In the post-pandemic sample, TESG social and corporate governance scores positively influence Tobin's Q, reaching significant levels of 5% and 10%, respectively. This indicates that investments in corporate social responsibility and enhanced corporate governance in the banking industry indeed contribute to improving

company value. Lastly, the presence of high market concentration negatively correlates with market value or investment willingness among firms, consistent with pre-pandemic and overall sample empirical results. Thus, in the Tobin's Q model, there exists an inverse interaction between firm market value or investment willingness and ESG investments or competitive environments.

Recommendations

The empirical findings demonstrate that firms' investment in ESG contributes to improved performance and promotes societal environmental changes. Implementing ESG disclosures also benefits operational performance. However, competitive environments may lead firms to overlook ESG investments or incur substantial ESG costs without corresponding performance growth. Therefore, governments should actively promote and formulate relevant policies and measures. This can include enacting corresponding legal regulations, providing further guidance to firms, or implementing subsidy policies to assist and encourage not only large enterprises but also small and medium-sized enterprises in practicing ESG principles. Additionally, promoting ESG education and training can enhance awareness among businesses and the public regarding ESG issues, thereby fostering the dissemination of ESG principles.

Investors are advised to prioritize companies that voluntarily disclose information and utilize diverse ESG rating tools available in the market for evaluation, aiming to identify suitable investment targets. When assessing ESG investment targets, investors should adopt a long-term investment perspective. While ESG factors may not rapidly reflect in a company's financial statements, their impact over time can yield diverse outcomes.

Due to Taiwan's relatively recent development in ESG compared to other countries and challenges in accessing related ESG score information, insufficient data hindered comprehensive research. It is recommended that future researchers extend the study period. Moreover, with various ESG rating systems and institutions both domestically and internationally, each platform employs differing rating criteria and focuses. Finding a balance or integrating more objective indicators remains an area for future research exploration.

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