HUNGARIAN UNIVERSITY OF AGRICULTURE AND LIFE SCIENCES

Doctoral School of Economics and Regional Sciences

Nexus Between Green Financing Initiatives and the Financial Performance of Listed Banks in Kenya

DOI: 10.54598/006630

Doctoral (Ph.D.) dissertation

by
Martin Kamau Muchiri

Gödöllő, Hungary
2025

Name of Doctoral School: Doctoral School of Economic and Regional Sciences

Discipline: **Management and Business Administration**

Head of Doctoral School: **Prof. Dr. Zoltán Bujdosó**
Hungarian University of Agriculture and Life Sciences,
Institute of Agricultural and Food Economics Hungary

Supervisors: **Szilvia Dr. Erdeiné Dr. Késmárki-Gally**
Hungarian University of Agriculture and Life Sciences, Hungary
Prof. Dr. Mária Fekete Farkas
Hungarian University of Agriculture and Life Sciences, Hungary

…… ..…….

Approval of Head of Doctoral School Approval of Supervisors

Table of Contents

1. INTRODUCTION

1.1 Research Background

Financial institutions like banks across the globe are at the centre of allocating resources for green investments. Banking institutions play a critical role influencing customers' behaviour and decisions. Based on the PLS-method, a study by STAUROPOULOU et al. (2023) analyzed 1,084 questionnaires and established a positive relationship between banks SDG and customers loyalty, trust and perceived fairness in pricing policies. Banks like other institutions would seek to pursue strategies that lead them to optimal profitability. They must be highly accountable in their lending activities as they use customers' deposits which are liabilities to them. Commercial banks earn their revenue from the interest income on loans but must also pay costs for holding capital, fixed costs as well as cost of bad debts. Among other factors, banks must enhance their ability to reduce the cost of bad debts to achieve optimal profitability. THOMPSON and COWTON (2004) points out that in the era of escalating climate change, environmental risk is currently recognized as one of the most important factors that banks must take into consideration as it influences the overall credit risk.

On the other hand, climate change has also opened business opportunities for the banking sector. The growing interest across the globe to mitigate climate change has given rise to a new target group of green entrepreneurs which banks can target to expand their market. BAO and HE (2022) add that, with government incentives, commercial banks across the globe are likely to grow their interest in financing energy efficient and renewable projects in an endeavour to make profits while still addressing the climate change challenge. A study by PAULET et al. (2015) however argues that, like other institutions, banks seek to enhance their reputation as such increases their revenues and market share. The authors also adds that banks' responsibilities go beyond financial gains and extend to environmental and social concerns, especially after increased concerns about bank ethics following the financial crisis of 2008. The demand for more environmental and social responsibility for banks has increased the pressure for banks to be more accountable for their decisions and actions as the banks decisions affects their reputation (KHAN et al., 2024).

YAMEEN et al. (2024) notes that on matters of green financing for banks, the critical question is how to balance between the opportunities and risks involved. It is argued that environmental goals rank behind profitability goals for businesses and, therefore, government subsidies and incentives need to be in play to encourage banks to focus more on potential opportunities than risks.

1.2 Problem Statement

Kenya is part of the Sub-Saharan Africa that is least responsible for emission of carbon footprint to the environment yet the highly vulnerable region to the impact of climate change. Kenya is already

experiencing cases of extreme weather conditions including recurring cases of floods and prolonged droughts, landslides, and forest fires especially in the highland's parts of the country.

The banking sector, given its nature, is at the heart of facilitating industrial activities that damage the environment through lending activities. Previous studies have pointed out that banks participate indirectly in damaging the environment by facilitating industrial activities that harm the environment (JULIA and KASSIM, 2016). The banking sector across the globe has however shown their willingness to promote green transition by introducing green banking practices and green financial products even in light of limited standardized regulation across different regions. The Kenyan banking sector is one of those which have embarked into green financing initiatives at the national and sector level.

Despite the major initiatives taken by the Kenyan banking sector including issuing of green bonds, implementation of the Sustainability Financial Initiatives program, introduction of the Internal Capital Adequacy Assessment Process (ICAAP) as well as the Kenya Banking Sector Charter, publication of the Kenyan Green Taxonomy, the current implementation of the IFRS S1 and S2 to standardize sustainability and climate financing reporting, there is no single study conducted regarding the examination of the current implementation status, the effect such initiatives has on the banks environmental and financial performance. In addition, previous studies have focused on examining the nexus between green financing and overall financial performance however, it is my argument that the overall financial performance of banks is affected by many factors other than their green initiatives and correlating green financing initiatives with the overall financial performance metrics could be ambiguous and can lead to misleading results.

As such this study seeks to add to the existing body of knowledge on the bank's green financing practices by examining the nexus between the bank's progress on green financing initiatives and the financial implications resulting from the green financial initiatives undertaken by the listed banks. The predictor variables included in the conceptual model of this study include the green financing Awareness Initiatives, integration of climate risk management into the bank's risk management framework and adoption of in-house green banking practices. The bank's financial performance of the banks was measured by the growth rate of green loans, cost savings associated with green financing strategies, improvements in credit risk management, bank reputation, improved financial position, and strategic initiatives that are taken by the banks likely to enhance their future financial performance.

1.3 Significance of the Study

This paper adds to the existing body of empirical evidence literature on the financial implications of green financing, especially in filling the existing African context gap. The study provides great insights regarding the role of banks in fighting climate change. The findings of the research also provide useful scientific insights for policymakers, especially in developing economies such as Kenya and beyond, on the development of green financing strategies as well as the financial implications of such activities on the banks. Given the increased emphasis on climate finance across the globe, the findings of this study can inform policy frameworks seeking to accelerate green investments and sustainable banking practices. By exploring the interaction between green financing practices and banks' financial performance, this study provides valuable insights with potential to shape policies that promote the integration of sustainable banking practices without compromising financial stability. Besides, the findings of this study can be useful for scholars interested in exploring this area.

1.4 General Research Objective

The general objective of this study is to examine if the green financing initiatives undertaken by the banks influence their financial performance positively and if the size or type of banks alter this relationship.

1.5 Specific Research Objectives

The dissertation was guided by the following specific objectives.

1. Examining the extent to which green financing awareness influence the banks' green financing strategy and how it influences the banks' financial performance.
2. Assessing the extent to which green banking practices influence the collective green financing strategy of the banks and how it influences the bank’s financial performance.
3. Exploring how the integration of the CBK guidance on Climate Related Risk Management contributes to the overall green financing strategy of the banks and how it influences the bank’s financial performance.
4. To examine if there is any statistically significant difference between how green financing initiatives interact with banks' financial performance for different bank sizes and types of ownership.
5. Comparing how the relationship between green financing and banks financial performance in Kenya compares to the global context based on a quantitative approach.

1.6 Research Hypothesis

The study sought to pursue the following study hypothesis.

1) 1a. Climate Risk Management (CRM) contributes significantly to the collective Green Financing Initiatives.
2) 1b. Climate Risk Management (CRM) positively impacts Financial Performance (FP).
3) 2a. Green Banking Initiatives (GBI) contribute significantly to Green Financing Initiatives (GFI).
4) 2b. Green Banking Initiatives (GBI) positively impact Financial Performance (FP).
5) 3a. Green Financing Activities (GFA) contributes significantly to Green Financing Initiatives.
6) 3b. Green Financing Activities (GFA) positively impact Financial Performance (FP).
7) 4a. Green Financing Initiatives (GFI) collectively positively impact Financial Performance (FP).
8) 5a. The impact of Green Financing Initiatives (GFI) on Financial Performance (FP) is significantly different between small and large banks.
9) 5b. The impact of Green Financing Initiatives (GFI) on Financial Performance (FP) is significantly different between foreign and locally owned banks.
10) The impact of green financing on banks' financial performance in Kenya significantly differ from the global observed outcome as measured by common effect sizes.

2. MATERIALS AND METHODS

This chapter describes the methodology adopted in carrying out the study, testing the set hypothesis, and pursuing the research objectives. It details the philosophical orientation adopted in this study, the research design, research strategy, data collection method, the design of the data collection tool adopted, the population of study and selection of the sample, and the method of data analysis used.

2.1 Data Collection Tool

Structured questionnaires were distributed to 500 bank employees working across the ten listed banks as of December 2023 in credit sections, managerial positions and sustainability departments for the few banks with dedicated sustainability departments. Related questions for each latent variable (GFA, GBI, CRM, FP) were asked sequentially in the same category to avoid ambiguity. The study concentrated on three independent variables and one dependent variable, each of which was measured in five observable items. Other similar studies that have adopted this approach include CHEN et al. (2022a), DE VILLIERS et al. (2022), and others. Brevity was considered important while structuring the questionnaire to increase the chances of successful responses, given that bank employees are generally busy due to the demanding nature of the banking sector and may not have much time to

spare. Nevertheless, each item was accompanied by brief explanations and specific examples to further enhance the clarity of each item. On the meta-analysis part, a search strategy was applied in the web of science and Scopus databases and an inclusion and exclusion criteria applied to filter only studies that answered the question "what is the impact of green financing on banks financial performance ? quantitatively and reported the necessary information required for the calculation of the combined effect sizes.

2.2 Research Design

This study applied two major techniques i.e. the Partial Least Square (PLS) Structural Equation Modelling (SEM) and the meta-analysis technique which was used to situate the study outcomes of the Kenyan local context on the global scale to enhance understanding on how different social culture, economic and market dynamics shape the outcomes of green financing initiatives based on a quantitative approach.

PLS-SEM was considered due to its ability to analyze multiple latent variables even when dealing with complex models and is considered highly robust for handling small to medium-sized samples (PETTER and HADAVI, 2021). Besides, it does not require strict assumptions such as multivariate normality as it is a variance-based technique making it a more practical alternative to traditional regression models (HAIR and ALAMER, 2022; AHMED et al., 2024). Also, unlike the Covariance Based-SEM which mainly focus on model fitness and most appropriate for theory confirmation, PLS-SEM focuses more on predictive accuracy and variance explanation making it more appropriate for this study. The model design adopted in this study included three low-order constructs (IVs), a high order construct (GFI), and reflective and formative models, which the PLS-SEM is designed to handle easily through the pls algorithm and bootstrapping techniques as argued by (KONO and SATO, 2023). Traditional regression models are not designed to handle complex models such as those involving high order and low order constructs or even reflective and formative models.

Moreover, the PLS-SEM model does not require the data to be normally distributed making it highly suitable for real world circumstances as highly often finance and business-related datasets deviate from the ideal statistical conditions. Comparing the model with the family of other SEM techniques such as CB-SEM, the PLS-SEM offers a highly flexible and prediction-oriented option which is highly appropriate for this study especially because of its exploratory nature seeking to uncover underexplored relationship between green financing and banks profitability within the Kenyan banking sector.

While the same design could be implemented in other platforms such as R, AMOS and Stata, Smart PLS 4 was preferred due to its intuitive and user-friendly interface (CHEAH et al., 2024). After data was thoroughly cleaned and imported into the smart PLS 4, pls algorithm was run to assess the models' validity and reliability using Cronbach Alpha, AVE and Composite Reliability. After these criteria were met, evaluation of the structural model's path co-efficient, predictive power, R-squared values, et cetera was carried out, after which bootstrapping was carried out to test the hypotheses. Model fitness was examined through Q-squared values and SRMR and lastly, a multi-group analysis on bank size and type of ownership was examined. Cohens D and z-transformations were used to calculate the effect sizes necessary for running the meta-analysis. Publication bias was examined through forest plot, funnel plot and egger regression while heterogeneity was tested using Q, PQ, I2, T2 and T. The meta-analysis was conducted based on the user data manual for meta-analysis essentials as guided by (VAN RHEE et al. 2015).

2.3 Target Population

This study targeted bank employees working among the 10 listed banks in the Nairobi Stock Exchange (NSE). A total of 500 structured questionnaires were distributed to bank employees working across the ten listed banks as of December 2023 in credit sections, managerial positions and sustainability departments for the few banks with dedicated sustainability departments. The Cochran formula was used to calculate the appropriate sample size. Permission was sought to conduct the research in seven counties as required by the Science, Technology and Innovation Act of 2013 (Rev. 2014). The seven counties selected included Embu, Kajiado, Kiambu, Kirinyaga, Murang'a, Nairobi and Nyeri. These counties were selected because they were easily accessible to the researcher and affordable as most of the questionnaires were administered physically and physically to the bank employees at their respective branches.

2.4 Sampling Technique and Sample Size

While there are many other ways of selecting a sample, this study adopted a purposeful sampling technique as it allows the researcher to select the population based on a given criteria that increases the chances of selecting the right participants (LO, 2019). In this case, the main aim was to select participants who were more likely to have the information needed to respond to the questionnaire. The study targeted bank staffs working in credit, management level or sustainability-related departments. Consequently, there are various approaches for determining the sample size of a population. These include the thumb rule, use of statistical software and the empirical formulae. The recommended sample size for SEM analysis ranges from 150 to 400 responses (WOLF et al., 2024). Similarly,

another study by LONG and VIET-ANH (2021) used a sample size of 128 and was considered reasonable for conducting a significant statistical analysis. Other studies used sample sizes of between 100 to 150 including KONO and SATO (2023) and AFTHANORHAN (2020). COCHRAN (1977) formula was adopted to determine the appropriate size for the study for large and unknown populations and the calculations are presented as follows.

$$n_0 = \frac{z^2.p.\ (1-p)}{e^2} \quad [1]$$

Where;

n_0 = Sample size

z = Z-score (1.96 for 95% confidence level)

p = Estimated proportion of the population with the characteristic of interest (usually the default is 0.5 if unknown), e = Margin of error (commonly 0.05 for 5%)

$$\mathrm{n}_0 = \frac{(1.96)^2 \times 0.5 \times (1-0.5)}{0.05^2} = \frac{3.8416 \times 0.25}{0.0025} = \frac{0.9604}{0.0025}$$

$$\mathrm{n}_0 = 384.16$$

Based on this criterion, a sample of 384 respondents was recommended as sufficient. This study analyzed a total of 387 valid respondents, which is more than the minimum responses required and way above the threshold recommended by previous literature.

2.5 Tool Validation, Data Analysis and Model Design

Before full deployment of the questionnaire for data collection, the questionnare were validated by my two supervisors and sustainability baking experts with an aim of improving the clarity, structure, and relevance of the items, thereby enhancing content validity and minimizing ambiguity to the respondents. The feedback Data was cleaned using Excel and then imported into smart PLS 4. The first step was to create the study model that connected latent constructs to latent variables. The latent constructs for the three independent variables, i.e. GFA, GBI, and CRM, formed the high order construct (GFI), which was connected as a reflective-formative model. The GFI was connected to the dependent variable, Financial Performance (FP), through a formative-reflective model. As for the fourth study objective, four groups were generated based on the dataset to classify responses of large vs small banks and foreign vs local banks to facilitate multi-group analysis necessary in testing the eighth and ninth hypothesis. The PLS-SEM technique was used to run the analysis.

The PLS-SEM entails selecting the model, screening data, estimating the model parameters, analyzing the model fitness, and interpreting the model parameters (CHEN et al., 2022a). PLS algorithm was used to evaluate the quality criteria of the model, while pls bootstrapping was used to test the first six hypotheses, and the multi-group pls algorithm was used to test the eighth and ninth hypotheses.

Cronbach alpha, composite reliability (rho_a, rho_c), the Average variance extracted (AVE), collinearity tests by Variance Inflation factor (VIF), outer weights/loadings, explained variance (R^2), Q^2 and predictive relevance were used to assess the quality criteria of the model. The results from the Kenyan context were compared to the international context through both empirical synthesis but also quantitatively through common effect sizes based on meta-analysis. Heterogeneity and publication bias was examined through Q-statistics, Pq, I^2, T^2, T while publication bias was assessed through a standardized residual histogram, funnel plot and the Egger's regression test. Figure 1 below presents a summary of the research framework adopted.

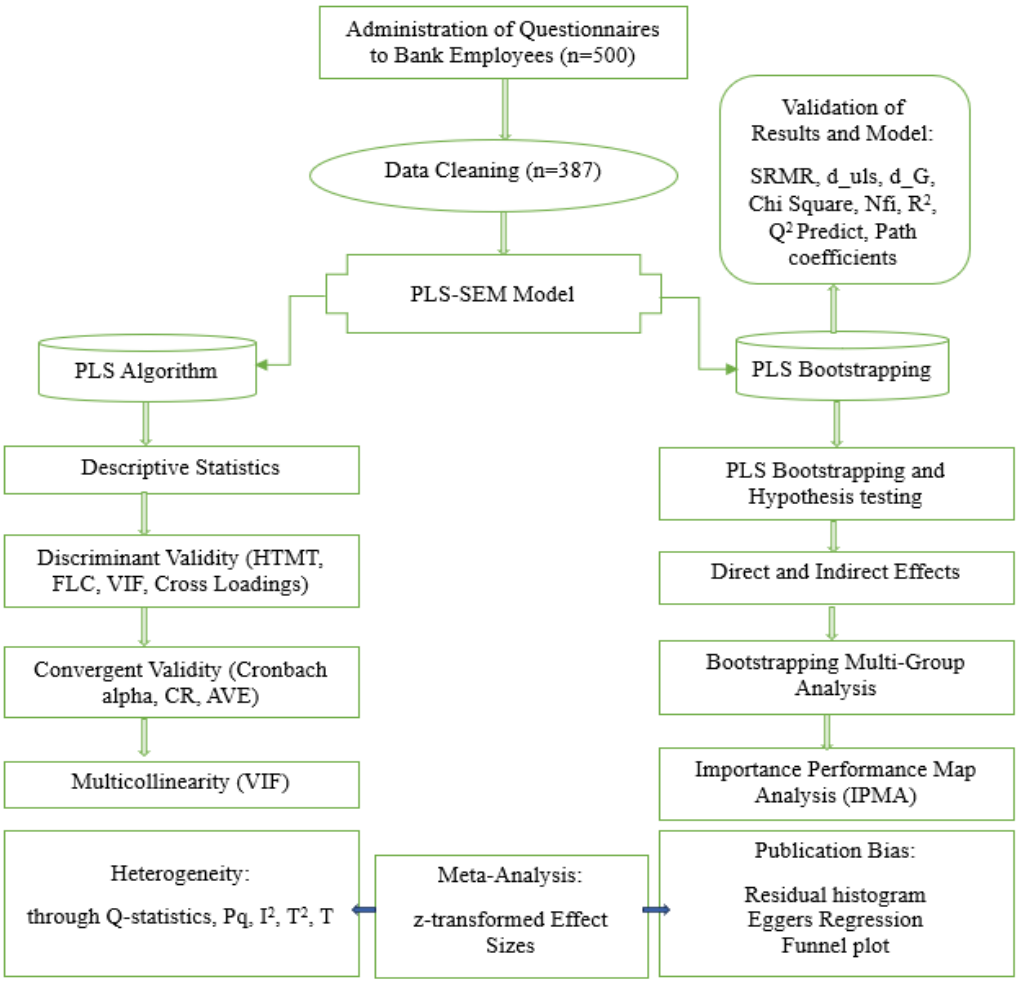

Figure 1: Research Framework Adopted

Source: Author's work

3. RESULTS AND DISCUSSION

3.1 Demographic and Descriptive Statistics

This section presents descriptive and inferential statistics exploring the study objectives and testing the study hypothesis, their interpretation and critical discussions.

3.1.1 Demographic Statistics

The results are based on a total of 387 responses collected through the research questionnaire which was a response rate of 77.4% (Table 1). The questionnaires were administered both physically and online to bank employees working at the management level, credit sections and sustainability departments for the banks with dedicated departments for sustainability-related operations. There was a good balance between both male (45%) and female gender (55%) and above 80% of the respondents have sufficient banking experience of over 6 years with majority (35%) ranging between 11 to 15 years. 44% of the respondents worked in what was classified as large banks (market share equal or greater than 9%) while 56% were from small banks i.e. those with the market share of below 9%). The respondents were purposely selected to increase chances of getting feedback from respondents more likely informed about the bank's green financing initiatives.

Table 1: Demographic Statistics

	Characteristics	Frequency	Percentage
Response Rate	Questionnaires Issued	500	
	Questionnaires Filled	387	
	Response rate		77.4%
Gender	Male	175	45%
	Female	212	55%
		387	**100%**
Education Background	Diploma	39	10%
	Bachelor's Degree	232	60%
	Master's degree	108	28%
	PhD. and above	8	2%
		387	**100%**
Work Experience	Less than 5 years	77	20%
	Between 6 to 10 years	120	31%
	Between 11 to 15 years	135	35%
	Between 16 to 20 years	39	10%
	21 years and above	16	4%
		387	**100%**
Bank Ownership	Foreign Owned	136	35%
	Locally Owned	251	65%
		387	**100%**
Bank Size	Large	171	44%
	Small	216	56%
		387	**100%**
Work Experience	Less than 5 years	77	20%
	Between 6-10 years	120	31%
	Between 11-15 years	135	35%
	Between 16-20 years	39	10%
	21 years and above	16	4%
		387	**100%**

Source: Author's work

3.1.2 Constructs Descriptive Statistics

Construct descriptive statistics measured in the form of measures of central tendencies, standard deviation, skewness and kurtosis were conducted to check if the dataset suffered from the possibility of outliers. According to COOKSEY (2020), a dataset exhibits a normal univariate distribution if its skewness and kurtosis values lie within the ±2 range. All values for kurtosis and skewness are within the recommended range, and the data did not suffer from any extreme outliers. Most of the constructs have a median of 4 indicating that generally the respondents agreed with the statements placed to them on the green financing initiatives. The std deviation range from (0.85 to 1.07) indicating that the responses were moderately spread but still clustered around the mean. Majority of the latent constructs are negatively skewed todays the values 4 and 5 further confirming high level agreeableness among the respondents. The negative skewness (-0.3 to -1.2) indicate a flatter distribution showing that the responses are relatively spread out while the Cramer-von Mises p-value (0.000) indicate that the distribution of response significantly deviates from a uniform distribution.

3.2 Quality Criteria Assessment of the PLS-SEM model

While determining the relevant quality criteria to carry out, it is important to identify the type of model used i.e. whether it is reflective or formative to determine the relevant quality criteria checks associated with the model (BYON and JANG, 2024). This study adopted a type II hierarchical component model where the relationship between the low-order constructs (LOCs) i.e. (GFI, GBI, CRM) and financial performance (FP) was reflective-reflective while the relationship between the high-order constructs (HOC) i.e. GFI and financial performance was formative-reflective.

As such, it was important to check for the validity of the measurement model (reflective model) for the three LOCs and financial performance and afterwards assess the validity of the reflective-formative model i.e. HOC and Financial performance. The construct and convergent reliability of the measurement model (reflective-reflective) was assessed using Cronbach alpha, composite reliability (rho_a, rho_c), the Average variance extracted (AVE), Variance Inflation factor (VIF) for assessing multicollinearity, outer weights/loadings, explained variance (R^2) and predictive relevance. The quality criteria for the formative-reflective model, i.e. HOC and FP were assessed by checking collinearity through VIF, significance of the p-values for the outer weights and standard values through bootstrapping. To enhance readability, easier presentation and interpretation of results, the Table 2 summarizes the full meaning of the codes/acronyms used to refer to the latent variables and item constructs.

Table 2: Constructs Acronyms and Full Meaning

	Acronym	Full Meaning
Latent Variables	GFA	Green Financing Awareness
	GBI	Green Banking Initiatives
	CRM	Climate Risk Management
	FP	Financial Performance
	GFI	Green Financing Initiatives
Latent Constructs	GFA_1	Awareness Channels
	GFA_2	Workshops and Seminars
	GFA_3	Events and Sponsorships
	GFA_4	Green Metrics Reporting
	GFA_5	Green Awareness Rating
	GBI_1	Employee-Centric Green Banking Initiatives
	GBI_2	Operations-Centric Green Banking Initiatives
	GBI_3	Customer-Centric Green Banking Initiatives
	GBI_4	Policy-Centric Green Banking Initiatives
	GBI_5	Green Loan Products
	CRM_1	Climate Risk Control Measures
	CRM_2	Climate Risk KPI's
	CRM_3	Climate IT systems
	CRM_4	Climate Resource Allocation
	CRM_5	Climate Roles and Responsibilities
	FP_1	Access to International Market
	FP_2	Enhanced brand Image and Reputation
	FP_3	Long-term Capacity for CRM
	FP_4	Cost Savings from Green Banking Activities
	FP_5	Enhanced Financial Position due to Green Products

Source: Author's work

3.2.1 Construct Reliability

Construct reliability is the degree to which a variable is consistent with what it intends to measure (ABURUMMAN et al., 2023). This test is important in establishing dependability and reliability while applying Structural Equation Modelling (SEM) and similar techniques such as Confirmatory Factor Analysis (CFA). Composite reliability (CR) and Cronbach's Alpha (CA) are the two most popular tests for construct reliability. CR focuses on the average variance among the observed items, is based on factors loadings and does not assume the tau-equivalence of the items. It accounts for the fact that some items may contribute more to measuring a given construct than others and, therefore, allows for different factor loadings for each of the observable items. This assumption makes the CR measure more realistic and flexible for real-world applications.

Cronbach's Alpha (CA), on the other hand, focuses on the average correlation among the observed items and assumes tau-equivalence. Unlike CR, Cronbach's Alpha does not require the creation of a structural model for calculation. To calculate both easily in smart PLS, the first step was to create a PLS-SEM model clearly defining the relationship between three independent variables as the low-order latent constructs, the green finance strategy (GFS) as the high-order construct (HOC) and the

relevant financial performance metric as the dependent variable. Combining both measures boosts the dependability of the construct's reliability results, as the two methods evaluate the validity and reliability differently, leveraging on the advantages of each of them. Also, it is argued that the Cronbach Alpha is more conversant and has been used widely for many years, while Composite Reliability (CR) is more flexible due to the tau-equivalence assumption. In both CR and CA, the acceptable threshold is 0.7 (ABURUMMAN et al., 2023; BYON and JANG 2024).

3.2.2 Convergent Reliability

Convergent reliability assesses whether those items in a survey measuring the same construct are highly correlated. In this study, convergent reliability was measured using the average variance extracted (AVE). This statistical measure (AVE) shows how well items represent the constructs by quantifying the average variance an item represents relative to the variance caused by measurement error. The AVE scores range between 0 and 1, the higher the better, but a commonly acceptable threshold for this test is 0.5 (ABURUMMAN et al., 2023).

The construct reliability and convergent validity tests were conducted by running the Partial Least Square SEM model. The first evaluation was done on the measurement model (Outer model) while the second evaluation was done on the structural model (inner model) and finally, the overall model fitness test was examined. The PLS-SEM algorithm was run using the path weighting scheme and reporting was done based on standardized results. The path weighting scheme was preferred as it applies to all kinds of PLS path models and gives the highest R^2 values for endogenous constructs. After running the standard PLS algorithm, the following results, some item constructs were removed to ensure that only the construct items that met the required threshold made were included in the final model, in the end all the quality criteria were met as demonstrated in Table 3.

Table 3: Reliability and validity after the removal of non-qualifying items

2nd quality criteria test results		Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)	Items Removed
Reliability and validity results after removal of items with lower loadings	CRM	0.937	0.937	0.952	0.800	Nil
	FP	0.957	0.957	0.967	0.853	Nil
	GBI	0.896	0.896	0.923	0.799	Nil
	GFA	0.700	0.702	0.789	0.555	2
	GFI	0.949	0.954	0.956	0.646	Nil

Source: Author's work

As shown in Table 3 above, all the variables meet the construct reliability acceptable criteria for Cronbach's alpha and Composite reliability (rho_a) and (rho_c) as all variables have values ≥ 0.7. Similarly, all the variable constructs meet the convergent validity minimum requirement of AVE

values of ≥ 0.5. The AVE values for the variables are Climate Risk Management Constructs (CRM) (0.800), Green Banking Initiatives (GBI) (0.799), Green Financing Awareness initiatives (GFA) (0.555), Green Finance Strategy (GFS) (0.646) and Banks' Financial Performance (0.853).

3.2.3 Discriminant Validity (DV)

This test examines if the latent constructs are unique to other constructs in the model. It helps to make sure that there is no redundancy among or between constructs implying that the construct measures are distinct. To check for the existence of discriminant validity, this study assessed the latent variables cross-loadings and also checked for the Fornell Larcker Criterion (FLC) criteria. Cross-loadings help to ensure that the observable indicators load more strongly in the latent construct it is measuring than on other latent constructs. The basic rule for the FLC is that the square root of AVE for a construct should be greater than its correlations with the other constructs. The results indicated good discriminant validity for all the latent items as they all load at least higher than 0.1 in the latent variables they are measuring. The results and interpretation for the cross-loadings are summarized in the Table 4.

Table 4: Discriminant Validity Cross-loading Results and Interpretation

	CRM	FP	GBI	GFA	Interpretation
CRM_1	0.875	0.737	0.785	0.654	Pass
CRM_2	0.899	0.762	0.793	0.630	Pass
CRM_3	0.893	0.756	0.776	0.631	Pass
CRM_4	0.910	0.769	0.791	0.630	Pass
CRM_5	0.893	0.767	0.790	0.665	Pass
FP_1	0.780	0.921	0.726	0.664	Pass
FP_2	0.760	0.914	0.712	0.625	Pass
FP_3	0.799	0.932	0.748	0.661	Pass
FP_4	0.790	0.927	0.738	0.720	Pass
FP_5	0.786	0.924	0.735	0.710	Pass
GAI_1	0.563	0.550	0.515	0.736	Pass
GAI_2	0.549	0.580	0.513	0.774	Pass
GAI_3	0.489	0.506	0.444	0.724	Pass
GBI_1	0.733	0.656	0.842	0.541	Pass
GBI_2	0.755	0.685	0.870	0.599	Pass
GBI_3	0.763	0.651	0.792	0.523	Pass
GBI_4	0.719	0.666	0.838	0.560	Pass
GBI_5	0.729	0.674	0.859	0.549	Pass

Source: Author's work

3.2.4 The Fornell Larcker Criterion (FLC)

The Fornell Larcker Criterion (FLC) results were referred to further confirm the existence of discriminant validity in the SEM. As observed in the FLC Table 5, all the diagonal values representing

the square roots of the AVE values for the latent constructs are greater than other values within their corresponding columns and rows, confirming discriminant validity.

Table 5: Fornell Larcker Criterion (FLC) Results

Latent Variables	CRM	FP	GBI	GFA
CRM	0.894			
FP	0.848	0.924		
GBI	0.880	0.793	0.893	
GFA	0.718	0.733	0.660	0.745

Source: Author's work

3.2.5 Collinearity Test

To check if there exists a multicollinearity problem, the VIF test was run. The aim was to check if the latent variables' VIF values fell within the acceptable limit of ≤5. After running the collinearity test, the results indicated that all the VIFs are within the acceptable ceiling limit of ≤5. Although high VIF values were noted for the latent constructs FP_1 to FP_5, there is no evidence to prove that there is a multicollinearity problem as all values fall below the acceptable threshold. The results are summarized in the Table 6.

Table 6: Collinearity Results for the Reflective-Reflective Locs-FP Model

	VIF	Decision Criteria
CRM_1	2.851	VIF ≤5, Acceptable.
CRM_2	3.434	VIF ≤5, Acceptable.
CRM_3	3.252	VIF ≤5, Acceptable.
CRM_4	3.737	VIF ≤5, Acceptable.
CRM_5	3.219	VIF ≤5, Acceptable.
FP_1	4.348	VIF ≤5, Acceptable.
FP_2	4.066	VIF ≤5, Acceptable.
FP_3	4.885	VIF ≤5, Acceptable.
FP_4	4.560	VIF ≤5, Acceptable.
FP_5	4.458	VIF ≤5, Acceptable.
GAI_1	1.178	VIF ≤5, Acceptable.
GAI_2	1.226	VIF ≤5, Acceptable.
GAI_3	1.203	VIF ≤5, Acceptable.
GBI_1	2.289	VIF ≤5, Acceptable.
GBI_2	2.617	VIF ≤5, Acceptable.
GBI_3	1.872	VIF ≤5, Acceptable.
GBI_4	2.299	VIF ≤5, Acceptable.
GBI_5	2.482	VIF ≤5, Acceptable.

Source: Author's work

After confirming that all the latent constructs measuring the four latent variables met the reflective quality criteria as documented above, a High-order construct (HOC) i.e. Green Financing Initiatives (GFI) was introduced into the model. The HOC is formative as it's caused by the three main LOCs i.e. the Green Financing Initiatives are informed by the cumulative banks' efforts in promoting green awareness, green banking practices and climate risk management. As such, the arrows point from the

three LOCs to the HOC making this relationship reflective formative. It was important to first examine the quality criteria of the three LOCs and the dependent variable before introducing the HOC into the model as Smart pls handles the quality checks for reflective-reflective models differently from reflective-formative models. In this case, before introducing the HOC, the model was reflective-reflective i.e. the model aimed at examining the direct effects of the three independent latent variables on the dependent variable. After introducing the HOC, a reflective-formative relationship was introduced to the model i.e. the HOC was formed by the three independent LOCs to help assess the cumulative or indirect effect. The graphical output of the new model is illustrated in Figure 1. To confirm if the quality criteria was retained after the introduction of the HOC latent variable, the collinearity test was run again, and the significance of outer weights and outer loadings were run, and all the t-statistics were ≥ 1.96 and significant ($p \leq 0.05$).

3.2.6 Heterotrait-Monotrait Ratio (HTMT)

To confirm if discriminant validity was still present after the HOC was introduced, the HTMT (Bias-Corrected) ratio was computed based on the new hierarchical model. HTMT is a popular measure for discriminant validity tests applied in PLS-SEM that helps determine whether two latent constructs are unique (DIRGIATMO, 2023). It establishes if discriminant validity has been established or violated by comparing hetero-trait correlations (between different constructs) and mono-trait correlations (within the same constructs) (ROEMER et al., 2021). The Bias Corrected Bootstrapping (Bca) was preferred over percentile bootstrapping due to its ability to minimize systemic errors making the results more reliable and less susceptible to type 1 and type II errors.

The expectation is that if the constructs are truly distinct, then hetero-trait correlations should be less than mono-trait correlations. If otherwise, it would then imply that the constructs could not be distinct enough to be said to be measuring a different thing. As a rule of thumb, an HTMT ratio of <0.85 indicates that discriminant validity is established, but an HTMT ratio of <0.90 is acceptable (EL-AMMARI et al., 2023). A ratio of >0.90 signals a potential overlap of the constructs (RHAYHA and ALAOUI ISMAILI, 2024). If the bias-corrected HTMT confidence intervals (CI) include 1.00, the constructs are not unique, and discriminant validity is therefore violated (SHARIF-NIA et al., 2024). The acceptable threshold is that the CI should not include 1.00. The HTMT tests confirmed that all the constructs fell within the acceptable discriminant validity criteria as all the values fell below 0.85 with (FP<-> CRM) having the highest value of 0.838 and all others having lower values. There is minimal bias (-0.003 to 0.004) and there are no values close to 1 present in the upper bound (97.5%, CI) confirming that discriminant validity is upheld implying that although the latent variables are

interconnected, they are measuring different aspects of green financing initiatives. Table 7 below summarizes the HTMT results.

Table 7: HTMT Discriminant Validity Results

Construct Pair	Original Sample (O)	Sample Mean (M)	Bias	2.5% CI	97.5% CI
FP <-> CRM	0.722	0.838	0.004	0.734	0.761
GBI <-> CRM	0.742	0.786	-0.001	0.796	0.751
GBI <-> FP	0.748	0.763	-0.001	0.793	0.795
GFA <-> CRM	0.715	0.821	-0.001	0.817	0.820
GFA <-> FP	0.782	0.743	0.003	0.711	0.826
GFA <-> GBI	0.788	0.720	-0.003	0.748	0.811
GFI <-> CRM	0.714	0.812	-0.002	0.790	0.826
GFI <-> FP	0.716	0.724	0.000	0.817	0.799
GFI <-> GBI	0.803	0.707	0.004	0.813	0.842
GFI <-> GFA	0.82	0.706	-0.003	0.756	0.847

Source: Author's work

To further confirm if the minor bias signals any problem, the VIF test incorporating both the LOCs and the HOC indicators was run to check if the VIF values were within acceptable range. After running the collinearity check, it was, established that all the VIF values were below ≤5 which is below the acceptable threshold of <10 as suggested by (O'BRIEN, 2007).

3.2.7 Q2 Predict MV Summary

The Q^2 values were computed to determine the predictive relevance of the structural equation model. This study utilized PLSpredict which is a new method in smart PLS used to compute the predictive relevance of the model as an improvement to the traditionally used blindfolding method. PLSpredict is more robust, accurate, advanced and modern than blindfolding. Unlike blindfolding, PLSpredict utilizes a separate set of prediction errors including Mean Absolute Error (MAE) and Root Mean Square Error (RMSE) to assess how well a model generalize data (CHEAH et al., 2024). Contrastingly, blindfolding calculates predictive relevance by re-using the data points. In addition, it provides a comprehensive view allowing for comparison of the PLS model with other modelling approaches such as linear models (CHIN et al., 2020). The decision criteria for interpreting PLSpredict are that if the Q^2 values are close to 1, it implies that there is good predictive relevance in the model. According to HAIR et al. (2019), if Q^2 values range from 0.02 to 0.35, the model has small to moderate predictive relevance. Q^2 values above 0.36 to 1 indicate high predictive relevance.

Based on the study results, Green Financing Awareness constructs have relatively moderate predictive relevance as shown by the Q^2 values (GFA_1 ($Q^2 = 0.373$), GFA_2 ($Q^2 = 0.367$), GFA_3 ($Q^2 = 0.291$). All the Q^2 values are above the minimum threshold of 0.02. The Q^2 values for green banking constructs

indicate relatively high predictive relevance ranging from 0.618 to 0.684 (GBI_1= 0.684, GBI_2 = 0.642, GBI_3 = 0.632, GBI_4 =0.618 and GBI_5 =f 0.623). A similar case for financial performance indicators whose Q^2 values range from 0.590 to 0.657 (FP_1= 0.625, FP_2 = 0.590, FP_3 = 0.655, FP_4 = 0.657, and FP_5 = 0.648). Climate Risk Management (CRM) Q^2 values however had the highest predictive relevance with Q^2 values ranging from 0.740 to 0.766 (CRM_1= 0.741, CRM_2 = 0.766, CRM_3 = 0.740, CRM_4 =0.758, and CRM_5 = 0.762).

3.2.8 Robustness Check – PLS-SEM vs. Indicator average (IA)

To further validate the PLS-SEM model, its loss i.e. prediction error was compared to another model i.e. Indicator Based-Average Loss as a simpler benchmark to assess the PLS-SEM model's accuracy. To enhance comparability, the two models compute the prediction errors using the latent indicators individually without considering the latent variable structure. This test provides a comparative report on how much loss each model has and tests whether the difference in the losses from each model is statistically significant (RINGLE and SARSTEDT, 2016). The table below shows that PLS loss is relatively lower for both FP and GFI latent variables i.e. FP (0.629<1.726, t=15.488, p=0.000) and their t-values are statistically significant GFI (0.470 <1.276, t=18.375, p= 0.000). Overall, the prediction accuracy of the PLS-SEM model compared to the IA model is statistically significant (t=18.649, p=0.000). These results are summarized in the Table 8 below as follows.

Table 8: CVPAT LV Summary – PLS-SEM vs. Indicator Average (IA)

	PLS loss	IA loss	Average loss difference	t-value	p-value
FP	0.629	1.726	-1.097	15.448	0.000
GFI	0.470	1.276	-0.806	18.375	0.000
Overall	0.514	1.401	-0.887	18.649	0.000

Source: Author's work

3.2.9 Overall Model Fitness

The fitness of the model was assessed by the Standardized Root Mean Square Residual (SRMR) and d_ULS measures. SRMR measures the average discrepancy between the predicted and observed correlations (PAVLOV et al.,2021). The smaller the better, however, an SRMR ≤ 0.08 is acceptable (INTIMAYTA-ESCALANTE et al., 2025). The d_ULS uses the unweighted least square estimations to assess model fitness by measuring how well the model fits the data (RASOOLIMANESH et al., 2019). The results of this study show that the SRMR for the saturated and estimated models are all <0.08 and within the acceptable threshold (saturated= 0.044 and estimated= 0.044) respectively. The d_ULS and the d_G (Geodesic Discrepancy) all measure the discrepancy between implied and observed covariance matrices. While there is no established criteria for interpreting the d_ULS and

d_G results independently, the lower the values the better fit the model is. Notably, the estimated and saturated values for both d_ULS and d_G i.e. (0.330) and (0.218) respectively all match indicating consistency in the model fit tests of both models and measures. As the d_ULS and d_G results do not provide sound criteria to comment on the model fitness, the Normed Fit Index (NFI) is used to re-affirm the model fitness. The NFI compares the estimated model fit to the null or baseline model. Its rule of thumb is that, if the value ≥ 0.90, then the model is an acceptable fit (MCNEISH et al., 2018). In this case, the NFI value is 0.929 indicating the model is a good fit. The model fit results are summarized in the Table 9.

Table 9: Model Fit Results

	Saturated model	Estimated model
SRMR	0.044	0.044
d_ULS	0.330	0.330
d_G	0.218	0.218
Chi-square	456.137	456.137
NFI	0.929	0.929

Source: Author's work

3.3 Coefficient of Determination (R^2)

The R^2 value is also used to test the sample consistency of the model used. The rule of the thumb according to CHENG et al. (2014), is that for the SEM to be valid, the R^2 value of the endogenous variable must be >0.1. An R^2 of less than 0.5 is considered weak, 0.5 is considered moderate and R^2 >0.5 is considered strong. In this case, the R^2 (0.746, t=37.347, p=0.000) indicates that green financing initiatives collectively (GFI) explains about 74.6% of the variances in financial performance (FP). The adjusted R^2 (0.746, t=37.217, p=0.000) is nearly identical implying that the model is robust, and additional predictors are not inflating the models' explanatory power unnecessarily further confirming the model's fitness. Table 10 summarizes the results of the Coefficient of Determination (R^2).

Table 10: Coefficient of Determination (R^2)

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
R-Square					
GFI<-> FP	0.746	0.747	0.020	37.347	0.000
Adjusted R-Square					
GFI<-> FP	0.746	0.746	0.020	37.217	0.000

Source: Author's work

3.4 Bootstrapping and Hypothesis Testing

After the validity, reliability, predictive relevance and fitness of the measurement model were established without a doubt, the bootstrapping approach was used to test the study hypothesis. Bootstrapping measures the significance of the PLS coefficients by employing resampling methods (STREUKENS and LEROI-WERELDS, 2024). The bootstrapping approach was done based on a 95% confidence level, 5000 samples and utilized the bias-corrected and accelerated bootstrap confidence interval (Bca) option. The aim was to test the direct and indirect effect of green financial initiatives on financial performance through testing *seven* study hypotheses where *three* of them established the direct relationship between the three LOCs i.e. GAI, GBI and CRM on the dependent variable Financial Performance (FP).

3.4.1 Hypothesis Testing Results

The other *three* examined how the three LOCs interacted with the HOC i.e. GFI and *one* hypothesis examined how the HOC i.e. GFI interacted with the dependent variable financial performance (FP). The criteria for rejecting or failing to reject the hypothesis was based on the statistical significance of the path coefficients. All seven hypotheses were supported as all the t-values were found to be statistically significant i.e. $p \leq 0.05$. The results indicate that CRM positively impacts banks' FP (CRM -> FP, t = 65.307, p= 0.000), CRM impacts GFI positively and the relationships are significant (CRM -> GFI, t-70.055, p=0.000) therefore supporting hypothesis 1a and 1b.

GBI positively impacts FP and HOC as indicated by (GBI -> FP, t = 53.669, P=0.000, GBI -> GFI, t=69.497, p= 0.000) respectively, therefore, supporting hypotheses 2a and 2b. Similarly, GFA positively impacts FP (t=24.193, p=0.000), and has a positive significant impact on GFI (t=26.985, p = 0.000) therefore supporting hypotheses 3a and 3b. Lastly, green financial initiatives (GFI) positively influence banks' financial performance, and the relationship is statistically significant (t= 74.572, p=0.000).

3.4.2 Direct and Indirect Effects on Financial Performance

The positive coefficients (CRM → FP, total effect = 0.420) indicate that CRM has a moderate effect on banks' financial performance (FP). Similarly, GBI → FP total effects = 0.357, t=53.669, p=0.000) also reveals a moderate direct impact on FP. Comparatively, Green Financing Awareness (GFA) has a relatively weaker total effect on FP (total effects = 0.146, t = 24.193, p = 0.000). Collectively, Green Financing Initiatives (GFI) has the highest impact on FP (total effect = 0.864, t=74.572, p=0.000), implying that active engagements with green financing initiatives result in notable financial benefits on cost savings, revenue from green products and enhanced brand reputation.

3.4.3 Direct and Indirect Effects on Green Financing Initiatives (GFI)

CRM depicts a strong positive impact on GFI (total effects = 0.486, t=70.055, p = 0.000), suggesting that banks which have integrated strong climate risk management policies are highly likely to engage in green financing activities. GBI also exhibits a similar strong positive effect on financial performance (FP) (total effects = 0.413, t = 69.487, p = 0.000), potentially implying that banks engaged with policy and operations-related, customer and employee-centric green banking practices are more likely to engage in green financing. Notably, GFA has the smallest but positive and significant impact on GFI (total effects = 0.169, t =26.985, p=0.000) Implying that while promoting green awareness is essential, practical measures such as green banking and climate risk management initiatives play the most important role in informing the overall green financing initiatives undertaken by the listed Kenyan banks.

In conclusion, the Green Financing Initiatives (GFI) have the strongest impact on financial performance (total effect = 0.864). GBI and CRM strongly influence the overall green financing initiatives (GFI), supporting the notion that banks can leverage structured climate risk management and green banking policies to exploit the opportunities brought about by climate change. The weak effect of green awareness initiatives reveals the need to combine green awareness initiatives with other actionable strategies to realize improved financial performance from green financing activities. The Table 11 summarizes the path coefficient significance results.

Table 11: Path Coefficient Significance Results

No.	Ha	Variable Relationships	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Decision
1.	**1a**	**CRM -> FP**	0.420	0.420	0.006	65.307	0.000	*Supported*
2.	**1b**	**CRM -> GFI**	0.486	0.486	0.007	70.055	0.000	*Supported*
3.	**2a**	**GBI -> FP**	0.357	0.357	0.007	53.669	0.000	*Supported*
4.	**2b**	**GBI -> GFI**	0.413	0.413	0.006	69.497	0.000	*Supported*
5.	**3a**	**GFA -> FP**	0.146	0.146	0.006	24.193	0.000	*Supported*
6.	**3b**	**GFA -> GFI**	0.169	0.169	0.006	26.985	0.000	*Supported*
7.	**4a**	**GFI -> FP**	0.864	0.864	0.012	74.572	0.000	*Supported*

Source: Author's work

To easily visualize the results, Figure 2 below present the model results with the p values for all the hypotheses tested respectively.

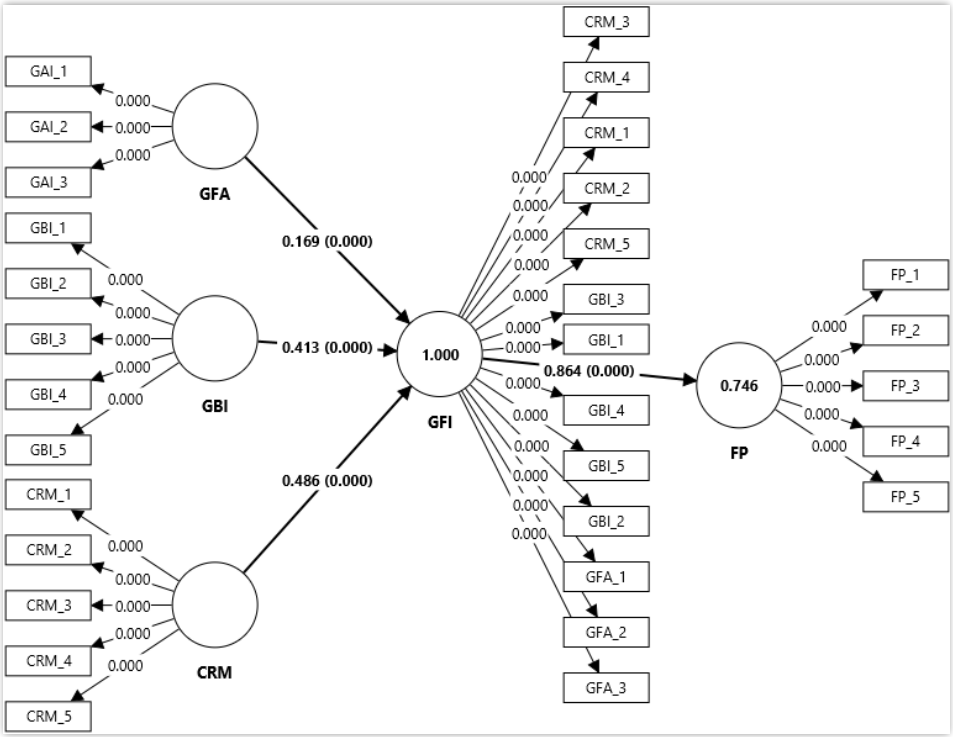

Figure 2: P Values of tested hypothesis

Source: Author's work

3.5 Bootstrapping Multi-Group Analysis

Multi-group analysis was used to pursue the fourth and fifth objectives, which aimed at determining whether bank sizes and type of ownership affected the interaction between green financing and financial performance. According to KONIETSCHKE et al. (2015) and HUANG (2018), multi-group analysis is recommended when using complex structures and such as those involving hierarchical structures or multiple groups as it is the case in this study. The fourth objective sought to determine whether the relationship between green financing initiatives and financial performance was significantly different for different bank sizes, while the fifth objective examined whether the interaction between green financing initiatives and financial performance was significantly different between foreign-owned and locally owned banks. Banks were categorized as either small or large based on their market share. Regarding the status of bank ownership, banks were categorized as either foreign if foreign stake was > 50% or locally owned if the local shareholding was < 50%. The following hypotheses were tested.

Ha 5a: The impact of Green Financing Initiatives (GFI) on Financial Performance (FP) is significantly different between small and large banks.

Ha 5b: The impact of Green Financing Initiatives (GFI) on Financial Performance (FP) is significantly different between foreign and locally owned banks.

3.5.1 The Significance of Bank Size Results

As mentioned earlier, the banks were categorized into either large or small banks based on their market share. To determine the threshold for defining banks as either large or small, the average market share was computed based on the market share standings as of December 2024, as that is what was publicly available. Then, banks whose market share was above the market average were coded as large banks, while those whose market share fell below the determined average were coded as small banks. These two categories were used in creating the dummy variable upon which group categories were created in smart pls. Using the multigroup PLS bootstrapping, the following results were obtained for purposes of making the relevant comparison.

Table 13 presents the results of the multi-group bootstrapping analysis that sought to compare whether there was any statistically significant difference in how the green financing initiatives undertaken by the banks impacted financial performance. The positive difference of (0.017, the one-tailed p-value of 0.094) for the pair construct CRM -> GFI suggests some weak evidence that CRM might be more influential in smaller banks, but the 2-tailed p values (0.187) completely discard the possibility of a statistically significant difference on the influence of CRM on GFI between small and large banks. This concludes that Climate Risk Management initiatives drive better financial performance regardless of whether the banks are large or small.

Green Banking Practices (GBI) seem to be more influential to the collective green financing initiatives (GFI) in large banks as indicated by the difference value (-0.021). Notably, the 2-tailed value (0.08) suggests that some evidence that GBI might strongly influence the overall green financing strategy (GFI) for the large banks; however, this observation is not conclusive as the p-value 0.08>0.05 and is therefore statistically insignificant. There are no notable variations in how green financing awareness initiatives influence the green financing strategies between large and small banks as indicated by the difference value (-0.005, p=0.712) implying that although large banks seem to promote their GFI through accelerating green awareness initiatives or investments, the difference is very meagre compared to similar initiatives by the small banks.

Lastly, green financing initiatives (GFI) seem to relate almost the same way with financial performance across different bank sizes as indicated by the minor difference (-0.011). Although the negative value suggests that large banks might experience better financial performance from green financing initiatives than small banks, the p values (0.685 and 0.630) confirm that there are no significant statistical variations.

Based on these results, it can be concluded that bank size does not significantly alter how green financing initiatives impact the bank's financial performance. Although with weak evidence (p=0.08), it is worth noting that large banks might leverage more on green banking practices to drive their green financing strategies and investments probably better than the smaller banks. Such could be attributed to large banks facing high regulatory scrutiny from governments, having high ESG commitments and having more financial resources than small banks. Nonetheless, these results conclude that the impact of green financing initiatives on the bank's financial performance is consistent across small and large banks as there is no statistically significant difference between small and large banks. These results are summarized in Table 12.

Table 12: The Significance of Bank Size Results

	Difference (Small-Large)	1-tailed (Small vs Large) p-value	2-tailed (Small vs Large) p-value	Decision All P<0.05
CRM -> GFI	0.017	0.094	0.187	Not supported
GBI -> GFI	-0.021	0.960	0.080	Not supported
GFA -> GFI	-0.005	0.644	0.712	Not supported
GFI -> FP	-0.011	0.685	0.630	Not supported

Source: Author's work

3.5.2 Testing the Significance of Bank Ownership Results

The fifth objective was to compare how the relationship between green financing awareness activities, green banking practices and climate risk management strategies informs the overall green financing initiatives and interacts with financial performance between foreign-owned banks and locally owned banks. The comparison was done by running a multi-group bootstrapping analysis to test if the differences in the variable relationships were statistically significant.

As indicated in the results in Table 14, there is a minimal difference of 0.002 which is statistically insignificant (p = 0.441 for a one-tailed test and p = 0.882 for a two-tailed test) between foreign and local banks. Similar observations are noted for the Green Banking Initiatives (GBI), on green financing initiatives (GFI) (difference = -0.000, p= 0.502 for one-tailed and 0.996 for two-tailed.

However, foreign banks exhibit a stronger marginal influence of green financing awareness (GFA) on the overall green financing strategy (GFI) with a notable difference of 0.021 which is statistically significant with the one-tailed p-value (p=0.05). The two-tailed value (p=0.100), however, weakens this conclusion implying that the difference is not statistically stronger. Lastly, the overall impact of green financing initiatives (GFI) on the financial performance (FP) appears to be stronger among the local banks than among the foreign banks (difference = -0.033) but is however statistically insignificant (p=0.926 for one-tailed, p=0.147 for two-tailed). Based on the above analysis, the results

suggest that bank ownership does not appear to be a differentiating factor in determining how green financing strategies impact banks' financial performance among the listed banks in Kenya. The results, therefore, conclude that the effect of sustainable green practices on financial performance remains the same regardless of whether the banks are foreign or locally owned. The results are summarized in Table 13 below.

Table 13: Testing the Significance of Bank Ownership Results

Relationships	Difference (Foreign Bank – Locally Owned)	1-tailed (Foreign Bank vs Locally Owned) p-value	2-tailed (Foreign Bank vs Locally Owned) p-value	Decision
CRM -> GFI	0.002	0.441	0.882	Not supported
GBI -> GFI	-0.000	0.502	0.996	Not supported
GFA -> GFI	0.021	0.050	0.100	Not supported
GFI -> FP	-0.033	0.926	0.147	Not supported

Source: Author's work

3.6 Importance Performance Map Analysis (IPMA)

IPMA expands the standard PLS-SEM results by identifying the crucial areas of improvement by assessing the total effects and latent performance on the predictor variable (FERDIN et al., 2024). These results provide practical insights to decision-makers, policymakers, and managers on what areas need to be focused on.

The IPMA performance results for the indicators GBI_1, GBI_2 and GAI_3 with MV values were 59.755, 59.302 and 56.912 respectively. Notably, most indicators for Green Banking Initiatives show relatively high performance, implying that most of the listed banks have sufficiently implemented green banking activities. The constructs for green financing awareness GAI_1: 56.395, GAI_2: 55.491, green financing awareness (GFA_1: 56.395, GFA_3: 56.91) and CRM ranging from (CRM_1:54.134 to CRM_5:55.168) depict moderate performance implying decent performance but still shows room for improvement. The constructs GBI_4 (mv=38.302) show the lowest performance, indicating that most of the banks have not yet established sufficient green banking policies, especially on setting minimum thresholds for green issuance to polluting sectors.

3.7. Comparing Kenyan Context to Global Effect Sizes

To better understand how the impact of green financing on banks financial performance in the Kenyan context compares to the global trends, this study statistically tested the difference between the locally observed effect size against the global effect size derived from the meta-analysis. To make the comparison possible, both the Kenyan and global effect sizes were transformed into a common z-score. For the Kenyan context, using the path coefficients (GFI -> FP) of 0. 864, standard error =

0.012, t-statistics = 74.572 from the SEM model as summarized in table above was used to compute the fisher's Z-transformation as follows:

$$z_{Kenyan\ Context} = \frac{1}{2} ln\left(\frac{1+r}{1-r}\right) \quad [2]$$

$$z_{Kenyan\ Context} = \frac{1}{2} ln\left(\frac{1+0.864}{1-0.864}\right) = \frac{1}{2} ln\left(\frac{1.864}{0.136}\right) = \frac{1}{2} ln(13.706) = \frac{1}{2} \times 2.617$$

$$z_{Kenyan\ Context} = 1.308$$

To test if there exist a statistical difference between how green financing interacts with banks financial performance in Kenya against the observed global context as calculated through the meta-analysis, the Z value is calculated as follows:

$$z_{Difference} = \frac{1.308-0.16}{\sqrt{0.012^2+0.07^2}} = = \frac{1.148}{\sqrt{0.000144+0.0049}} = \frac{1.148}{\sqrt{0.005044}} = = \frac{1.148}{0.071}$$

$$z = 16.17$$

The z-score of 16.17 from the standard normal distribution table has a p-value of 0.001 indicating that there exists a statistically stronger difference in how green financing translates to enhanced bank financial performance in the Kenyan context when compared to the global average effect size ($p<0.001$). Based on the high z-score of 16.17 is greater than ±3.29 critical value implies that $p < 0.001$, which is statistically highly significant, this study therefore supports the hypotheses that "The impact of green financing on banks' financial performance in Kenya significantly differ from the global observed outcome as measured by effect sizes".

4. FINDINGS AND DISCUSSIONS

The main aim of the study was to examine how green financing initiatives among listed banks in Kenya impact the bank's financial performance in terms of cost savings, access to the international market, brand reputation, enhancement of their balance sheet and ability to manage climate-related risks in the long run. The green financing initiatives examined focused on the banks' current and ongoing initiatives on green financing awareness, green banking practices and climate risk management strategies, which formed the independent variables. Multi-group analysis based on bank size and type of ownership was also conducted to establish whether there existed any statistically significant difference in how green financing initiatives interacted with the assessed aspects of financial performance. To pursue these specific objectives, a total of ten study null hypotheses were developed and tested, as revealed in Table 14. Among the ten hypotheses, eight hypotheses were supported, while two were rejected.

Table 14: Summary of Hypothesis Testing Results

Hypothesis	Statement	Effect Type	Test/Model Used	p-value	Decision
H1a	Climate Risk Management (CRM) contributes significantly to Green Financing Initiatives (GFI)	Indirect	Structural Equation Modeling (SEM)	0.000	Supported
H1b	CRM positively impacts Financial Performance (FP)	Direct	SEM	0.000	Supported
H2a	Green Banking Initiatives (GBI) contribute significantly to GFI	Indirect	SEM	0.000	Supported
H2b	GBI positively impact FP	Direct	SEM	0.000	Supported
H3a	Green Financing Activities (GFA) contribute significantly to GFI	Indirect	SEM	0.000	Supported
H3b	GFA positively impact FP	Direct	SEM	0.000	Supported
H4a	GFI collectively positively impact FP	Indirect	SEM	0.000	Supported
H5a	The impact of GFI on FP differs significantly between small and large banks	Moderating	Multi-group SEM	0.630	Rejected
H5b	The impact of GFI on FP differs significantly between foreign and local banks	Moderating	Multi-group SEM	0.147	Rejected
H6	The impact of green financing on FP in Kenya significantly differs from global outcomes (effect sizes)	Comparative (Cross-study)	Meta-analytic Comparison	0.001	Supported

Source: Author's work

Hypothesis *1a* proposed that climate risk management (CRM) contributes significantly to the bank's collective green financing initiatives, while *1b* proposed that banks' CRM positively impacts banks' financial performance. These findings agree with other studies such as CHALABI-JABADO and ZIANE (2024) argued that banks enhance their green financing capability by integrating robust climate risk management into their risk framework. Similarly, CUCINELLI et al. (2024) notes that CRM is crucial in helping banks pursue their green goals. AIJAZ et al. (2025) also concludes that environmental and social risk management promotes sustainable financing and aligns with green financing objectives.

FAN et al. (2024) expounds on CHALABI-JABADO and ZIANE (2024) findings that climate risk management enhances banks' stability and profitability by mitigating transition and physical risks. Studies by HISHAMUDDIN et al. (2024) and FAN and GAO (2024) confirm that through addressing risks associated with climate change, CRM has been seen to enhance banks' profitability. CONLON et al. (2024) extends the argument that banks with robust CRM frameworks are better placed to deal

with climate shocks, therefore requiring them to maintain low levels of loss reserves, which enhance their financial stability. WU et al. (2024) however poses a different argument that banks can only attempt to mitigate climate risks through strategies such as capital adequacy but cannot wholly avoid climate losses.

Hypothesis *2a* and *2b* sought to examine whether green banking initiatives contribute significantly to the collective green financing initiatives and financial performance. The results reveal positive and significant relationships for both hypotheses *2a* and *2b*. These findings agree with other studies including VALENCIA and CALABUIG-TORMO (2023), ZHANG et al. (2022) and BANSAL et al. (2023) who argue that green banking practices influence banks' green and environmental financial resources positively. These initiatives help banks boost their sustainability indexes by reducing their carbon footprint (VALENCIA and CALABUIG-TORMO, 2023). SINGH et al. (2022) and JAIN and SHARMA (2023) also adds that green banking practices enhance banks' cost savings, product development and operational efficiency which makes banks financially efficient and more competitive. RAHMAN et al. (2023) and MANDAGIE et al. (2025) further argues that implementing green banking initiatives promotes the bank's green financing capacity.

Multiple studies have also established a positive relationship between green banking and financial performance. MONDAL and SAHU (2023), ASLAM and JAWAID (2023) and AL-KUBAISI and KHALAF (2023) established a positive relationship between green banking and Return on Equity (ROE) and Return on Asset (ROA). PUTRI et al. (2022) further argues that green banking enhances banks' financial performance indirectly through promoting their reputation and enhancing their operational efficiency which in return promotes its long-term profitability and cost savings. SINGH et al. (2022) however, did not find any significant direct impact of GBI on banks' financial performance but noted enhanced operational efficiency.

Hypotheses *3a* proposed that green financing awareness activities contribute significantly to the Impact of GFI on FP while *3b* proposed that GFI positively and significantly influences banks' financial performance. The results supported these two hypotheses and agree with many other previous studies. SHARMA et al. (2025) argue that green awareness initiatives are instrumental in promoting the adoption of fintech which is essentially a green financial technology that contributes to sustainable banking practices. KHAN et al. (2024) add that GFA is effective in promoting brand image which results in attracting customers who place high value on sustainability. Promoting GFA among employees can easily translate into operational efficiency by cutting down operational costs associated with traditional banking practices (BHUIYAN et al., 2024). NARAYANAN and PRADHAN (2024)

further note that promoting sustainable and ethical business practices attracts socially responsible investors. CHANDRAN et al. (2024) and ANJALIDEVI et al. (2024) add that green awareness promotes banks' green products such as green credit cards, green loans or related products, therefore enhancing the bank's balance sheet in the long run.

Hypothesis *4a* proposed that green financing initiatives generally positively influence banks' financial performance. The results supported the hypothesis which aligns with the findings of multiple previous studies. YU et al. (2023) note that green financing positively promotes banks' financial performance through information transmission and capital aggregation. HUANG and LUAN (2024) adds that green financing promotes sustainable banking practices by fostering innovation and removing financial barriers which enhances social and economic performance. QIAN and YU (2024) and YE and TIAN (2025) associate green financing with enhanced ESG and financial outcomes. LI and WANG (2023) also points out that green financing drives digital innovations like fintech that influence the bank's financial performance positively. MOHAN and MUHAMMAD (2024) notes that although the impact of green financing on the overall FP may be weak, it plays a major role in enhancing the bank's capacity to manage climate risks. LI, et al. (2017) argues that the impact of green financing on financial performance may not be experienced in the short run but most likely felt in the long run.

Hypotheses *5a* and *5b* propose that the impact of GFI on FP is significantly different between different bank sizes and between foreign and locally owned banks. The results rejected the two hypotheses, implying that bank size and type of ownership did not matter in determining the interaction between green financing initiatives and financial performance. These findings, however disagree with other studies. CHEN et al. (2022b) for instance, observed that the impact of green financing on FP tends to be more profound among small banks than in large banks. GALÁN and TAN (2024) however, notes that small banks suffer more from the negative impact of green credit. Regarding large banks, ZHOU et al. (2024) argues that the interaction of green financing and financial performance among large banks is mixed noting that while it can reduce insolvency risk it can affect the net profits negatively. Regarding bank ownership, SISWANTI et al. (2024) and YANG et al. (2024) argues that the impact of green financing on FP is more likely to be highly pronounced among foreign banks than in local banks.

The last hypothesis proposes that the impact of green financing on banks' financial performance in Kenya significantly differ from the global observed outcome as measured by effect sizes. The statistical test ($z = 16.17$, $p < 0.001$) supports this hypothesis possibly because of the higher financing of renewable energy which accounts for more than 90% of the Kenyan national energy grid, the highly

growing market niche of e-mobility, expanding climate smart agriculture and growing number of international partners who support green lending through derisking mechanisms.

Overall, the meta-analysis results indicate that there tend to be a global consensus that green financing activities tend to have a small but significant impact on banks financial performance. Although the results show high heterogeneity possibly due to the diverse regional, social economic, cultural, context specific factors and diverse methodologies adopted, the pattern observed in the Kenyan banking context aligns with the overall globally observed trend that green financing positively impacts banks financial performance, but the extent to which this impact largely depends on local context factors, institutional factors, social cultural and policy contexts that influence the market dynamics.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The study aimed at examining how green financing initiatives by the listed banks in Kenya affects their financial performance and whether the nature of this relationship is affected by the size of the banks or type of ownership. The green financing initiatives focused on the study included green financing awareness, climate risk management and green banking practices as the independent variables. The dependent variable was financial performance which was measured through cost savings associated with green initiatives, access to international market, enhancement of the bank's loan portfolio by including green products such as green bonds, sustainability linked loans and enhanced capacity to manage long term climate risk. A total of ten hypothesis were tested and eight of them were supported while two were rejected.

Climate Risk Management was found to significantly influence the collective green financing initiatives among the listed banks in Kenya and positively impact financial performance. Based on these are findings, this study supports the argument that integrating a robust climate risk management framework into bank lending criteria helps the banks to reduce loss reserves therefore promoting both stability and long-term profitability. It is however important to note that CRM can only help in mitigating these losses but does not make the banks entirely immune to climate related financial vulnerabilities.

Green banking practices were also found to play a significant role in enhancing banks financial performance especially through promoting banks operational efficiency, product development such as green bonds and cost savings associated with the adoption of green banking practices such as reducing paperwork, promoting mobile banking, water and energy efficiency practices etc. This

finding aligns with other previous studies which identified that green banking practices positively influenced brand reputation and sustainability indices which enhanced banks profitability in the long run.

Similarly, green financing awareness initiatives such as leveraging on website to inform and educate about green products, conducting seminars, workshops targeting investors and employee training also contribute significantly to banks financial performance. This finding supports the notion that promoting green awareness among employees and customers attracts socially responsible investors and promotes demand for green products. The finding supports previous studies that green awareness enhances long-term financial stability and strengthens the banks' balance sheet.

Further, the study established that overall green financing initiatives i.e., green banking practices, climate risk management practices and green awareness initiatives collectively positively impact banks financial performance. The findings support the notion that green financing initiatives drives digital innovation, fosters capital aggregation and enhances banks resilience in managing climate related risks. While short term results from green initiatives may be limited, long-term sustainability driven benefits are evident.

Contrary to the findings of most previous research, this study found no statistically significant difference on how different bank sizes and type of ownership shapes the interaction between green financing initiatives and financial performance. The findings contradict with previous studies in the literature which suggest that the impact of green financing on banks financial performance is more profound to foreign owned banks than locally owned and on small sized banks than large banks. The dissertation, therefore, implies that banks that engage in green financing initiatives are likely to derive related benefits regardless of their sizes or type of ownership. Further, the IPMA analysis indicate reveal that majority of the banks are reluctant in implementing strict lending policies such as setting maximum thresholds they can lend to polluting sectors.

The general trend on the nexus between green financing and banks performance as investigated within the Kenyan banking contexts aligns with the overall global pattern that green financing practices and lending activities generally, tend to have a positive impact on banks profitability. However, the extent to which the green financing strategies translates to financial benefits depends on multiple factors including social cultural and economic factors, institutional related characteristics, policy, regulation and local contexts and that this relationship majorly but not universally accepted.

5.2 Limitations and Suggestion for Future Research

The data used in synthesizing the results of this study was collected using closed-ended questionnaires. Future research studies in this area might explore alternative methods of data collection, such as open-ended interviews to gather deep insights from experienced bank professionals. Also, as many banks are continuing to embrace annual sustainability reporting, future studies might explore whether the same observations hold based on quantitative data. This study could not be based on quantitative data as the data reported by the banks was insufficient and incomparable, making it unreliable to complete the study sufficiently. There is high potential for access to data in the future similar studies in Kenya especially following the voluntary implementation of the IFRS S1 and S2 in January 2024 and the phased mandatory implementation beginning the year 2027 (Large Public Entities (PIEs), 2028 (large non-PIEs) and 2029 (SMEs).

While conducting the multi-group analysis based on bank size and type of ownership, this study only dealt with two categories of bank sizes as either large or small based on the market share and classified the banks as either foreign or locally owned based on the dominant stake of ownership. Future studies might consider classifying the banks in tier 1, 2 and 3 to define bank sizes and probably consider three categories of bank ownership as either foreign, locally owned or mixed. Lastly, as green financing in emerging economies like Kenya has been emerging rapidly in recent years, it is recommended that future studies might utilize data as it emerges to evaluate the performance of the eco-friendly loan products.

5.3 Recommendations

Based on these results, this study makes the following specific recommendations.

1. First, the integration of climate risk management through operationalization of bank policies and tools such as applying internal green scoring criteria for investment projects and borrowers to assess their sustainability alignment and climate risk exposure is recommended. Additionally, climate stress testing should be embedded within the regular planning scenario to evaluate transition and physical risks.
2. Secondly, the adoption of green banking practices whether operations, customer, employee or policy centric drives both operational efficiency and banks sustainability goals. As such, it is beneficial for banks to deliberately invest more in greening its operations and its other stakeholders' relationships such as customers, employees and investors by adopting green banking activities such as advancing low interest rates to eco-friendly loan products to encourage high

customer uptake for sustainable banking products. Such initiatives are not only a good strategy for promoting sustainability goals but also financially beneficial to the banks.

3. Thirdly, the concept of green financing is more of an emerging area of interest yet very crucial. The Kenya Bankers Association has gone a long way in floating sustainable banking modules whose uptake by bank staffs is reasonably positive so far. However, it was noted during data collection that while some banks have made this training mandatory and assess their banks employees as part of their performance KPI's, some leave it at the discretion of the employees. Employees who are trained on these green practices are more likely to be ecologically conscious and able to promote eco-friendly bank products than those who are not trained. In the case of the Kenyan banking sector, this study recommends that the banking regulatory institutions such as the Kenya bankers association should enforce policies requiring mandatory training of bank employees on the sustainable banking practices to generally promote the level of awareness and knowledge among the bank employees in the Kenyan banking sector. Such policy support is likely to accelerate the customer uptake, management and performance for eco-friendly loan products by the banks.
4. While the Kenyan banking sector has made significant strides by channelling green investments, it is worthwhile to note that just a few large banks with wide access to international organizations and sustainable oriented development partners have managed to offer significant green financing to the Kenyan economic sectors either by managing the green loans or sustainability linked loans on behalf of international partners or directly from their own loan portfolio after benefiting from de-risking strategies by international partners. Further interventions of the Kenyan government through fiscal incentives to promote green transition would go a long way in promoting more green financing and investments. Specifically, this study recommends fiscal incentives that encourage other sectors to invest in green transition, attract new market entrants and create an enabling environment for green investments that minimizes market distortion and enhances long-term sustainability. More importantly, a stability for the already deployed fiscal incentives including the 10% excise duty reduction for the electric cars, the 16% VAT exemptions under the VAT Act amendments and the 0% and 10-20% reduction on import duty for electric and hybrid cars respectively is highly recommended. These fiscal incentives have attracted new market entrants such as Roam and BasiGO companies as well as new EV brands such as Nissan Leaf, BYD and Hyundai Kona in the Kenyan markets. Since the implementation of these government incentives effective July 2021, the growth for EV sales surged by 108% from 2022 to 2023 and

41% increase from 2023 to 2024 with huge contribution from the banking sector which has supported this transition in multiple ways including; partnering with E-Mobility companies and start-ups to de-risk green loans, supporting rapid deployment of EVs in the Kenyan urban transit especially by the cooperative bank of Kenya and KCB banks, tailored financing models such as "pay as you drive" e-mobility financing and financing of charging infrastructures among others. These interventions have been quite effective in promoting green transition, creating market for green financing, shaping green consumption behaviour and attracting green investments into the country. To prevent market distortion and long-term sustainability, clear guidelines and timelines e.g. deciding how many years these incentives remain stable are highly recommended to encourage stakeholders' participation in the sector and protect the banks from potential exposures as they support the green transition endeavours.

5. Through the Central Bank of Kenya, the government could encourage commercial banks to channel more green financing in support of the green transition in various ways; As successfully implemented by the Magyar Nemzeti Bank (MNB), the Hungarian Central Bank, the Central Bank of Kenya could also consider implementing a gradual Green Preferential Capital Requirements Program for commercial banks that achieve certain levels of green exposures to encourage green lending especially in climate smart agriculture, renewable sector and e-mobility among other key sectors. The objective of this intervention would be to encourage banks to target green investments without having to raise additional capital especially now that Kenya has finally published its green taxonomy (2025) which largely inhibits the potential challenge of misclassification of loans by banks or greenwashing. With the reduced capital requirements, banks would therefore, have more capital savings to reinvest, or advance more loans therefore, enhancing their profitability.
6. While there are notable strides by the Kenyan banking sector in exploring green products such as green credit, sustainability linked loan products and leveraging on fin-tech in promoting green financing among others, less has been done in exploring the emerging carbon credit market in Kenya. This study recommends that banks can exploit this opportunity by designing carbon credit backed loans that can be advanced to the vast small and medium sized businesses which can leverage on their future earnings as collateral to access carbon financing. To protect the banks from default risks associated with the proposed carbon credit backed loans, the banks can leverage on their expertise to engage third party institutions who would provide technical support for instance verifying the carbon credits, securing purchase guarantee from international buyers or even working with insurance companies to cover them against potential default on the carbon

backed loan products. The loan could be structured in a manner that disbursement could be based on verified project milestones to increase chances of success to such projects.

7. Seventh, there are notable recent initiatives by the Kenyan government such as the amendment of the climate change act of 2016 to include carbon credit trading, revision of the national building code which now requires commercial buildings to dedicate at least 5% of their packing to electric cars and installation of charging facilities, tax incentives for importation, assembly and local manufacturing of green road, water and air automotives among others. This study recommends future studies to explore how these sector-specific and government interventions promote the uptake of green financing especially in light of the ongoing phased implementation of IFRS S2 and S1 on sustainability and climate finance reporting. Such insights would validate the effectiveness of the current national and sector initiatives in promoting environmental performance and inform Kenya's progress with its revised National Determined Contributions of reducing the greenhouse emissions.
8. Lastly, the meta-analysis result reveals an overall weak positive but significant relationship between green financing and banks financial performance indicating that green lending and green banking activities may not always translate to financial benefits but must be practiced prudently based on the local economic, social cultural, and local market realities to realize financial benefits.

6. NEW SCIENTIFIC RESULTS

Based on my results and discussions above, the study reveals the following new scientific insights as outlined below.

1. Through bootstrapping, this study identified that different green financing activities contribute differently to the green financing strategy for banks. This study revealed that climate risk management and green banking practices contribute more significantly to the collective green financing strategy than green awareness initiatives. The results imply that while green awareness initiatives are important in promoting the green financing strategy, they can't be sufficiently effective if implemented alone but should be combined with robust green banking and climate risk management initiatives for banks to realize financial benefits.
2. The study also reveals that green financing initiatives significantly influence the financial performance of the banks, especially in enhancing their balance sheet, gaining access to the international market, cost savings associated with climate risk management, enhancing brand reputation and enhancing banks long term ability to manage climate related risks. The study,

however, notes that although these green financial initiatives collectively impact banks' financial performance positively, they do not make banks entirely immune to climate shocks.

3. To the best of my knowledge, this study is the only one seeking to examine the influence of green financing initiatives on the financial performance of listed banks in Kenya by examining how green financing awareness initiatives, green banking and climate risk management practices collectively influence banks' financial performance. Further, other similar studies done in Kenya related to this study are based on literature review and secondary materials, and none is based on primary insights, as is the case in this study. This study achieved the research purpose in examining the direct and indirect effects through creating a moderating pathway by introducing a high order construct into the baseline model to collectively measure the green financing initiatives and later determined its influence on the financial performance through PLS-SEM.
4. This study also adopts a unique way of assessing the moderating effect of bank size and ownership through conducting advanced multi-group bootstrapping rather than the conventional way of introducing interaction terms. This was considered more appropriate when dealing with categorical variables for bank sizes and type of ownership and the complex type II hierarchical model and was made possible by the multi-group bootstrapping feature available in smart PLS 4, therefore contributing novel methodological approaches to the existing body of knowledge as future researchers can easily replicate the same approach to compare variable relationships involving different groups.
5. Lastly, when the Kenyan local contexts results are compared to the global patterns based on the meta-analysis effect sizes, the study reveals evidence that green financing tend to contribute positively to the overall banks performance however, banks must localize their green financing strategies to align with the local social cultural, economic and geographical specific market realities to profit from such initiatives otherwise, green financing may not always result to financial gains as indicated by some other few studies which established negative relationships between green financing and banks financial performance reducing the overall effect to a weak positive though significant relationship.

7. SUMMARY

The study was based on five specific research objectives, which were pursued through testing ten research hypotheses. The main objective of the study was to establish whether the green financing initiatives currently undertaken by the listed banks in Kenya positively influence the banks' financial

performance directly or indirectly and whether the size of the bank or its type of ownership matters in determining the financial implications of these initiatives. The first three objectives focused on examining the direct impact of green financial awareness, green banking activities and climate risk management initiatives of banks' financial performance. The fourth objective examined how the three major green financing activities collectively informed the banks' green financing strategy, while the fifth objective sought to examine the financial implications of the collective green financing strategies. The sixth objective examined whether there was any statistical difference between how green financing interacted with the banks' financial performance for large vs small banks as well as foreign vs locally owned banks.

The partial least square structured equation model (PLS-SEM) in smart pls 4 was utilized in testing the research hypothesis, and out of the ten hypotheses, eight were supported, and two on bank size and bank ownership were not supported. The analysis process involved running the quality criteria to ensure that only the valid item constructs were used in creating the final model. The quality checks employed included tests for construct reliability and convergent, discriminant validity, collinearity tests, predictive relevance and model fitness. After careful quality scrutiny, bootstrapping was used to test the hypothesis.

The study revealed that green awareness activities, green banking activities and climate risk management strategies all positively impact banks' financial performance independently. However, climate risk management was found to have the strongest impact, followed by green banking activities, while the green awareness initiatives had the least financial implications on the bank's financial performance when assessed independently. The highest influence of green financing on the bank's financial performance was realized when all three initiatives were combined.

The multigroup analysis based on bank size and bank ownership indicated no evidence of statistically significant differences in how green financing interacts with banks' financial performance, implying that all banks would benefit from engaging in green financing activities regardless of their size or type of ownership. The meta-analysis results confirm the positive and significant relationship between green financing and banks financial performance the overall effect is weak indicating that the extent to which green financing translates to financial benefits depends on how the banks aligns their green financing strategies with the social cultural, economic, and local context realities.

In conclusion, the study singles out several new scientific insights. First, green awareness activities, green banking activities and climate risk management all influence positive financial performance either independently or collectively. Secondly, green awareness initiatives have a weak correlation

with financial performance and should be combined with green banking and climate risk management strategies to translate to financial benefits. Thirdly, while some strategies might result in short-term, immediate financial benefits, the major financial implications are long-term in nature and affect the bank's financial performance either directly or indirectly. Fourthly, while green financial initiatives positively and significantly result in financial benefits, they do not guarantee the banks ultimate immunity from climate shocks. Lastly, all banks can benefit from engaging in green financing initiatives regardless of their bank sizes or type of ownership, but the banks must localize their green initiatives to the local contexts, economic and social cultural market realities.

8. REFERENCES

1. ABURUMMAN, O.J., OMAR, K., AL SHBAIL, M., and ALDOGHAN, M., (2023). How to Deal with the Results of PLS-SEM? *Lecture Notes in Networks and Systems*, **495 LNNS**, pp.1196–1206, [Available from: DOI:10.1007/978-3-031-08954-1_101].
2. AFTHANORHAN, A., (2020). General discussion on small sample size in consistent PLS. *Advances in Mathematics: Scientific Journal*, **9**(3), pp.1053–1060, [Available from: DOI:10.37418/amsj.9.3.30].
3. AHMED, R.R., STREIMIKIENE, D., STREIMIKIS, J., and SIKSNELYTE-BUTKIENE, I., (2024). A comparative analysis of multivariate approaches for data analysis in management sciences. *E a M: Ekonomie a Management*, **27**(1), pp.192–210, [Available from: DOI:10.15240/tul/001/2024-5-001].
4. AIJAZ, A., ANWAR, N.F., and QASIM, M., (2025). *Islamic Green Finance Risk Assessment and Mitigation for Banks in Pakistan*. *Islamic Finance and Sustainability: A Research Companion*pp.293–314.
5. AL-KUBAISI, M.K. and KHALAF, B.A., (2023). DOES GREEN BANKING AFFECT BANKS' PROFITABILITY? *Journal of Governance and Regulation*, **12**(4), pp.157–164, [Available from: DOI:10.22495/jgrv12i4art15].
6. ANJALIDEVI, S., SREEDEVI, R.S., HARIKRISHNAN, R., and SHIVDAS, A., (2024). Green Banking Awareness: A Study on Tier 3 Locations—With Special Reference to Kerala. *Lecture Notes in Networks and Systems*, **997 LNNS**, pp.581–597, [Available from: DOI:10.1007/978-981-97-3242-5_39].
7. ASLAM, W. and JAWAID, S.T., (2023). Green banking adoption practices: improving environmental, financial, and operational performance. *International Journal of Ethics and Systems*, **39**(4), pp.820–840, [Available from: DOI:10.1108/IJOES-06-2022-0125].
8. BAO, J. and HE, M., (2022). Does green credit promote green sustainable development in regional economies?—Empirical evidence from 280 cities in China. *PLoS ONE*, **17**(11 November), [Available from: DOI:10.1371/journal.pone.0277569].
9. BHUIYAN, M.A., RAHMAN, M.K., PATWARY, A.K., AKTER, R., ZHANG, Q., and FENG, X., (2024). Fintech Adoption and Environmental Performance in Banks: Exploring Employee Efficiency and Green Initiatives. *IEEE Transactions on Engineering Management*, **71**, pp.11346–11360, [Available from: DOI:10.1109/TEM.2024.3415774].
10. BYON, K.K. and JANG, W.W., (2024). *Partial least squares sem*. *Encyclopedia of Sport Management, Second Edition*pp.702–704.
11. CHALABI-JABADO, F. and ZIANE, Y., (2024). Climate risks, financial performance and lending growth: Evidence from the banking industry. *Technological Forecasting and Social Change*, **209**, [Available from: DOI:10.1016/j.techfore.2024.123757].
12. CHANDRAN, S.M.C., SEBASTIAN, G., and KUMAR, V.K. Are the customers aware of green banking and green banking products? An empirical study.
13. CHEAH, J.-H., MAGNO, F., and CASSIA, F., (2024). Reviewing the SmartPLS 4 software: the latest features and enhancements. *Journal of Marketing Analytics*, **12**(1), pp.97–107, [Available from: DOI:10.1057/s41270-023-00266-y].
14. CHEN, J., SIDDIK, A.B., ZHENG, G.-W., MASUKUJJAMAN, M., and BEKHZOD, S., (2022a). The Effect of Green Banking Practices on Banks' Environmental Performance and Green Financing: An Empirical Study. *Energies*, **15**(4), p.1292, [Available from: DOI:10.3390/en15041292].
15. CHEN, Z., MIRZA, N., HUANG, L., and UMAR, M., (2022b). Green Banking—Can Financial Institutions support green recovery? *Economic Analysis and Policy*, **75**, pp.389–395, [Available from: DOI:10.1016/j.eap.2022.05.017].

16. CHENG, C.-L., SHALABH, and GARG, G., (2014). Coefficient of determination for multiple measurement error models. *Journal of Multivariate Analysis*, **126**, pp.137–152, [Available from: DOI:10.1016/j.jmva.2014.01.006].
17. CHIN, W., CHEAH, J.-H., LIU, Y., TING, H., LIM, X.-J., and CHAM, T.H., (2020). Demystifying the role of causal-predictive modeling using partial least squares structural equation modeling in information systems research. *Industrial Management and Data Systems*, **120**(12), pp.2161–2209, [Available from: DOI:10.1108/IMDS-10-2019-0529].
18. COCHRAN, W.G. and COCHRAN, W.G., (1977). *Sampling techniques*. 3. ed. New York, NY: Wiley.
19. CONLON, T., DING, R., HUAN, X., and ZHANG, Z., (2024). Climate risk and financial stability: evidence from syndicated lending. *European Journal of Finance*, **30**(17), pp.2001–2031, [Available from: DOI:10.1080/1351847X.2024.2343111].
20. COOKSEY, R.W., (2020). Descriptive Statistics for Summarising Data. *Illustrating Statistical Procedures: Finding Meaning in Quantitative Data*, pp.61–139, [Available from: DOI:10.1007/978-981-15-2537-7_5].
21. CUCINELLI, D., NIERI, L., and PISERÀ, S., (2024). Climate and Environment Risks and Opportunities in the Banking Industry: The Role of Risk Management. *International Journal of Finance and Economics*, [Available from: DOI:10.1002/ijfe.3083].
22. DE VILLIERS, C., JIA, J., and LI, Z., (2022). Corporate social responsibility: A review of empirical research using Thomson Reuters Asset4 data. *Accounting & Finance*, **62**(4), pp.4523–4568, [Available from: DOI:10.1111/acfi.13004].
23. DIRGIATMO, Y., (2023). Testing the Discriminant Validity and Heterotrait-monotrait Ratio of Correlation (HTMT): A case in Indonesian SMEs. *International Symposia in Economic Theory and Econometrics*, **33A**, pp.157–170, [Available from: DOI:10.1108/S1571-03862023000033A011].
24. EL-AMMARI, A., EL MALKI, H., MOUTAWAKKIL, S.G., EL HILALY, J., EL HOUARI, F., EL GNAOUI, S., RAGALA, M.E.A., EL RHAZI, K., and ZARROUQ, B., (2023). Validation of the Center for Epidemiologic Studies Depression Scale (CES-D) in a Moroccan sample with substance use disorder. *BMC Psychiatry*, **23**(1), [Available from: DOI:10.1186/s12888-023-05245-2].
25. FAN, Q. and GAO, W., (2024). Climate risk and financial stability: The mediating effect of green credit. *Finance Research Letters*, **65**, [Available from: DOI:10.1016/j.frl.2024.105558].
26. FAN, W., WANG, F., ZHANG, H., LING, R., and JIANG, H., (2024). Heterogeneous Responses of Commercial Banks to Various Climate Risks: Evidence from 42 A-Share Listed Banks in China. *Climate Change Economics*, **15**(4), [Available from: DOI:10.1142/S2010007824500064].
27. FERDIN, A.E.J., CHANDRA ARYAL, U., DHUNGANA, N., RAM LAMICHHANE, B., WEI CHOOK, J., and LEE, C.-H., (2024). Prioritizing human-wildlife conflict management strategies through importance-performance analysis: Insights from Chitwan National Park, Nepal. *Journal for Nature Conservation*, **81**, [Available from: DOI:10.1016/j.jnc.2024.126675].
28. GALÁN, J.E. and TAN, Y., (2024). Green light for green credit? Evidence from its impact on bank efficiency. *International Journal of Finance and Economics*, **29**(1), pp.531–550, [Available from: DOI:10.1002/ijfe.2697].
29. HAIR, J. and ALAMER, A., (2022). Partial Least Squares Structural Equation Modeling (PLS-SEM) in second language and education research: Guidelines using an applied example. *Research Methods in Applied Linguistics*, **1**(3), [Available from: DOI:10.1016/j.rmal.2022.100027].

30. HAIR, J.F., RISHER, J.J., SARSTEDT, M., and RINGLE, C.M., (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, **31**(1), pp.2–24, [Available from: DOI:10.1108/EBR-11-2018-0203].
31. HISHAMUDDIN, M.R.A., BUJANG, I., RIMIN, F., and KEBAHYANG, I.F.M., (2024). A Beacon of Climate Change and Green Financing Toward Bank Stability Among Tiger Cub Economics. *ASEAN Journal on Science and Technology for Development*, **41**(2), pp.185–190, [Available from: DOI:10.61931/2224-9028.1581].
32. HUANG, F.L., (2018). Using Cluster Bootstrapping to Analyze Nested Data With a Few Clusters. *Educational and Psychological Measurement*, **78**(2), pp.297–318, [Available from: DOI:10.1177/0013164416678980].
33. HUANG, S. and LUAN, Z., (2024). Can green finance supports improve environmental firm performance? Evidence from listed environmental firms in China. *Finance Research Letters*, **70**, [Available from: DOI:10.1016/j.frl.2024.106321].
34. INTIMAYTA-ESCALANTE, C., PLASENCIA-DUEÑAS, R., NUÑEZ-LUPACA, J.N., FLORES-LOVON, K., RAMIREZ-BERNUY, N., PARES-BALLASCO, G., BARRIENTOS-ODIAS, N., and CASTILLO-BLANCO, R., (2025). Adaptation, validation, and factorial invariance of a scale to assess the quality of virtual courses developed for Peruvian health sciences students during the COVID-19 pandemic. *Educacion Medica*, **26**(3), [Available from: DOI:10.1016/j.edumed.2024.101008].
35. JAIN, P. and SHARMA, B.K., (2023). Impact of Green Banking Practices on Sustainable Environmental Performance and Profitability of Private Sector Banks. *International Journal of Social Ecology and Sustainable Development*, **14**(1), pp.1–19, [Available from: DOI:10.4018/IJSESD.330135].
36. JULIA, T. and KASSIM, S., (2016). Green financing and bank profitability: Empirical evidence from the banking sector in Bangladesh. *Al-Shajarah*, **21**(Specialissue), pp.307–330.
37. KHAN, I.U., HAMEED, Z., KHAN, S.U., and KHAN, M.A., (2024). Green banking practices, bank reputation, and environmental awareness: evidence from Islamic banks in a developing economy. *Environment, Development and Sustainability*, **26**(6), pp.16073–16093, [Available from: DOI:10.1007/s10668-023-03288-9].
38. KONO, S. and SATO, M., (2023). The potentials of partial least squares structural equation modeling (PLS-SEM) in leisure research. *Journal of Leisure Research*, **54**(3), pp.309–329, [Available from: DOI:10.1080/00222216.2022.2066492].
39. LI, S., NGNIATEDEMA, T., and CHEN, F., (2017). Understanding the Impact of Green Initiatives and Green Performance on Financial Performance in the US. *Business Strategy and the Environment*, **26**(6), pp.776–790, [Available from: DOI:10.1002/bse.1948].
40. LI, S. and WANG, Q., (2023). Green finance policy and digital transformation of heavily polluting firms: Evidence from China. *Finance Research Letters*, **55**, [Available from: DOI:10.1016/j.frl.2023.103876].
41. LO, L., (2019). *Sampling*. *International Encyclopedia of Human Geography, Second Edition*pp.67–77.
42. LONG, N.L.H. and VIET-ANH, H., (2021). Determinants of perceived organizational support: An empirical study of administrative staff at public hospitals in viet nam. *Journal of Public Health and Development*, **19**(1), pp.186–196.
43. MANDAGIE, Y.R.O., HATTA, I.H., WAHYOENI, S.I., and AHMAR, N., (2025). Development of a Green Banking And Green Financing Practice Model for Enhancing Sustainability Development Goals (SDGs). *Journal of Lifestyle and SDG's Review*, **5**(1), [Available from: DOI:10.47172/2965-730X.SDGsReview.v5.n01.pe02775].

44. MCNEISH, D., AN, J., and HANCOCK, G.R., (2018). The Thorny Relation Between Measurement Quality and Fit Index Cutoffs in Latent Variable Models. *Journal of Personality Assessment*, **100**(1), pp.43–52, [Available from: DOI:10.1080/00223891.2017.1281286].
45. MOHAN, R.S. and MUHAMMAD, A.M., (2024). Impact of green financial funding on improving the financial efficiency of a sample of companies listed on the iraq stock exchange. *Edelweiss Applied Science and Technology*, **8**(5), pp.498–508, [Available from: DOI:10.55214/25768484.v8i5.1712].
46. MONDAL, S. and SAHU, T.N., (2023). Do green initiatives and green performance affect firm performance? Empirical evidence from India. *Asian Journal of Business Ethics*, **12**(2), pp.305–321, [Available from: DOI:10.1007/s13520-023-00175-4].
47. NARAYANAN, S. and PRADHAN, S.K., (2024). Exploring the research landscape of socially responsible investment through bibliometrics. *Multidisciplinary Reviews*, **7**(1), [Available from: DOI:10.31893/multirev.2024022].
48. O'BRIEN, R.M., (2007). A caution regarding rules of thumb for variance inflation factors. *Quality and Quantity*, **41**(5), pp.673–690, [Available from: DOI:10.1007/s11135-006-9018-6].
49. PAULET, E., PARNAUDEAU, M., and RELANO, F., (2015). Banking with Ethics: Strategic Moves and Structural Changes of the Banking Industry in the Aftermath of the Subprime Mortgage Crisis. *Journal of Business Ethics*, **131**(1), pp.199–207, [Available from: DOI:10.1007/s10551-014-2274-9].
50. PAVLOV, G., MAYDEU-OLIVARES, A., and SHI, D., (2021). Using the Standardized Root Mean Squared Residual (SRMR) to Assess Exact Fit in Structural Equation Models. *Educational and Psychological Measurement*, **81**(1), pp.110–130, [Available from: DOI:10.1177/0013164420926231].
51. PETTER, S. and HADAVI, Y., (2021). With Great Power Comes Great Responsibility. *Data Base for Advances in Information Systems*, **52**(SI), pp.10–23, [Available from: DOI:10.1145/3505639.3505643].
52. PUTRI, P.I., RAHAYU K, N., RAHMAYANI, D., and SIREGAR, M.E.S., (2022). The Effect of Green Banking and Financial Performance on Banking Profitability. *Quality - Access to Success*, **23**(191), pp.38–45, [Available from: DOI:10.47750/QAS/23.191.05].
53. QIAN, S. and YU, W., (2024). Green finance and environmental, social, and governance performance. *International Review of Economics and Finance*, **89**, pp.1185–1202, [Available from: DOI:10.1016/j.iref.2023.08.017].
54. RAHMAN, M.H., RAHMAN, J., TANCHANGYA, T., and ESQUIVIAS, M.A., (2023). Green banking initiatives and sustainability: A comparative analysis between Bangladesh and India. *Research in Globalization*, **7**, [Available from: DOI:10.1016/j.resglo.2023.100184].
55. RASOOLIMANESH, S.M., NOOR, S.M., and JAAFAR, M., (2019). Positive and Negative Perceptions of Residents Toward Tourism Development: Formative or Reflective. *Perspectives on Asian Tourism*, **Part F184**, pp.247–271, [Available from: DOI:10.1007/978-981-13-2463-5_12].
56. RHAYHA, R. and ALAOUI ISMAILI, A., (2024). Development and validation of an instrument to evaluate the perspective of using the electronic health record in a hospital setting. *BMC Medical Informatics and Decision Making*, **24**(1), [Available from: DOI:10.1186/s12911-024-02675-0].
57. RINGLE, C.M. and SARSTEDT, M., (2016). Gain more insight from your PLS-SEM results the importance-performance map analysis. *Industrial Management and Data Systems*, **116**(9), pp.1865–1886, [Available from: DOI:10.1108/IMDS-10-2015-0449].

58. ROEMER, E., SCHUBERTH, F., and HENSELER, J., (2021). HTMT2–an improved criterion for assessing discriminant validity in structural equation modeling. *Industrial Management and Data Systems*, **121**(12), pp.2637–2650, [Available from: DOI:10.1108/IMDS-02-2021-0082].
59. SHARIF-NIA, H., FROELICHER, E.S., SHAFIGHI, A.H., OSBORNE, J.W., FATEHI, R., NOWROZI, P., and MOHAMMADI, B., (2024). The persian version of the fear-avoidance beliefs questionnaire among iranian post-surgery patients: a translation and psychometrics. *BMC Psychology*, **12**(1), [Available from: DOI:10.1186/s40359-024-01884-6].
60. SHARMA, R., VASISHTA, P., and SINGLA, A., (2025). Impact of green banking awareness on green FinTech adoption: a way towards profitable and sustainable practices. *Managerial Finance*, **51**(3), pp.377–394, [Available from: DOI:10.1108/MF-04-2024-0272].
61. SINGH, R.P., NAGDEV, K., and KISHOR, N., (2022). Do green banking initiatives lead to competitiveness and improved financial performance? An empirical analysis of Indian banks. *International Journal of Public Sector Performance Management*, **10**(1), pp.22–40, [Available from: DOI:10.1504/IJPSPM.2022.124115].
62. SISWANTI, I., RIYADH, H.A., CAHAYA, Y.F., PROWANTA, E., and BESHR, B.A.H., (2024). Unlocking sustainability: exploring the nexus of green banking, digital transformation, and financial performance with foreign ownership moderation. *Discover Sustainability*, **5**(1), [Available from: DOI:10.1007/s43621-024-00597-5].
63. STAUROPOULOU, A., SARDIANOU, E., MALINDRETOS, G., EVANGELINOS, K., and NIKOLAOU, I., (2023). The role of customers' awareness towards the sustainable development goals (SDGs) of banks on their behavior. *Environmental Science and Pollution Research*, **30**(5), pp.13495–13507, [Available from: DOI:10.1007/s11356-022-23111-8].
64. STREUKENS, S. and WERELDS, S.L.-, (2024). Bootstrapping and PLS-SEM: A step-by-step guide to get more out of your bootstrap results | Request PDF. *ResearchGate*, [Available from: DOI:10.1016/j.emj.2016.06.003].
65. THOMPSON, P. and COWTON, C.J., (2004). Bringing the environment into bank lending: implications for environmental reporting. *The British Accounting Review*, **36**(2), pp.197–218, [Available from: DOI:10.1016/j.bar.2003.11.005].
66. VALENCIA, D.C. and CALABUIG-TORMO, C., (2023). The Impact of Green Banking Activities on Banks' Green Financing and Environmental Performance. *Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration*, **31**(1), [Available from: DOI:10.46585/sp31011681].
67. VAN RHEE, H., SUURMOND, R., and HAK, T., (2015). User Manual for Meta-Essentials: Workbooks for Meta-Analysis. *Erasmus Research Institute of Management*, [Available from: DOI:10.2139/ssrn.3241355].
68. WOLF, E., HARRINGTON, K., SHAUNN, C., and MILLER, M.W., (2024). Sample Size Requirements for Structural Equation Models: An Evaluation of Power, Bias, and Solution Propriety | Request PDF. *ResearchGate*, [Available from: DOI:10.1177/0013164413495237].
69. WU, B., WEN, F., WEN, F., ZHANG, Y., and HUANG, Z.J., (2024). Climate risk and the systemic risk of banks: A global perspective. *Journal of International Financial Markets, Institutions and Money*, **95**, [Available from: DOI:10.1016/j.intfin.2024.102030].
70. YAMEEN, J., KIJKASIWAT, P., and HUSSAIN, A., (2024). (PDF) Green finance in banking industry: a systematic literature review. *ResearchGate*, [Available from: DOI:10.1007/s43546-024-00683-w].
71. YANG, C., LIU, M., and LIU, R., (2024). Does financial liberalization promote corporate environmental performance? Evidence from foreign banks' entry into China. *Economic Change and Restructuring*, **57**(3), [Available from: DOI:10.1007/s10644-024-09683-0].

72. YE, X. and TIAN, X., (2025). Green finance and ESG performance: A quasi-natural experiment on the influence of green financing pilot zones. *Research in International Business and Finance*, **73**, [Available from: DOI:10.1016/j.ribaf.2024.102647].
73. YU, B., LIU, L., and CHEN, H., (2023). Can green finance improve the financial performance of green enterprises in China? *International Review of Economics and Finance*, **88**, pp.1287–1300, [Available from: DOI:10.1016/j.iref.2023.07.060].
74. ZHANG, X., WANG, Z., ZHONG, X., YANG, S., and SIDDIK, A.B., (2022). Do Green Banking Activities Improve the Banks' Environmental Performance? The Mediating Effect of Green Financing. *Sustainability (Switzerland)*, **14**(2), [Available from: DOI:10.3390/su14020989].
75. ZHOU, Z., TONG, J., LU, H., and LUO, S., (2024). The impact of green finance and technology on the commercial banks' profit and risk. *Finance Research Letters*, **66**, [Available from: DOI:10.1016/j.frl.2024.105715].

9. PUBLICATION LIST (in the MTMT)

1. **MUCHIRI, MARTIN KAMAU** ; ERDEI-GALLY, SZILVIA ; FEKETE-FARKAS, MÁRIA: Nexus Between Green Financing and Carbon Emissions: Does Increased Environmental Expenditure Enhance the Effectiveness of Green Finance in Reducing Carbon Emissions? JOURNAL OF RISK AND FINANCIAL MANAGEMENT 18: 2 Paper: 90, 22 p. (2025).
2. **MUCHIRI, MARTIN KAMAU** ✉ ; ERDEI-GALLY, SZILVIA KESMARKI ; FEKETE-FARKAS, MARIA: Green Banking Practices, Opportunities, and Challenges for Banks: A Systematic Review. CLIMATE 13 : 5 Paper: 102 , 16 p. (2025)
3. **MUCHIRI, MARTIN KAMAU** ✉ ; FEKETE-FARKAS, MÁRIA ; ERDEI-GALLY, SZILVIA ✉: How Do Green Banking Practices Impact Banks' Profitability? A Meta-Analysis. JOURNAL OF RISK AND FINANCIAL MANAGEMENT 18 : 6 Paper: 320 , 15 p. (2025)
4. **MUCHIRI, MARTIN KAMAU** ; ERDEI-GALLY, SZILVIA ✉ ; FEKETE-FARKAS, MÁRIA ✉: Effect of CSR on the Financial Performance of Financial Institutions in Kenya. ECONOMIES 10 : 7 p. 1 Paper: 174 , 24 p. (2022).
5. **MUCHIRI, MARTIN KAMAU** ; ERDEI-GALLY, SZILVIA ; FEKETE-FARKAS, MÁRIA ; LAKNER, ZOLTÁN: Bibliometric Analysis of Green Finance and Climate Change in Post-Paris Agreement Era. JOURNAL OF RISK AND FINANCIAL MANAGEMENT 15 : 12 Paper: 561 (2022).
6. **MARTIN, KAMAU MUCHIRI** ; RÓBERT, MAGDA: IS GROSS DOMESTIC GROWTH A CAUSE OR A SOLUTION FOR ENVIRONMENTAL DEGRADATION? In: Miroslav, RUSKO; Peter, ANDRÁŠ; Ružena, KRÁLIKOVÁ Recenzovany zborník zo VI. medzinárodnej vedeckej konferencie (2021) pp. 120-128. , 9 p.
7. **MARTIN, KAMAU MUCHIRI** ; ROBERT, GITAU MUIGAI: Effect of Environmental CSR Activities on the Financial Performance of Financial Institutions in Kirinyaga County. RESEARCH JOURNAL OF FINANCE AND ACCOUNTING 10 : 5 pp. 78-87. , 10 p. (2019)