Volume 23
Number 2
Summer 2025

ISSN 1854-6935

Managing Global Transitions International Research Journal

EDITOR IN CHIEF
Jana Hojnik

Managing Global Transitions
International Research Journal
ISSN 1854-6935 · www.mgt.fm-kp.si

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Managing Global Transitions
International Research Journal
VOLUME 23 · NUMBER 2 · SUMMER 2025 · ISSN 1854-6935

https://doi.org/10.26493/1854-6935.23_2

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INDEXING AND ABSTRACTING

Managing Global Transitions is indexed/ listed in the International Bibliography of the Social Sciences, EconLit, IBZ Online, DOAJ, Erih Plus, EconPapers, Cabell's, EBSCO, and ProQuest.

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PUBLISHED BY

University of Primorska Press
Titov trg 4, 6000 Koper, Slovenia
zalozba@upr.si · www.hippocampus.si

Revija Managing Global Transitions je namenjena mednarodni znanstveni javnosti; izhaja v angleščini s povzetki v slovenščini. Izid revije je finančno podprla Javna agencija za znanstvenoraziskovalno in inovacijsko dejavnost Republike Slovenije iz sredstev državnega proračuna iz naslova razpisa za sofinanciranje izdajanja domačih znanstvenih periodičnih publikacij.

The Impact of Demographic Dynamics on Household Saving in Pre-COVID-19 South Africa

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This paper examines the effect of demographic dynamics on household saving in pre-COVID-19 South Africa, across all nine provinces of South Africa. The study used panel autoregressive distributed lag (PARDL) and Dumitrescu-Hurlin panel causality methods. The results revealed a long-run relationship between demographic dynamics and household saving in South Africa, showing that the White working age population had a significant effect on South Africa's household saving in both the long-run and short-run, while the Black and Coloured working age population groups significantly impacted household saving only in the long-run. However, the Asian/Indian working age population had no effect on household saving in either the long run or short run. The Dumitrescu-Hurlin panel causality analysis revealed a bidirectional causality running between Asian/Indian, Black, and Coloured population groups and household saving, while a unidirectional causality was found running from the White population group to household saving.

Keywords: demographics, working age population, aged/elderly population, life-cycle hypothesis, household saving, panel ARDL, Dumitrescu-Hurlin panel causality
JEL *Classification:* J1; E2; C0

Received 2024/09/01 · Revised 2024/11/12 · Accepted 2024/01/16

Published online 2025/06/30 https://doi.org/10.26493/1854-6935.23.121-146

Introduction

The debate on the relationship between demographics and household saving seems to be a perennial one among different economic schools of thought. The discourse on population age structure and household saving has been mainly based on the Modigliani and Ando (1963) life-cycle hypothesis. This hypothesis classifies the life cycle into three stages (structures): pre-reproductive (young dependent), reproductive (working age) and post reproductive (old dependent). These structures of the population are found to be crucial among the various factors that play significant roles in explaining savings (Keho 2012). Many factors impact a country's household saving behaviour, of which the demographic dynamics of a country are among the notable factors that can impact a country's household saving decisions as well as its rates (Modigliani and Ando 1963; Attanasio and Banks 2001). The life-cycle model indicates that a country's changing population age structure plays a role in informing the country's household saving behaviour (Modigliani and Ando 1963). It links the age of individuals to their savings and consumption. The model postulates that individuals seek to maximise their utility through a consumption profile, across their stages of life, that is in harmony with their lifetime earnings.

As population age structure informs the household's consumption-saving decisions, changes in population age structure that adversely impact household saving may have the potential to perpetuate low growth levels, given the role that savings play in the economy (Aron and Muellbauer 2000; Imoughele and Ismaila 2014). In view of this, population age structure can be seen as one of the channels through which demographics affects household saving in a country (Albuquerque and Ferreira 2015; Nagarajan et al. 2016). Conventionally, the a priori expectations based on the life-cycle model are that the young population does not save, and the working population saves, while the aged/elderly population dissaves. These a priori expectations and the emphasis that household saving behaviour is a function of age supports the hump-shaped pattern that the life-cycle hypothesis proposes.

There are numerous studies on the population age structure and household saving relationship. Many of the previous studies are in support of the life-cycle hypothesis, but a few are in disagreement with the life-cycle proposition. Household savings is one of the components of domestic savings and it is essential for investment and long-term eco-

nomic growth. Increased household savings helps to improve domestic savings and therefore reduces a country's need to borrow in the international capital markets, thereby helping to avoid the volatility associated with cross-border borrowing (Stals 1995; Asia-Pacific Economic Cooperation 2002; Touny 2008). A high saving ratio to gross domestic product can be viewed as a good economic indicator by foreign investors when assessing a country's economic performance (Mikesell and Zinser 1973).

Although there are numerous studies on the population age structure and saving relationship nationally and globally, none (to the best of our knowledge) has empirically investigated this relationship with population age structure (working age population) disaggregated into four racial groups and according to provinces. Thus, unlike the previous studies, and given South Africa's unique population groupings, this study will focus on the effect of the working age population, disaggregated into the four main racial groups (Asian/Indian, Black, Coloured, and White) and nine provinces, on household saving in South Africa for the period 1995 to 2019.

The remainder of this study is organised as follows. The second section discusses the literature. The third section discusses methodology. The fourth section presents the empirical results, and finally, the conclusions and recommendations of the study are presented in the fifth section.

Literature Review

THEORETICAL REVIEW

Economic theory emphasises the significant role that saving plays in the economy, suggesting that low saving rates constrain investment, which negatively impacts on economic growth (Mongale et al. 2018). Like many contemporary studies, this study is based on the saving theory, which is influenced by these two notable saving hypotheses: Friedman's (1957) Permanent Income Hypothesis (PIH) and Modigliani and Ando's (1963) Life-Cycle Hypothesis (LCH). The PIH follows the pioneering work of Keynes (1936), which defines saving as a linear function of income (Muradoglu and Taskin 1996). The combination of these two hypotheses informs the analysis of the modern theory on consumption and saving behaviour (Simleit et al. 2011).

However, the point of deviation between the LCH and PIH hypotheses is that Friedman's Permanent Income Hypothesis views savings as the outcome of transitory income, which is the difference between current income and permanent income (Ting and Kollamparambil 2015). Fried-

man's hypothesis affirms that transitory incomes, short-term changes in income, have little or no effect on households' spending behaviour, and that such changes contribute to household saving in that period, whereas the Modigliani and Ando Life-Cycle Hypothesis emphasises household saving as the outcome of intertemporal utility-maximisation by the rational household.

The life-cycle model predicts that individuals smooth consumption across all stages of life. The model predicts borrowing prior to labour market entry, wealth accumulation during the working life, and dissaving in retirement (Modigliani and Ando 1963). In view of this, households smooth their consumption over their life cycle given that household saving in each period is household consumption postponed in that given period. This summarises the essence of the Modigliani and Ando (1963) life-cycle approach. The life-cycle model is the model most referred to in the study of household saving (Ozcan et al. 2003:6). The proponents of the life-cycle model, which sees saving to smooth out consumption due to income fluctuations, recognise demographics as one of the forces that influence household consumption-savings decisions (Modigliani and Ando 1963; Attanasio and Banks 2001).

The conventional view is that demographic changes inform household saving. The working population group positively impacts household saving while young and elderly population groups negatively affect households' saving rates (Leff 1969; Muradoglu and Taskin 1996; Athukorala and Tsai 2003). As the composition of population age structures of a household changes, the household's consumption-saving decision will also be affected as the household adjusts to accommodate such changes in demographics (Bloom et al. 2001; Albuquerque and Ferreira 2015). Such changes in socio-demographic factors can exert a ripple effect in the economy, which can influence the pattern and composition of household saving that may have the potential to influence the performance of the economy (Okere and Ndugbu 2015).

The age structure of a country's population influences the saving rate of the country; therefore, households that consist mainly of the young and the elderly will have a low saving rate. This is because there is much dissaving among youths and young adults who are working, as well as in the early stages of establishing a family (Ahmad 2002; Navaneetham and Dharmalingam 2012). For instance, Modigliani and Ando's (1963) life-cycle model predicts that household saving behaviour is a function of age, and an individual borrows when young, saves as middle-aged and

dissaves when old, which supports the hump-shaped pattern that the life-cycle hypothesis proposes.

In contrast, Hock and Weil (2012) argue that population ageing will be neutral on the saving pattern of the household given that a rise in the elderly share of the population, resulting in a decrease in the supply of labour, will lead to a rise in the wage rates as well as saving rates of the working population. This rise in saving of the working population will absorb the dissaving on the part of the elderly population. Nonetheless, empirical results partially support Leff's (1969) findings that the dependency burden has negative and significant effects on the saving ratio for both developed and underdeveloped countries (Doshi 1994:3).

EMPIRICAL LITERATURE

There are numerous studies on the population age structure and household saving relationship, both nationally and globally. Results of some of the empirical studies on the population age structure and household saving nexus provide strong evidence in support of the life-cycle hypothesis (Athukorala and Tsai 2003; Yang and Zhang 2013; Zwane et al. 2016; Hanif et al. 2022; among others), while some of the empirical investigations are not totally in agreement with the life-cycle model (Hock and Weil 2012; Hyung 2013; Nduku and Simo-Kengne 2018; Huizheng 2020; among others).

Loayza et al. (2000) observe that age-related consumer heterogeneity seems to be the cornerstone of the life-cycle hypothesis, which predicts that saving follows a hump-shaped pattern (that is, high at middle age and low at young and old age). The study finds that young and old dependency ratios have a significantly negative impact on the private saving rate. The negative coefficients of the dependency ratios are consistent with the standard life-cycle model of consumption-saving. However, a study by Kraay (2000) is not in harmony with the findings by Loayza et al. (2000). Kraay (2000) finds that the dependency ratio has no significant impact on the household saving rates. This is supported by Athukorala and Tsai (2003)

In like manner, Ozcan et al. (2003) investigate the effects of several policy and non-policy variables on private saving in Turkey covering the period 1968–1994. The results show mixed support for the life-cycle hypothesis. However, the coefficient of the life expectancy rate is negative and statistically significant in all estimations and for every sample. This is in line with the predictions of the life cycle and precautionary saving models.

Horioka and Wan (2007) conducted a dynamic panel analysis of the determinants of the household saving rate in China using a life-cycle model and panel data on Chinese provinces for the period 1995–2004 from China's household survey. This study provides a mixed support for the life-cycle hypothesis as well as the permanent income hypothesis. The study finds that population aging has significant impact on savings for the rural sample but has insignificant effect on savings for the urban sample and overall sample of the study. This is supported by Horioka and Terada-Hagiwara (2010). It is also supported by Yang and Zhang (2013).

Hyung (2013) examines the relationship between the old-age dependency ratio and domestic saving rates using a data set of 15 high income countries for the period 1975–2010 and found that the old-age dependency ratio has no significant effect on the domestic saving rates. Ahmad's (2015) identifies the dependency ratio as one of the variables that significantly impact the private savings rate in Pakistan. This in in line with Zhang et al. (2016). Cruz and Ahmed (2016) find a positive association on the interaction between changes in the share of the working age population and saving.

Curtis et al. (2017) find that age distributions vital in the explanation of the conflicting patterns of household saving in the three countries. The model simulations also reveal that the growing number of retirees adversely impacts Japanese saving rates, whereas decreasing family size increases saving for both China and India. Ha and Hoa (2018) show evidence of a unidirectional causality running from demographics to domestic savings in Vietnam.

Pascual-Saez et al. (2020) examine the effect of population ageing on private savings on a sample of selected European countries over the period 1990–2013. The study reveals that the old-age dependency variable has a significant but negative effect on savings. However, Huizheng (2020) finds that the old-age variable has significant effect on the savings rate of OECD countries, while the effect of old-age dependency ratios on savings is insignificant in BRICS countries.

Hanif et al. (2022) reveal that a rise in the ratio of the working age population has a positive effect on domestic savings in 45 countries. This is supported by Jain and Goli (2022), and it is consistent with the economic life-cycle hypothesis.

In the context of South Africa, many studies have been conducted to assess the life-cycle hypothesis of saving (Prinsloo 2000; Esson 2003; Odhiambo 2007; Du Plessis 2008; Chipote and Tsegaye 2014; Sithebe

2014; Zwane et al. 2016; Nduku and Simo-Kengne 2018; Tshabalala 2018; among others) and to ascertain the contributions of demographic variables in informing household saving decisions. Prinsloo (2000) observes that a country's household saving is influenced by the age distribution of the country. Thus, the life-cycle model of saving behaviour indicates dissaving among young adults engaged in education and in the early stages of establishing a family, saving among older working adults and dissaving among retired people. Esson (2003) shows that personal income and demographic variables play significant roles in influencing household saving decisions.

Odhiambo (2007) found that that gross domestic savings is positively related to the growth rate of real GDP, as postulated by the life-cycle hypothesis. This is supported by Du Plessis (2008). In line with the Odhiambo (2007) approach, Chipote and Tsegaye (2014) show that the level of income and household saving are negatively related, while the age-dependency ratio and household saving are positively related.

However, Sithebe (2014) reveals that youth dependency negatively impacts household saving while elderly dependency has a weak influence on household saving in South Africa. Zwane et al. (2016) also indicate that a larger households' size puts more pressure on its consumption spending, as more of the budget is diverted to consumption spending as opposed to saving, thereby leading to low saving, which is in line with the findings of Akpan et al. (2011) and Nigus (2015).

Nduku and Simo-Kengne (2018) results indicate a positive and significant relationship between saving and the age dependency ratio in South Africa. However, this is not consistent with the finding of Tshabalala (2018) who indicated that dependency ratio and gross domestic saving have an inverse relationship at the national level.

Most of the studies on household saving (such as Athukorala and Tsai 2003; Horioka and Wan 2007; Simleit et al. 2011; Mongale et al. 2013; Chipote and Tsegaye 2014; Zwane et al. 2016; among others) focused mainly on the determinants of household saving but did not disaggregate population age structure and population groups. They also did not capture the effect of the age structure among population groups on household saving at provincial levels

This study identified this lacuna and has undertaken to empirically test how the working age population of these racial groups impacts household saving in South Africa.

Methodology

The discussion of the model and sources of data used in investigating the impact of demographic dynamics (population age structure) on household saving in the context of South Africa are presented in this section.

MODEL SPECIFICATION

This study adopts and modifies Hanif et al.'s (2022) model by disaggregating the working population into the four population groups in South Africa. This is based on the Life-Cycle Hypothesis (LCH) and is expressed as follows:

$$\begin{aligned} HSG_{it} = {} & a_0 + \beta_1 AWP_{it} + \beta_2 BWP_{it} + \beta_3 CWP_{it} \\ & + \beta_4 WWP_{it} + \beta_5 TEP_{it} + \beta_6 INF_{it} \\ & + \beta_7 GDP_{it} + \mu_t, \end{aligned} \tag{1}$$

where HSG is household saving growth rate, AWP is the growth rate of the working population of the Asian/Indian race, BWP is the growth rate of the working population of the Black race, CWP is the growth rate of working population of the Coloured race, and WWP is the growth rate of working population of the White race. TEP is the growth rate of the total elderly population, INF is inflation rate, and GDP is the growth rate of provincial total output (proxy for GDP). While α_0 is the constant term, β_1, β_2, β_3, β_4, β_5, β_6, and β_7 represent the elasticities of household saving growth rate relative to the respective explanatory variables, i is for provinces and t is for year. A priori expectations are as follow:

- Working age population: changes in the share of the working age population of a country are expected to impact the country's household saving in the same direction in line with the life-cycle hypothesis. As a result, the changes in the four racial groups' shares of the working population are expected to impact household saving in the same direction, which is in line with the life-cycle hypothesis. The coefficient of this variable (AWP, BWP, CWP, WWP) is expected to be positive.
- Elderly population (TEP): the share of the elderly (aged) population to the working-age population of a country is expected to have a negative impact on the household saving rate as suggested by theory.
- Inflation (INF): the coefficient of inflation can be negative or positive as there is no consensus on the likely effects of inflation on the

household saving rate. The coefficient of inflation can be negative where periods of high inflation tend to be associated with a high negative real rate of interest, which deters opportunities for saving. On the other hand, the coefficient of inflation can be positive where inflation increases uncertainty, causing people to save more to maintain consistent consumption levels in the future.

- GDP: the anticipated coefficient of total output is positive. As total outcome increases, the Life-Cycle Hypothesis predicts that increase in the growth rate of income per capita will lead to an increase in household saving. The growth in provincial total output will lead to a rise in income, thereby resulting in a rise in the household saving growth rate. Thus, the a priori expectation between household saving and the growth rate of total provincial total output is a positive relationship (Nwachukwu and Egwaikhide 2007).

DATA SOURCES

The study used South African annual panel data on the nine provinces in South Africa and the time period for data usage covers the period 1995–2019. The South African provinces in this study are Eastern Cape, Free State, Gauteng, KwaZulu-Natal, Limpopo, Mpumalanga, North West, Northern Cape, and Western Cape. The data set used in this study, as shown in table 1, is secondarily sourced from the South African Reserve Bank (https://www.resbank.co.za/en/home/what-we-do/statistics), Quantec South Africa (https://www.easydata.co.za), and the World Bank (https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?locations=ZA). Growth rate of household saving (HSG) is the study's dependent variable, and is sourced from Quantec (Easy Data), Pretoria, South Africa. The following are the variables of interest in this study:

- The explanatory variables comprise the components of population age structure, with inflation rate and economic growth as the control variables.

ESTIMATION TECHNIQUE

The current study employs the panel data technique to investigate how changes in population age structure affect household saving behaviour in South Africa. The panel model is considered appropriate for this study in evaluating the quantitative impact of population age structure

TABLE 1 Variables and a Priori Expectations

Variables	Explanation	Expected sign	Source/s
Growth rate of household saving (HSG) is the study's dependent variable	This is the percentage change in household savings. It is the dependent variable	Dependent variable	Quantec EasyData
Working population (WP) of the four race groups (AWP, BWP, CWP, and WWP)	Growth rate of working population (WP): the share of the total population of a country above the age of 15 and below the age of 65 (also referred to as productive population).	Positive (+)	Quantec EasyData
Total elderly population (TEP)	Growth rate of the share of total population of a country aged 65 years and above (also referred to as old dependency)	Negative (−)	Quantec EasyData
Inflation rate (INF)	A rise in the general price level: consumer price index (CPI)	Negative (−) or Positive (+)	World Bank and South African Reserve Bank (South African Reserve Bank 2019)
GDP	Growth rate of provincial output: measured as percentage change in provincial real total output from one period to another. (It is a proxy for real economic growth (Real GDP).)	Positive (+)	Quantec EasyData

NOTE Working population (WP) is disaggregated in four groups; AWP, BWP, CWP and WWP, representing Asian/Indian, Black, Coloured, and White population groups, respectively. Author's compilation (from Quantec EasyData, South Africa, South African Reserve Bank, and World Bank)

on the South African household saving rate. The data is tested for stationarity using Levin, Lin, and Chu (LLC), Im, Pesaran, and Shin (IPS) and Hadri LM tests. It is vital to test for stationarity to avoid the problem of spurious regression, which would be the outcome when one or more non-stationary series are regressed on each other (Gujarati 2004).

The panel autoregressive distributed lag technique (PARDL) model is utilised to estimate the long-run and short-run equations, as well as the

error correction term, which affirms the speed of adjustment from short-run deviation to long-run equilibrium. Panel ARDL corrects the problem of serial autocorrelation simultaneously. The problem of endogeneity is reduced when panel ARDL is utilised with sufficient lags (Pesaran and Smith 1995). The panel ARDL technique is appropriate for this study as it is relatively more efficient given the current study's small sample size of 25 years. The panel ARDL model is ideal for panel analysis as it accounts for cross-sectional dependency (CSD), and applying the ARDL technique enables the study to obtain robust and unbiased long-run estimates. The details of PARDL are not included here due to space limitations but can be obtained from the authors on request.

The study also employs the Dumitrescu-Hurlin panel Granger causality test to assess the presence of Granger causality in these panel data settings. The Dumitrescu-Hurlin panel Granger causality test developed by Dumitrescu and Hurlin (2012) extends traditional Granger causality testing to accommodate the complexities of panel data, which includes multiple cross-sectional units observed over time. The null hypothesis () postulates that *X* does not Granger-cause *Y* for all individuals in the panel. The alternative hypothesis () suggests that *X* Granger-causes *Y* for at least one individual in the panel. This flexibility is crucial as it acknowledges that causality may exist for some units but not others.

Empirical Results

DESCRIPTIVE ANALYSIS

Table 2 presents the descriptive summary of the study variables, which aids in understanding the characteristics of the variables involved in this study. The study used a balanced panel data of 225 observations over 9 provinces in South Africa over the period 1995–2019. The descriptive statistics presented in table 2 show that the average growth rate of household saving is 6.13, with the value ranging from −59.01 to 205.91and with the highest standard deviation of 46.11 across the provinces over the study period, while the total elderly population (TEP) has a mean value of 2.22 ranging from −10.29 to 15.18 and with the lowest standard deviation of 2.20.

CORRELATION ANALYSIS

The correlation matrix for the study variables presented in table 3 shows the absence of multicollinearity among the variables as no two regressors in the matrix have any coefficient that is 0.8 and above. Thus, the

TABLE 2 Descriptive Analysis

Variables	Obs	Mean	Std. Dev.	Max	Min
HSG	225	6.130989	46.11059	205.9064	−59.0132
AWP	225	1.981514	3.466269	19.54239	−13.5057
BWP	225	2.293349	3.120436	19.86516	−13.3487
CWP	225	1.103526	2.556670	14.16989	−10.5881
WWP	225	−1.03826	2.667253	13.34602	−14.2038
TEP	225	2.223374	2.195431	15.18113	−10.2936
INF	225	5.706137	2.263618	10.07458	−0.69203
GDP	225	2.740860	2.412311	11.57068	−3.52281

NOTE Balanced panel data of 225 observations over 9 provinces in the 1995–2019 period Author's computation (data from Quantec EasyData, South Africa, South African Reserve Bank, and World Bank)

TABLE 3 Correlation Matrix of the Study Variables

Probability	HSG	AWP	BWP	CWP	WWP	TEP	INF	GDP
HSG	1							

AWP	0.07988	1						
	0.2327	-----						
BWP	0.11809	0.7910	1					
	0.0771	0.0000	-----					
CWP	0.04438	0.69989	0.60914	1				
	0.5077	0.0000	0.0000	-----				
WWP	−0.1368	0.10662	−0.1383	0.24649	1			
	0.0404	0.1107	0.0382	0.0002	-----			
TEP	0.07987	0.71428	0.79882	0.71414	−0.0475	1		
	0.2327	0.0000	0.0000	0.0000	0.4782	-----		
INF	0.43638	0.07791	0.00251	0.11626	0.1166	−0.0081	1	
	0.0000	0.2444	0.9702	0.0819	0.0810	0.9034	-----	
GDP	−0.1369	0.11147	0.05169	0.12507	0.23498	−0.0959	−0.0766	1
	0.0403	0.0953	0.4404	0.0611	0.0004	0.1517	0.2523	-----

NOTE Author's computation (data from Quantec EasyData, South Africa, South African Reserve Bank, and World Bank)

correlation coefficients in the matrix do not suggest the presence of multicollinearity given that there is no strong linear relationship observed between the study variables.

TABLE 4 Stationarity Test Results

Variables	LLC		Hadri LM		IPS	
	Level	First Difference	Level	First Difference	Level	First Difference
HSG	−8.96809	−10.0667	−1.51490	−0.66919	−7.38331	−10.8942
	(0.000)***	(0.000)***	(0.9351)	(0.7483)	(0.000)***	(0.000)***
AWP	−2.00208	−3.28465	2.11351	0.11966	−5.50682	−7.85521
	(0.0226)**	(0.000)***	(0.0173)##	(0.4524)	(0.000)***	(0.000)***
BWP	−4.51854	−14.7223	0.29134	−0.31592	−5.10226	−7.91289
	(0.000)***	(0.000)***	(0.3854)	(0.6240)	(0.000)***	(0.000)***
CWP	−3.7595	−2.80849	2.69965	0.02649	−5.17028	−7.67739
	(0.000)***	(0.003)***	(0.0035)#	(0.4894)	(0.000)***	(0.000)***
WWP	−1.14969	−3.48144	−0.39269	−0.19882	−3.6019	−7.31119
	−0.1251	(0.000)***	(0.6527)	(0.5788)	(0.000)***	(0.000)***
TEP	−2.31265**	−9.68973	5.40911	−0.04260	−0.20301	−5.66127
	(0.010)**	(0.000)***	(0.0000)#	(0.5170)	−0.4196	(0.000)***
INF	−4.86111	−4.01519	0.85095	−1.09729	−4.28869	−4.77209
	(0.000)***	(0.000)***	(0.1974)	(0.8637)	(0.000)***	(0.000)***
GDP	−3.85425	−11.8107	1.47279	−0.75447	−5.1661	−5.4034
	(0.000)***	(0.000)***	(0.0704)	(0.7747)	(0.000)***	(0.000)***

NOTE ***, **, and * indicates significance at the 1%, 5%, and 10% level, respectively (rejection of the null hypothesis of nonstationarity). # and ## indicates rejection of the null hypothesis of stationarity at the 1%, and 5% level, respectively. Figures within parentheses indicate P-values. Author's computation (data from Quantec EasyData, South Africa, South African Reserve Bank, and World Bank)

PANEL UNIT ROOT TEST

table 4 shows the study's results of the panel unit root tests. Levin, Lin, and Chu (LLC), Im et al. (IPS) and Hadri LM tests are employed in this study to attain variable conditions at the level *I(0)* or 1st difference *I(1)*. With 9 numbers of panels and a 25-year-period, LLC and Hadri LM are suitable for this study. Thus, N (panel) is small relative to T (period) (Hadri 2000; Levin et al. 2002; Baltagi 2013). Both LLC and Hadri tests assume that all panels share a common autoregressive parameter and require balanced datasets. The IPS panel unit root test is incorporated in this study to augment other panel unit root tests. The IPS test relaxes the assumption of a common autoregressive parameter and does not require balanced datasets, though there should not be gaps within any of the panels (Im et al. 2003).

The null hypothesis () for both LLC and IPS is that panel data has unit root, against the alternate hypothesis () that panel data has no unit root. On other hand, the Hadri LM test null hypothesis () is that panel data is stationary (does not have unit root), against the alternate hypothesis () that panel data is non-stationary (has unit root). Testing for unit root using LLC and IPS, the study accepts the null hypothesis, that there is unit root in the panel data, where the *P-value* is greater than 5 percent (0.05), but rejects the null hypothesis where the *P-value* is less than 5 percent (0.05). However, using Hadri LM to test for unit root in the panel data, the null hypothesis (stationarity) is accepted for five variables in levels while the null hypothesis (stationarity) is rejected at all percentage levels for the other three variables (AWP, CWP, and TEP) but only to be accepted at first difference. Thus, there is a combination of levels *I(0)* and first difference *I(1)* stationarity among the study variables.

The findings of the three stationarity tests shown in table 4 indicate that none of the considered variables is of order two, *I(2)*. The LLC and IPS test results attest that most variables are stationary at levels. However, there is evidence that WWP and TEP are nonstationary at levels but become stationary at first difference. This study uses evidence of unit root by at least one test to assume a verdict of a combination of stationarity at levels and first difference. This makes the panel autoregressive distributed lag (PARDL) technique the appropriate model for this study. The lag length criteria are not shown here due to space limitation but can be obtained from the authors on request.

ESTIMATION RESULTS

The study's empirical results of the panel autoregressive distributed lag (PARDL) procedure used in this investigation are presented in two versions (regressions) in this subsection. In the first version (regression), the working age population of the four race groups will be incorporated in one regression and presented in table 7. The second version (regression) will run four distinct variations of the regression with the working age population of each of four race groups as the focus variable and will be presented in table 8. Thus, tables 7 and 8 will consist of two sections, A and B, in which the long-run estimates are presented in section A, and the short-run estimates are depicted in section B.

TABLE 5 Empirical Results of the Long-Run Estimated ARDL Model
Dependent variable: HSG

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
AWP	−1.16454	1.876466	−0.6206	0.5368
BWP	−22.1441	2.863559	−7.73307	0.0000***
CWP	−22.2204	2.457183	−9.04304	0.0000***
WWP	21.26393	2.898585	7.335968	0.0000***
TEP	12.30124	1.6387	7.506705	0.0000***
INF	−2.98054	1.280181	−2.32822	0.0226**
GDP	8.182632	1.160225	7.052625	0.0000***

NOTES ***, ** and * indicate statistically significant at the 1%, 5% and 10% levels, respectively

Panel ARDL with Single Regression

The study's empirical results of the panel autoregressive distributed lag (ARDL) procedure used in this investigation are presented in this section. ARDL (1, 2, 2, 2, 2, 2, 2, 2) is the optimal lag-length model selected in the regression. Tables 5 and 6 present the long-run and short-run results of the selected model, respectively.

Long-Run Estimates (ARDL)

The results of the long-run estimate of the impact of demographic dynamics on household saving is presented in table 5. The findings show that except for AWP that has insignificant effect on household saving, the working age population variables for Black, Coloured, and White race groups have a statistically significant relationship with household saving in the South African province in the long run.

Likewise, TEP, INF, and GDP have significant influence in explaining household saving in South Africa in the long run.

The long-run estimates reveal that a 1% increase in the Black working age population reduces household saving by 22.14%; likewise, a 1% increase in the CWP results in a 22.22% decrease in HSG. The negative coefficients of BWP and CWP contradict expectations based on the life-cycle hypothesis. Conversely, a 1% rise in WWP leads to a 21.26% increase in household saving, which aligns with prior expectations and supports findings from Cruz and Ahmed (2016), Hanif et al. (2022), and Jain and Goli (2022). The positive coefficient of TEP suggests that a 1% rise in TEP causes HSG to increase 12.30%. The positive coefficient of TEP also con-

TABLE 6 Short-Run Estimated ARDL Model

Dependent variable: HSG				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
ECT_1	−0.88072	0.022332	−39.4385	0.0000***
Δ(AWP)	7.717857	7.545854	1.022794	0.3097
Δ(AWP(−1))	−8.40253	22.26839	−0.37733	0.7070
Δ(BWP)	9.164669	8.16697	1.122163	0.2654
Δ(BWP(−1))	36.51211	22.8758	1.596102	0.1147
Δ(CWP)	14.49358	12.00973	1.20682	0.2313
Δ(CWP(−1))	−1.0187	18.0441	−0.05646	0.9551
Δ(WWP)	−28.3642	13.82044	−2.05234	0.0437**
Δ(WWP(−1))	10.40759	20.34023	0.511675	0.6104
Δ(TEP)	−9.82115	4.458541	−2.20277	0.0307**
Δ(TEP(−1))	11.34002	4.927661	2.301299	0.0242**
Δ(INF)	1.532558	0.872671	1.756169	0.0832*
Δ(INF(−1))	3.701158	0.742849	4.982386	0.0000***
Δ(GDP)	−4.14378	0.665322	−6.22823	0.0000***
Δ(GDP(−1))	−3.47932	1.043445	−3.33446	0.0013***
C	61.68701	4.664632	13.22441	0.0000***

NOTES ***, ** and * indicate statistically significant at the 1%, 5% and 10% levels, respectively

tradicts initial expectations of a negative relationship in line with the life-cycle hypothesis but aligns with studies by Hock and Weil (2012) and Nduku and Simo-Kengne (2018). The coefficients for control variables align with expectations: a 1% increase in inflation results in a 2.98% decrease in household saving growth rate (HSG), while a 1% increase in GDP leads to an 8.18% increase in HSG.

Short-Run Estimates and Error Correction Model (ECM)

Table 6 presents the short-run estimates of the study, confirming a cointegration relationship in the model. The negative and statistically significant coefficient of the error correction term (ECT) indicates a long-run equilibrium, with deviations corrected at a rate of 88.07%. The negative coefficient of ECT denotes a long-run relationship between household saving (HSG), and its explanatory variables.

Among the four working age population variables (AWP, BWP, CWP, and WWP), only WWP is statistically significant in the short run when lagged one period (D(WWP)). AWP, BWP, and CWP do not significantly impact household saving in the short run. The total elderly population (TEP) is also significant in the short run. Both control variables, inflation rate (INF) and economic growth (GDP), are statistically significant in explaining household saving in the provinces of South Africa in the short run.

Panel ARDL Regression with Four Variations

In this section, four variations of the panel autoregressive distributed lag model will be conducted with the aim to capture the individual effects of each of the four race groups' working-age population on household saving in South Africa's provinces. The empirical findings for the long-run and short-run estimations of the selected model are presented in tables 7 and 8, respectively. ARDL (1, 3, 3, 3, 3) is the optimal lag-length model selected in the regression.

Long-Run Estimates (PARDL)

The empirical findings of the long-run panel autoregressive distributed lag (PARDL) regression are presented in table 7. The analysis of the long-run equation indicates that the significant coefficients associated with the working age population in variations 1, 2, and 3 are negative, which contradicts expectations derived from the life-cycle hypothesis. This finding diverges from prior expectations and does not corroborate the conclusions of Cruz and Ahmed (2016), Hanif et al. (2022), and Jain and Goli (2022). Notably, Total Elderly Population (TEP) exhibits no significant impact on household saving (HSG) across the four model variations. However, inflation (INF) demonstrates a significant negative effect on HSG across the four variations. The negative coefficient of INF in relation to HSG in South Africa aligns with prior expectations and supports the findings of Hanif et al. (2022).

The significant coefficients of gross domestic product (GDP) in variations 1, 2, and 3 are positive and consistent with expectations. In Variation 1 of the study model, which focuses on the Asian working age population (AWP), it is found that AWP, INF, and GDP significantly influence household saving in the long run. The long-run estimates in variation 1 indicate that a 1% increase in AWP results in a 12.77% decrease in HSG; similarly, a 1% rise in INF leads to a 9.24% reduction in HSG, whereas a 1% increase in GDP leads to a 6.58% increase in HSG.

TABLE 7 Estimated Long-Run PARDL (for four variations)

Dependent Variable: D(HSG)				
Long Run Equation				
Variables	AWP	BWP	CWP	WWP
	Variation 1	Variation 2	Variation 3	Variation 4
	Selected Model: (1, 3, 3, 3, 3)	Selected Model: (1, 3, 3, 3, 3)	Selected Model: (1, 3, 3, 3, 3)	Selected Model: (1, 3, 3, 3, 3)
Focus Variable	AWP −12.7722 (0.0000)***	BWP −26.4852 (0.0000)***	CWP −21.1609 (0.0000)***	WWP 3.026917 (0.4281)
TEP	TEP −2.82587 (0.3505)	TEP 4.685861 (0.0898)*	TEP 1.01724 (0.7320)	TEP −1.3814 (0.6861)
INF	INF −9.24264 (0.0000)***	INF −9.57443 (0.0000)***	INF −8.13003 (0.0003)***	INF −8.46676 (0.0021)***
GDP	GDP 6.579433 (0.0024)***	GDP 9.481895 (0.0001)***	GDP 8.202115 (0.0007)***	GDP −2.69851 (0.2913)

NOTES ***, **, and * indicates significance at the 1%, 5%, and 10% level, respectively (rejection of the null hypothesis of nonstationarity. Figures within parenthesis indicate P-values. Author's computation (data from Quantec EasyData, South Africa, South African Reserve Bank, and World Bank)

In Variation 2 with the Black working age population (BWP) as the focus variable, it is observed that BWP, INF, and GDP significantly affect household saving, while TEP has no impact on HSG in the long run within South African provinces. The findings reveal that a 1% increase in BWP results in a 26.49% decrease in HSG; moreover, HSG decreases by 9.57% with a 1% rise in INF, while a 1% increase in GDP leads to a 9.48% increase in HSG in the long run.

Variation 3 in table 7 shows that the Coloured working age population (CWP), INF, and GDP significantly influence HSG, while TEP does not have a significant effect on HSG over the long term. Specifically, an increase of 1% in CWP will result in HSG reducing by 21.16%, while a 1% rise in INF causes HSG to decrease by 8.13%. Conversely, a 1% increase in GDP results in HSG increasing by 8.20% in the long run.

Finally, the long-run results of Variation 4 indicate that only INF has a significant impact on HSG; WWP (White working age population), TEP, and GDP are insignificant predictors of HSG within South African provinces. Thus, a 1% increase in INF leads to an 8.47% reduction in HSG in the long run.

TABLE 8 Short-Run Estimated PARDL Model (four variations)

AWP		BWP		CWP		WWP	
ECT_1	−0.57045 (0.0000)***	ECT_1	−0.58652 (0.0000)***	ECT_1	−0.62691 (0.0000)***	ECT_1	−0.59803 (0.0000)***
Δ(AWP)	−4.46254 (0.6286)	Δ(BWP)	11.27138 (0.0135)**	Δ(CWP)	11.49651 (0.1538)	Δ(WWP)	−5.41711 (0.6598)
ΔD(AWP(1))	0.223238 (0.9481)	Δ(BWP(−1))	6.966073 (0.1106)	Δ(CWP(−1))	−2.22339 (0.7950)	Δ(WWP(1))	−0.58873 (0.9445)
Δ(AWP(−2))	−7.39396 (0.0078)***	Δ(BWP(−2))	−19.2439 (0.0019)***	Δ(CWP(−2))	−0.07335 (0.9925)	Δ(WWP(−2))	11.73173 (0.0774)*
Δ(TEP)	9.56042 (0.2458)	Δ(TEP)	3.695449 (0.5488)	Δ(TEP)	4.144507 (0.5872)	Δ(TEP)	−3.10312 (0.7471)
Δ (TEP(−1))	8.433403 (0.1769)	Δ(TEP(−1))	10.86668 (0.1416)	Δ(TEP(−1))	10.47367 (0.2147)	Δ(TEP(−1))	6.428285 (0.4981)
Δ(TEP(−2))	−5.07126 (0.5400)	Δ(TEP(−2))	7.883387 (0.1562)	Δ(TEP(−2))	−4.79624 (0.0445)**	Δ(TEP(−2))	−3.08126 (0.6681)
Δ(INF)	4.165957 (0.0012)***	Δ(INF)	2.717179 (0.0002)***	Δ(INF)	2.947817 (0.0002)***	Δ(INF)	3.280774 (0.0091)***
Δ(INF(−1))	7.407183 (0.0001)***	Δ (INF(−1))	5.691884 (0.0000)***	Δ(INF(−1))	7.597118 (0.0000)***	Δ(INF(−1))	9.454327 (0.0000)***
Δ(INF(−2))	2.664887 (0.1499)	Δ(INF(−2))	−0.74089 (0.2046)	Δ(INF(−2))	2.047906 (0.0119)**	Δ (INF(−2))	1.389751 (0.3892)
Δ(GDP)	−1.78428 (0.1830)	Δ (GDP)	−4.14896 (0.0038)***	Δ(GDP)	−4.38004 (0.0001)***	Δ(GDP)	1.311287 (0.3001)
Δ(GDP(−1))	−3.26375 (0.0008)***	Δ(GDP(−1))	−3.86151 (0.0000)***	Δ(GDP(−1))	−3.00796 (0.0015)***	Δ(GDP(−1))	−0.47949 (0.7818)
Δ(GDP(−2))	1.91393 (0.4441)	ΔGDP(−2))	0.286507 (0.8038)	Δ(GDP(−2))	0.972207 (0.2588)	Δ(GDP(−2))	2.496636 (0.0605)*
C	37.02588 (0.0000)***	C	44.45094 (0.0000)***	C	29.31262 (0.0000)***	C	41.81761 (0.0000)***

NOTES Dependent Variable: D(HSG). ***, **, and * indicates significance at the 1%, 5%, and 10% level, respectively (rejection of the null hypothesis of nonstationarity. Figures within parenthesis indicate P-values. Author's computation (data from Quantec EasyData, South Africa, South African Reserve Bank, and World Bank)

Short-Run Estimates and Error Correction Model (ECM)

Table 8 presents the short-run estimations for the four variations of the estimated model. The results across these variations affirm the existence of cointegration relationships within the four variations in the study.

The short-run estimates show that the coefficients of the error correction term (ECT) in each of the four variations of the model are negative and statistically significant at the 1% level, which attests to the presence of a long-run relationship in the models. Evidence from table 10 shows the adjustment coefficients (ECT) of the variations 1, 2, 3, and 4 as −0.57045, −0.58652, −0.62691, and −0.59803, respectively. These coefficients signify a long-run relationship between household saving, each focus variable (race group's working-age population), total elderly population (TEP), inflation (INF), and gross domestic product (GDP) across all four variations of the study. The adjustment coefficient (ECT) implies that any deviations from long-run equilibrium in each variation are corrected at the speed of 57.05% for Variation 1, 58.65% for Variation 2, 62.69% for Variation 3, and 59.80% for Variation 4.

Dumitrescu-Hurlin Panel Granger Causality Test

The results of the causality test shown in table 9 reveal a strong evidence of feedback effects, that is a bidirectional causal relationship, between three of the four race variables (AWP, BWP, and CWP) and household saving (HSG).

This implies that the three race variables working-age population (AWP, BWP, and CWP), individually, homogeneously Granger cause household saving (HSG), and household saving also homogeneously Granger causes AWP, BWP, and CWP for all the individual provinces in the panel. As a result, there is enough evidence to reject the null hypothesis in all the three cases. The results also show that there is a unidirectional causality running from the White race variable (WWP) to household saving (HSG). The study thereby rejects the null hypothesis that WWP does not homogeneously cause HSG in the panel. Also, a unidirectional causality runs from the aged/elderly population variable (TEP) to household saving (HSG), affirming that TEP homogeneously Granger causes HSG, which is evidence to reject the null hypothesis. The outcome of the test shows no evidence of causality between inflation (INF) and household saving (HSG) in any direction. INF does not homogeneously cause HSG, and HSG does not homogeneously cause INF. Therefore, the null hypothesis cannot be rejected for INF and HSG in any direction. Between economic

TABLE 9 Dumitrescu-Hurlin Panel Granger Causality Test Results

Null Hypothesis	W-Stat.	Zbar-Stat.	Prob.	Conclusion
AWP does not homogeneously cause HSG	31.9073	34.8737	0.0000***	Bidirectional causality between AWP and HSG
HSG does not homogeneously cause AWP	0.47778	−2.08393	0.0372**	
BWP does not homogeneously cause HSG	77.3869	88.3526	0.0000***	Bidirectional causality between BWP and HSG
HSG does not homogeneously cause BWP	0.29288	−2.30136	0.0214**	
CWP does not homogeneously cause HSG	29.2957	31.8028	0.0000***	Bidirectional causality between CWP and HSG
HSG does not homogeneously cause CWP	0.35029	−2.23384	0.0255**	
WWP does not homogeneously cause HSG	19.5403	20.3314	0.0000***	Unidirectional causality from WWP to HSG
HSG does not homogeneously cause WWP	0.82743	−1.67278	0.0944*	
TEP does not homogeneously cause HSG	13.9585	13.7679	0.0000***	Unidirectional causality from TEP to HSG
HSG does not homogeneously cause TEP	2.43954	0.22288	0.8236	
INF does not homogeneously cause HSG	1.28263	−1.13752	0.2553	No causality between INF and HSG
HSG does not homogeneously cause INF	0.96619	−1.50962	0.1311	
GDP does not homogeneously cause HSG	2.57707	0.38459	0.7005	Unidirectional causality from HSG to GDP
HSG does not homogeneously cause GDP	7.72293	6.43556	1E−10***	

NOTES ***, ** and * show significance at 1%, 5% and 10% levels respectively. Author's compilation (data from Quantec EasyData, South Africa, South African Reserve Bank, and World Bank)

growth (GDP) and household saving (HSG), there is a unidirectional causality running from HSG to GDP. This outcome shows enough evidence to reject the null hypothesis that HSG does not homogeneously cause GDP.

Conclusions

This study emphasises the significance of demographic dynamics in influencing household saving decisions across South Africa's nine provinces. Using provincial-level data, the study employs the panel autoregressive distributed lag (PARDL) technique to examine the impact

of demographic dynamics on household saving in South Africa's nine provinces. In the model with all the racial variables incorporated in it, only Asian working age population (AWP) is found to be insignificant in explaining household saving in the long run in South Africa. However, when the working-age population variables are captured separately, the White working-age population (WWP) is found not to have any significant impact on household saving in South African provinces in the long run. However, the two models affirm the existence of a long-run relationship between household saving and independent variables of interest in the regression. The panel causality test indicates bidirectional causality between three racial groups (AWP, BWP, CWP) and household savings, while unidirectional causality runs from WWP and TEP to household savings and from HSG to GDP. No causal relationship exists between inflation and household savings. Given the limited empirical analyses at the provincial level regarding demographics and household savings in South Africa, these findings are particularly valuable. The study highlights the need for policies that address the negative impacts of working age populations on savings.

The study findings have brought to the fore the legacy of the apartheid regime that was characterised by high unemployment, poverty, and inequality that keep sustaining barriers that have continued to disadvantage some groups, particularly the Black and Coloured populations, resulting in persistent economic disparities. The findings of the two models underscore the need for well-informed policy intervention that will address the distinctive challenges that different racial groups face in South Africa. Policymakers need to think in favour of policies that will enhance the economic viability of the country's unique demographics and inclusive environment for all racial groups.

It is crucial to implement policies that stimulate economic activity, as these measures can lead to increased disposable income and foster a more positive saving culture.

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International Trade and Economic Growth in an Oil-Dependent Country: Case of Nigeria

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This paper examines the effect of disaggregated international trade on the economic growth of Nigeria. The data and specified model were analysed with Autoregressive Distributed Lag and Toda-Yamamoto techniques. It was found that both non-oil and oil exports enhance economic growth. However, non-oil and oil imports impede economic growth. Furthermore, overall causality results revealed that while non-oil and oil exports and non-oil imports had bi-directional causality with economic growth, non-oil imports did not have causality with economic growth. Consequently, the government should prioritise export-led policy to facilitate economic performance in Nigeria. Findings emphasised the need for the diversification of the economy for higher economic growth and sustainability in the long run. The paper enriches the literature on the relationship between international trade and economic growth in Nigeria by adequately disaggregating trade components to reflect the economic structure of the Nigerian economy. Also, it brings new empirical findings on the trade-growth relationship in an oil-dependent developing country. This study can provide a theoretical framework for research in countries that oil dependent.

Keywords: international trade, economic performance, trade policy, developing economies, ARDL, Toda-Yamamoto
JEL *Classification:* B17, F13, B23, O47

Received 2024/10/01 · Last revised 2025/01/10 · Accepted 2025/01/14

Published online 2025/06/30 https://doi.org/10.26493/1854-6935.23.147-174

Introduction

The level of openness across the globe has been increasing interdependence among nations, leading to high levels of cross-border cooperation and activities. This is because no single nation has all the necessary resources to promote growth and generate a high standard of living (Dare and Adekunle 2020). Therefore, international trade was established to support the resource deficiencies of nations. In theory, international trade is believed to promote economic growth and development (Abreo

2024). International trade can facilitate economic growth through the transfer and diffusion of knowledge and technology (Abendin and Duan 2021; Monyela and Saba 2024). Moreover, it has been argued that international trade could contribute to growth when countries focus on producing goods and services that give them advantages in the international market (Ji et al. 2022). This is expected to not only contribute to export performance, but also increase domestic consumption of local goods, which reduces the depletion of foreign reserves (Mullings and Mahabir 2018; Zhang et al. 2023).

As a result of the benefits of international trade, most developing countries like South Africa, Nigeria, Malaysia, Ghana, and other emerging countries adopted trade liberalisation policies to increase and promote cross-border trade. Restrictions and other factors that mitigate trade and international relations were removed, and the economy was opened to enhance the cross-border movement of goods and capital (Zahonogo 2017; Adekunle and Adodo 2019). The policy of trade liberalisation is anticipated to benefit developing countries through an increase in the inflow of foreign direct investment and capital inflow, promote economic specialisation and efficiency, and financially expand and incorporate the domestic market into the world market (Cantah et al. 2018; Espoir et al. 2024).

From a theoretical perspective, a country can benefit from international trade when it focuses its attention on resources in which it has a high competitive advantage over others (Heckscher 1919; Ohlin 1933). This has been empirically tested, and it was found that international trade represents one of the major instruments of growth and development, especially in developed countries (Zahonogo 2017; Abendin and Duan 2021; Monyela and Saba 2024). However, the positive direction of international trade on economic growth may differ in countries that are import-dependent, with low internal productive capacity to compensate for heavy importations of goods and services. There is an argument that some regions, such as sub-Saharan Africa, have yet to experience the positive impact of trade on macroeconomic indices such as poverty reduction, income equality, and employment (Sepehrdoust et al. 2019). To this end, Cerdeira and Moutinho (2016), Manwa et al. (2019), Menyah et al. (2014), Mullings and Mahabir (2018), Rahman and Mamun (2016), and Zheng and Walsh (2019) reported a negative relationship between international trade and economic growth of emerging countries. This has led to a debate on whether the trade openness policy favors the developed countries than the developing countries.

FIGURE 1 Stylised Fact of International Trade and Economic Growh (%) in Nigeria
SOURCE World Development Indicators

Nigeria, which is one of the sub-Saharan countries, has continued to experience underwhelming economic performance despite the openness policy of the country. For instance, figure 1, which shows a graphical presentation of the relationship between international trade and economic performance variables, which are GDP growth rate and GDP per capita growth rate, reveals that international trade in Nigeria has continued to fluctuate after the trade liberalisation policy of 1986. After this period, the Nigerian economy focused heavily on crude oil production and exportation, which is one of the major resources in which the country has a competitive advantage over other countries. This fluctuation in international trade has a major impact on both GDP growth rate and GDP per capita growth rate. Supporting this, in figure 1, the growth rate of the country's GDP fell from 2.6% in 2015 to a negative figure of −1.6% in 2016 before rising insignificantly to 0.8% in 2017 (World Development Indicators 2024). Although the GDP growth rate rose to 1.9% and 2.2% in 2018 and 2019, respectively, a negative figure of −1.8 was recorded in 2020. The GDP growth rate, however, peaked and rose to 3.6% in 2021; it later fell to 3.2% and 2.9% in 2022 and 2023, respectively (World Development Indicators 2024).

This shows fluctuation and deterioration of the economy in terms of overall productivity, with implications for the standard of living, with the country recording negative growth rates of GDP per capita of −4.1%,

−1.7%, −0.6%, −0.3%, and −4.1% in 2016, 2017, 2018, 2019, and 2020, respectively. While the growth rate of GDP per capita rose to 1.2% in 2021, it fell significantly to 0.8% and 0.4% in 2022 and 2023, respectively (World Development Indicators 2024).

Nigeria is still experiencing a high level of economic instability and vulnerability in terms of high inflation rate, high level of unemployment, adverse balance of payments, increasing poverty rate, and a widening gap between the rich and the poor (Yakubu and Akanegbu 2015). This is despite the vast resources of the country, especially its agricultural capacity, gold, bitumen, iron ore, coal, lead, zinc, and arable land. Over the years, diverse policies have been implemented by various governments aimed at diversifying the Nigerian economy away from its reliance on crude oil. Nevertheless, there is limited progress in developing other key sectors and harnessing other resources in the country. This points to the ongoing challenges in shifting the focus of the economy and realising its potential. From a structural perspective, Nigeria remains underdeveloped and lacks a cohesive framework, underlining the need for a comprehensive policy refocus and strategic realignment. To address these structural challenges in Nigeria, it is crucial to undertake a thorough analysis and investigate how components of international trade impact economic growth. This involves exploring how elements of trade such as oil exports, non-oil exports, oil imports, and non-oil imports impact economic growth. Understanding these dynamic relationships will give insights into optimising the trade policies of Nigeria and fostering sustainable growth and development.

However, while many studies have looked at how international trade affects economic growth (Ogudu et al. 2023; Ji et al. 2024; Celik et al. 2024), there is a gap in understanding the specific impact of international trade on economic growth in developing countries like Nigeria. This research gap is significant because Nigeria relies heavily on international trade and has a government policy that encourages trade relationships with other countries. To address this gap, the study breaks down the Nigerian international trade into oil exports, non-oil exports, oil imports, and non-oil imports, and examines their impact on economic performance. The study used the Autoregressive Distributed Lag method proposed by Pesaran and Shin (1999) to analyse the data, as it is suitable for understanding the short and long-term dynamic relationship among time series data with different integrations. Additionally, the

Toda-Yamamoto technique was employed to determine the direction of causality among the variables of interest.

This paper is structured as follows: Section 2 presents the theoretical and empirical literature that underpins the study. Section 3 focuses on the research methodology for addressing the research objective. Section 4 centres on the results from data analysis. Section 5 presents the discussion. Section 6 focuses on the conclusion, the policy implications, and recommendations emerging from the study.

Literature Review

CONCEPTUALISATION AND THEORETICAL UNDERPINNING

International trade, which involves the exchange of goods and services among nations with the use of foreign currency, has been changing the structure of the world economy in recent years (Ji et al. 2022). Abendin and Duan (2021) stated that international trade plays an important role in creating employment, foreign exchange earnings accumulation, and enhanced economic productivity through the adequate usage of domestic resources and revitalisation of the investment capacity of a nation. International trade can stimulate the economy through the promotion of cross-border activities that enhance economic performance and provide employment opportunities for the domestic workforce (Were 2015; Zahoor et al. 2023). Recently, developing countries have relied on international trade as a tool for enhancing growth (Nam and Ryu 2024). This is because trade relations with more developed economies promote comparative advantage, economies of scale, and technological innovation, which enhance the generation of income in an economy (Gwaindep et al. 2014; Shahzad et al. 2023). Also, international trade enables most developing countries to enjoy new and more advanced goods and services that cannot be locally produced from available resources (Fahlevi et al. 2024).

Theories in the ambit of international trade suggest that trade enhances economic performance and prosperity through the reallocation of capital and the reinforcement of competitive advantage as countries become more concentrated in the production and exportation of goods with which they have an edge over other countries: Mercantilist Theory, the Absolute Advantage Theory of Smith (1776), and the Comparative Cost Advantage theory of Ricardo (1817). A leading theory that demonstrates the linkage between international and economic growth is the

Heckscher-Ohlin theory (H-O) of Heckscher (1919) and Ohlin (1933). This model emphasises that international trade is driven by differences in the resources of countries. In addition, the H-O model proposes that comparative advantage is determined by differences in factors and intensity of production among countries (Lohani 2021). Moreover, the theory states that developing countries, in the absence of foreign trade, experience low economic growth due to their unskilled labour force and capital accumulation (Sujová et al. 2021). Hence, for a country to stimulate growth, there is a need to specialise in the production and exportation of products for which they have a greater advantage and an abundance of resources (Ji et al. 2022). Also, the country should engage in the importation of products that are costly to produce locally or that they lack resources to produce (Sujová et al. 2021).

In addition, multiple theories such as the Stolper-Samuelson (S-S) hypothesis, the factor-price equalisation theory, and the aggregate economic efficiency proposition have been developed following the H-O theory to provide a comprehensive explanation of the relationship between international trade and economic growth. The S-S hypothesis posits that an increase in the prices of a nation's intensively used factors will occur when there is a rise in the relative price of the commodity produced by that nation employing its abundant factor (Ji et al. 2022). On the other hand, the factor-price equalisation theory proposes that two trading nations that manufacture two identical items will face the same commodity prices and production methods (Krugman 2007). According to this theory, the presence of global commodity trade enables the prices of similar production components to be balanced among the participating nations. Furthermore, the aggregate economic efficiency illustrates that changes in prices that result from specialisation and trade relationship promote a higher level of exports and reduce imports for each country. This dynamic indicates that high welfare is linked to enhanced production and consumption efficiency, which result from these price changes (Krugman 2007).

Furthermore, the comparative advantage theory stresses that countries gain from trade when they specialise in the production of commodities in which they have a comparative advantage. In the context of Nigeria, the theory emphasises the potential advantages of engaging in international trade by adopting a trade liberalisation policy through high specialisation in a commodity such as crude oil. According to Krueger (1978) and Bhagwati (1978), trade liberalisation enhances specialisation in the sectors with

high economies of scale, thereby leading to increased long-term productivity and efficiency. In this regard, studies have supported this theory by finding a positive effect of trade on economic growth. Also, the endogenous growth theory of Frankel and Romer (1999) supported this by establishing a direct relationship between trade and economic growth resulting from global advancement and adoption of technologies. From the view of the endogenous growth theory, openness to trade can enhance innovation and transfer of knowledge, which is applicable in the case of Nigeria where collaboration with other nations can enhance its technological improvement. The level of openness of a developing nation can directly impact its ability to use the technologies manufactured in developed nations. Moreover, it has been argued that the cost of imitation could also play an important role in the trade-growth relationship (Pettinger 2019). Although it has been argued that developing countries can gain from going into trade with developed countries, there are arguments against this, especially when a country specialises in a sector where research and development have little or no impact (Monyela and Saba 2024).

EMPIRICAL REVIEW

Premised on the theories of international trade, many studies have been conducted to investigate the linkage between international trade and economic growth. For instance, Makhmutova and Mustafin (2017) investigated the linkage between international trade and the economic growth of China, the USA, Russia, and Germany. The study relied on descriptive statistical techniques, and it was discovered that while international trade hurt the economic growth of China, the USA, Russia, and Germany were found to achieve higher economic growth due to international trade. Findings from the research highlighted how emerging countries like China might experience a detrimental effect of trade on growth compared to developed countries such as the USA, Russia and, Germany. Moreover, in a digitalised economy, studies have shown that countries might experience a positive effect of international trade on economic growth. For instance, Abendin and Duan (2021) supported this, using data from 54 African countries analysed with panel regression technique, and it was discovered that the digital economy played a significant role in enhancing the relationship between international trade and economic growth. A similar study carried out in the context of sub-Saharan African countries by Yameogo and Omojolaibi (2020) showed that openness to trade, foreign trade, investment, and institu-

tional quality significantly improved economic growth and poverty reduction in the long run. This suggests that international trade might be beneficial to developing countries under some circumstances such as digital innovation and quality of institution, which may not be equally distributed. The implication of this is that some developing countries with these conditions may gain from trade compared to others.

The study of Ji et al. (2022) also looked into the effect of exports and imports in economic growth using the co-integration technique of Gregory and Hansen. The authors revealed that there is a long-run equilibrium relationship among exports, imports, and economic growth. Moreover, it was found that a bidirectional relationship existed among the selected macroeconomic variables. Sujová et al. (2021), focusing on Czechia's and Slovakia's wood process industries, explored the effect of foreign trade on economic growth. Analysis of data using the multivariate regression method showed that net exports will positively impact economic growth only when exports exceed imports. This implies that for countries to gain from trade, they must export more than what they import, which might not apply to a country like Nigeria which relies on high importation from other countries. This is supported by the findings of Khan and Pradhan (2022) who, analysing the effect of terms of trade on economic growth in Bangladesh, discovered that term of terms of trade significantly deteriorates economic growth both in the long run and short run.

Jain and Mohapatra (2024) studied the interplay between trade and macroeconomic indices (economic growth, poverty, and income equity) in 18 emerging countries. The study was based on panel data analysis and it was revealed that while trade is significant in reducing income inequality and promoting growth, it also has a significant linkage with poverty reduction. Banik (2023) analysed how the pandemic impacted the exports of Bangladesh through the transmission mechanism of the level of trade openness and credit growth. Results from the study revealed that while the pandemic negatively impacted exports in the short run, the relationship was positive in the long run through the credit growth channel. The author argued for an increase in credit support and an opening up of the economy after the pandemic to realise export recovery. Moreover, in the study of Mhaka et al. (2023) on the relationship between exchange movements and trade balances among five Southern African Customs Union (SACU) countries, it was found that although the depreciation in the exchange rate has the potential to improve trade balances in 8 countries, it hurt trade balance in 11 countries out of the 19 in

the region. However, Mehta et al. (2024) investigated whether economic openness through trade and capital openness impacted government size in India. The result of the study revealed that government size responded positively to trade openness, whereas capital openness diminishes government size.

In the context of Nigeria, studies have emerged to investigate the direction of the connection between international trade and economic growth. For instance, basing their research on Ricardian theory to explore how international trade impacted economic growth in Nigeria, Ajayi and Oguntomi (2022) argued that trade cost has a detrimental effect on the economic growth of Nigeria. This highlighted the current position of the Nigerian economy with increases in trading costs due to the high rate of inflation and the consumer purchase index, which resulted in high costs of importation. Moreover, the study of Owan (2023) which was based on a disaggregated analysis of international trade, revealed that both oil imports and non-oil imports hurt Nigerian economic growth, exposing the reliance of the country on importations, which is detrimental to economic prosperity. Furthermore, Shido-Ikwu et al. (2023) emphasised that international trade played no significant role in enhancing economic growth in Nigeria, especially with an increase in importation over exportation leading to a trade gap. This is supported by the result of Ihugba et al. (2024), revealing that an import dependency ratio negatively impacts the Nigerian economic stability. This reveals that for oil and import dependency countries like Nigeria, to realise economic growth from trade requires the reduction of overreliance on importation. Nevertheless, to achieve this, there is a need to look at the how the components of Nigeria's international trade impact economic growth.

Based on a comprehensive review of the literature, it is evident that there are differing views regarding the connection between international trade and economic performance. While some studies have indicated a positive relationship between international trade and economic growth, others have suggested that international trade has a negative impact on economic growth. These variations may be attributed to differences in research methodologies, the specific countries under study, and the scope of the research. However, it is worth noting that there is a significant gap in the existing literature, as there are few studies, if any, that analyse international trade in terms of oil exports, non-oil exports, oil imports, and non-oil imports, particularly in the context of Nigeria's trade relations with the rest of the world.

This study carried out an in-depth and comprehensive investigation of Nigeria's position in international relations by specifically focusing on essential trade components such as oil exports, non-oil exports, oil imports, and non-oil imports. It provides a detailed analysis of how each component performed and their overall influence on economic growth. The study not only highlighted the current challenges and opportunities within the country's trade framework, but also proposed strategic policy suggestions that could foster economic stability, boost trade competitiveness and enhance sustainable growth in the long run.

Therefore, the current research made a valuable contribution to the empirical literature by examining the disaggregated impact of international trade on Nigerian economic growth. This type of study is particularly relevant for developing countries like Nigeria, which is oil-dependent despite its vast natural resources.

Methods

The data set used in this research covered the years 1986 through 2023. Data on oil exports, non-oil exports, oil imports, non-oil imports, real gross domestic product, gross fixed capital formation, exchange rate, and inflation rate were obtained from The Central Bank of Nigeria Statistical Bulletin. These variables were selected according to the studies of Abendin and Duan (2021), Makhmutova and Mustafin (2017), and Mogoe and Mongale (2014).

VARIABLES DESCRIPTION

The dependent variable is economic growth. Based on existing studies such as Abendin and Duan (2021), economic growth was measured with real gross domestic product. This measured the overall production capacity of Nigeria's economy, adjusted for inflation.

The independent variable is international trade. As suggested in theories and literature, trade is an important part of the economy, and the openness and development of international trade can contribute positively to economic growth (Heckscher 1919; Ohlin 1933; Yameogo and Omojolaibi 2020). Thus, in this paper, international trade is divided into four components: oil exports, non-oil exports, oil imports, and non-oil imports, which reflect the nature of the Nigerian trade framework.

The control variables are gross fixed capital formation, inflation rate, and exchange rate:

TABLE 1 Variables Description

Variable	Measurement	Source of Data
Economic Growth (RGDP)	Log of Real Gross Domestic Product Growth	CBN Statistical Bulletin
Oil Exports (OIEXP)	Oil exports as a percentage of Gross Domestic Product	CBN Statistical Bulletin
Non-oil Exports (NON_EXP)	Non-oil exports as a percentage of Gross Domestic Product	CBN Statistical Bulletin
Oil Imports (OIMP)	Oil imports as a percentage of Gross Domestic Product	CBN Statistical Bulletin
Non-oil Imports (NON_IMP)	Non-oil imports as a percentage of Gross Domestic Product	CBN Statistical Bulletin
Gross Fixed Capital Formation (GFCF)	Investment as a percentage of Gross Domestic Product	CBN Statistical Bulletin
Inflation rate (INF)	Consumer Price Index	CBN Statistical Bulletin
Exchange rate (EXR)	Exchange rate of Naira to Dollar	CBN Statistical Bulletin

- Investment, which was measured as gross fixed capital formation, is the major driver of economic growth following the studies of Mishra (2020) and Ji et al. (2024). This is supported by the endogenous growth model which emphasises the positive role of investment in different sector of the economy as a factor to be considered in modelling the relationship between international trade and economic growth (Ji et al. 2024).
- Inflation rate measures the level of price changes internally and degree of economic stability (Fahlevi et al. 2024). Inflation rate is a major control variable in investigating the relationship between international trade and economic growth, because high inflation can reduce the competitiveness of a country's export in the international market and vice versa (Sahoo and Sethi 2020). Also, high inflation can increase the costs of imports, which may impact trade balance, especially when a country is import dependent (Ferrari et al. 2023; Ahmed et al. 2023).
- Exchange rate is used as a control variable to model the link between international trade and economic growth to control for the effect of trade balance, competitiveness and investment decisions, following the study of Ihugba et al. (2024). Moreover, exchange rate fluctuation can have a major impact on the relative prices of imports and exports, thus impacting the overall economic growth (Monyela and Saba 2024).

THEORETICAL FRAMEWORK AND MODEL

This study was based on multiple regression modelling to model the effect of international trade on economic growth in Nigeria. This is built on the theoretical framework of the Heckscher-Ohlin theorem developed by Heckscher (1919) and Ohlin (1933). The theory placed a strong emphasis on the significance of international trade as a vehicle for fostering national development and the necessity for countries to concentrate on producing and exporting commodities and services for which they have ample resources. This theory states that variations in comparative costs of production, which emerge from an abundance or scarcity of resources (labour and capital) among nations determine the growth of foreign trade. Therefore, to promote economic growth, nations must import commodities or resources that have become in short supply domestically and create and export commodities for which they have a low cost of production (Blaug 1992). According to this hypothesis, foreign trade should have a positive and significant effect on the economic growth of Nigeria.

However, the model for this study was built on the re-modified models of Ades and Glaeser (1999), Frankel and Romer (1999), Zahonogo (2017), and Abendin and Duan (2021) by disaggregating international trade into oil exports, non-oil exports, oil imports, and non-oil imports while controlling for inflation rate, capital formation, and exchange rate. The model is thus given as in equations (1) and (2):

$$\text{RGDP} = f(\text{NON\_EXP, OIEXP, NON\_IMP, OIMP, GFCF, INF, EXR}) \quad (1)$$

$$LRGDP = \beta_0 + \beta_1 \text{NON\_EXP} + \beta_2 \text{OIEXP} + \beta_3 \text{NON\_IMP} + \beta_4 \text{OIMP} + \beta_5 \text{GFCF} + \beta_7 \text{INF} + \beta_6 \text{LEXR} + e, \quad (2)$$

where:

- LRGDP = Log of Real Gross Domestic Product Growth
- NON_EXP = Non-oil Exports
- OIEXP = Oil Exports
- NON_IMP = Non-oil Imports
- OIMP = Oil Imports
- GFCF = Gross Fixed Capital Formation
- INF = Inflation Rate
- LEXR = Log of Exchange Rate
- β_o = Constant Term

- β_1 - β_7 = Parameters' Coefficient

In the model, oil exports, non-oil exports, oil imports, non-oil imports, and gross fixed capital formation were leveraged on gross domestic product to solve for the econometric problem of collinearity and ensure that the data series are at the same level.

ESTIMATION TECHNIQUES

The properties of the data were examined for unit root using the Augmented Dickey-Fuller (ADF) Unit Root approach because the study's data are time series, which may not be stationary. By doing this, dealing with false regression is avoided, and the variables are integrated at the level and first difference, which is the criterion for evaluating the link between economic growth and international trade in both the short and long terms. The ADF test of stationarity follows the model in equation (3):

$$\Delta Y_t = (p - 1) y_{t-1} + \alpha i \sum_{i=1}^{m} \Delta_{y-i} + \mu_t \tag{3}$$

The alternative hypothesis is tested against the null assumption of no unit root. If the test statistic is higher than the 5% critical value, the alternative hypothesis that a variable contains a unit root will be accepted, and the null of no unit root will be rejected. However, the results of the unit root tests indicated that the data series is a mix of the first difference (I(1)) and the level (I(0)), which is a requirement for using the dynamic Autoregressive Distributed Lag (ARDL) approach. Firstly, the ARDL Bound test for long-run relationships was initiated with model (4):

$$\begin{aligned}
\Delta \mathrm{LRGPD}_t = {} & \alpha_{01} + \beta_1 \mathrm{LRGPD}_{t-1} + \beta_2 \mathrm{NON_EXP}_{t-1} \\
& + \beta_3 \mathrm{OIEXP}_{t-1} + \beta_4 \mathrm{NON_IMP}_{t-1} + \beta_5 \mathrm{OIMP}_{t-1} \\
& + \beta_6 \mathrm{GFCF}_{t-1} + \beta_7 \mathrm{INF}_{t-1} + \beta_8 \mathrm{LEXR}_{t-1} \\
& + \sum_{i=1}^{q} \alpha_1 \mathrm{LRGPD}_{t-i} + \sum_{i=1}^{q} \alpha_2 \mathrm{NON_EXP}_{t-i} \\
& + \sum_{i=1}^{q} \alpha_3 \mathrm{OIEXP}_{t-i} + \sum_{i=1}^{q} \alpha_4 \mathrm{NON_IMP}_{t-i} + \sum_{i=1}^{q} \alpha_5 \mathrm{OIMP}_{t-i} \\
& + \sum_{i=1}^{q} \alpha_6 \mathrm{GFCF}_{t-i} + \sum_{i=1}^{q} \alpha_7 \mathrm{INF}_{t-i} + \sum_{i=1}^{q} \alpha_8 \mathrm{LEXR}_{t-i}
\end{aligned} \tag{4}$$

After the ARDL Bound Test was estimated, the coefficients for short- and long-run relationship are implemented as in equations (5) and (6), as follows:

$$\begin{aligned}\text{LRGPD}_t = {} & \alpha_0 + \sum_{i=1}^{p} \lambda_1 \Delta \text{LRGDP}_{t-i} + \sum_{i=1}^{p} \lambda_2 \Delta \text{NON\_EXP}_{t-i} \\ & + \sum_{i=1}^{p} \lambda_3 \Delta \text{OIEXP}_{t-i} + \sum_{i=1}^{p} \lambda 4 \Delta \text{NON\_IMP}_{t-i} + \sum_{i=1}^{p} \lambda_5 \Delta \text{OIMP}_{t-i} \\ & + \sum_{i=1}^{p} \lambda_6 \Delta \text{GFCF}_{t-i} + \sum_{i=1}^{p} \lambda_7 \Delta \text{INF}_{t-i} + \sum_{i=1}^{p} \lambda_8 \Delta \text{LEXR}_{t-i} \\ & + \Phi \text{ECT}_{t-1} + \mu_t \end{aligned} \tag{5}$$

where: Δ = difference, *Θ, α, λ and β* = confidents of the parameters. ECT = Error Correction Term.

This study employed the Toda-Yamamoto procedure developed by Toda and Yamamoto (1995) to estimate the direction of causality between international trade and economic growth alongside the control variable initiated in equation (7) as:

$$\begin{aligned}\text{LRGPD}_t = {} & \alpha_{01} + \sum_{i=1}^{p} \Theta_1 \text{NON\_EXP}_{t-i} + \sum_{i=1}^{p} \Theta_2 \text{OIEXP}_{t-i} \\ & + \sum_{i=1}^{p} \Theta_3 \text{NON\_IMP}_{t-i} + \sum_{i=1}^{p} \Theta_4 \text{OIMP}_{t-i} + \sum_{i=1}^{p} \Theta_5 \text{GFCF}_{t-i} \\ & + \sum_{i=1}^{p} \Theta_6 \text{INF}_{t-i} + \sum_{i=1}^{p} \Theta_7 \text{LEXR}_{t-i} + \varepsilon_t \end{aligned} \tag{6}$$

Results and Discussion

Table 2 displays the correlation matrix result among the data series. The data series of the dependent variables have a low correlation with the dependent variable, real gross domestic product growth. The result further indicates that non-oil exports and oil imports have a positive correlation with real gross domestic product while oil exports, non-oil imports, inflation rate, exchange rate, and gross fixed capital formation have a negative correlation with real gross domestic product.

In the study, a stationarity test was conducted to ensure that data series do not contain unit roots and to establish levels at which the variables are integrated. The adoption of non-stationary variables in regression estimation may yield spurious and misleading results. The unit root results

TABLE 2 Correlation Matrix

	LRGDP	NON_EXP _GDP	OIEXP _GDP	NON_IMP _GDP	OIMP _GDP	GFCF _GDP	INF	LEXR
LRGDP	1.00							
NON_EXP_GDP	0.62	1.00						
OIEXP_GDP	−0.12	−0.14	1.00					
NON_IMP_GDP	−0.049	0.098	0.62	1.00				
OIMP_GDP	0.20	0.168	0.62	0.68	1.00			
GFCF_GDP	−0.49	−0.49	−0.05	−0.06	−0.37	1.00		
INF	−0.44	−0.28	−0.13	0.04	−0.05	0.42	1.00	
LEXR	−0.04	−0.07	−0.23	−0.19	−0.29	0.16	0.59	1.00

TABLE 3 Summary of Unit Root Tests

Data Series	Unit Root at Level		Unit Root at First Difference		
	t-Statistic	Prob.	t-Statistic	Prob.	Level of Integration
LRGDP	−0.789370	0.8086	−3.140876	0.0334	I(1)
NON_EXP_GDP	−1.383937	0.5781	−4.879605	0.0004	I(1)
OIEXP_GDP	−3.034342	0.0420	-	-	I(0)
NON_IMP_GDP	−2.929312	0.0531	−9.958605	0.0000	I(1)
OIMP_GDP	−3.106430	0.0358	-	-	I(0)
GFCF_GDP	−1.896290	0.3299	−4.661226	0.0007	I(1)
INF	−2.733470	0.0796	−20.42867	0.0001	I(1)
LEXR	−2.568922	0.1094	−4.847964	0.0005	I(1)

NOTES 1(0) = Stationary at Level; 1(1) = Stationary at First Difference

at the level and first difference are reported in table 3. The unit of the data series is determined using the Augmented Dickey-Fuller (ADF) unit root technique. The ADF unit root results show that oil exports and oil imports do not contain unit roots when tested at level, while real gross domestic product, non-oil exports, oil imports, gross fixed capital formation, exchange rate, and inflation rate contain unit roots at level.

However, when tested at I(1) it is discovered that real gross domestic product is stationary. This implies that oil exports and oil imports are stationary at level I(0), while real gross domestic product, non-oil exports, oil imports, gross fixed capital formation, exchange rate, and inflation rate are stationary at first difference, I(1) as indicated by the results reported in table 3. Thus, the appropriate estimation technique to employ, as suggested by Pesaran and Shin (1999) and Pesaran and Pesaran (1997), is the Autoregressive Distributed Lag-Bound Co-integration approach to short and long-run relationships.

TABLE 4 ARDL Bound Co-integration Test

Test Statistic	Value	k
F-statistic	16.38940	7
Critical Value Bounds		
Significance	Io Bound	I1 Bound
5%	2.69	3.83

Selected Lag According to Akaike Information Criteria = 2 (20.80922*)

TABLE 5 Short-Run Co-integrating Coefficients

Dependent Variable: LRGDP			
Selected Model: ARDL(1, 2, 0, 2, 2, 2, 1)			
Variable	Coefficient	t-Statistic	Prob.
D(NON_OEXP_GDP)	0.029995	4.553624	0.0008
D(NON_EXP_GDP(-1))	−0.050724	−5.566477	0.0002
D(OIEXP_GDP)	0.000458	1.289225	0.2238
D(NON_IMP_GDP)	0.000834	0.896505	0.3892
D(NON_IMP_GDP(-1))	0.004274	4.089120	0.0018
D(OIMP_GDP)	−0.009134	−2.527335	0.0281
D(OIMP_GDP(-1))	0.010939	4.005151	0.0021
D(GFCF_GDP)	−0.005437	−8.989572	0.0000
D(GFCF_GDP(-1))	0.004560	4.904666	0.0005
D(INF)	−0.001489	−6.111468	0.0001
D(INF)	−0.000388	−2.570508	0.0260
D(LEXR)	0.042686	4.509634	0.0009
CointEq(-1)	−0.715362	−13.122342	0.0000

The determination of the co-integration relationship between international trade and the economic performance of Nigeria is ascertained using the ARDL Bound test approach. The test is conducted at lag two as suggested by the Akaike Information Criterion and displayed in table 4. The co-integration relationship shows that international trade has a long-term association with economic performance in Nigeria. According to table 3, the calculated F-statistic is given as 16.38940 which is greater than the lower critical bound value of 2.69 at a 5% significance level. This suggests that international trade in the long run would serve as a tool for enhancing economic growth and performance.

The ARDL short- and long-run coefficients on the effects of disaggregated international trade on economic growth are shown in tables 5 and 6. The short-run coefficient results presented in table 5 show that the coefficient of non-oil exports is positive and significant at the current period but becomes negative and significant at lag one. However, in the short

TABLE 6 Long-Run Coefficients

Variable	Coefficient	t-Statistic	Prob.
NON_EXP_GDP	0.161522	13.790582	0.0000
OIEXP_GDP	0.000640	1.255744	0.2352
NON_IMP_GDP	−0.008037	−4.045180	0.0019
OIMP_GDP	−0.039725	−5.303816	0.0003
GFCF_GDP	−0.022415	−18.462270	0.0000
INF	−0.001906	−5.702849	0.0001
LEXR	0.104781	12.114930	0.0000

run, oil exports is discovered to have a positive and non-significant effect on economic growth. It is found that the coefficient of non-oil imports is positive in the current period (insignificant) and at lag one (insignificant). The short-run result further reveals that gross capital formation is negative and significant during the current period but positive and significant at first period lag. However, inflation shows a negative and significant sign at the current and first period lag while the exchange rate exerted a positive and significant effect on real gross domestic product during the current period in the short run. Overall, the result implies that disaggregated international trade has mixed in predicting economic performance in the short run.

The long-run result presented in table 6 reveals that the relationship 'non-oil exports and real gross domestic product' is positive and significant in the long run. This implies that the concentration of productive capacity in the production and exportation of non-oil products would enhance the economic performance of Nigeria. Also, the result shows that oil exports, although positive, is insignificant in impacting real gross domestic product. However, the insignificance of the result is an indication of the dwindling oil fortune of the nation, especially in terms of a fall in oil prices, low demand for crude oil, and other structural problems.

It is discovered that the relationship between non-oil imports and real gross domestic product is negative and significant in the long run. This indicates the overreliance of Nigeria on importation of goods and services, which is undesirable for the growth of the economy. Most of these goods are mainly consumable goods which have continued to deplete the reserves of the nation and causing the outflow of capital which could have been invested in the country. Similarly, it is established that oil imports negatively and significantly impact gross domestic product. The long-run coefficient results reported in table 6 show that the control variables of fixed gross capital formation and inflation rate have negative

TABLE 7 Diagnostics Results

Diagnostics test	Observed value	P-value (Chi-square)
Normality Test (Jarque-Bera)	2.222171	0.8949
Breusch-Godfrey LM test for serial correlation	0.403726	0.5252
Heteroscedasticity Test: Breusch-Pagan-Godfrey	21.08251	0.3923
Ramsey RESET Test	0.464747	0.5109

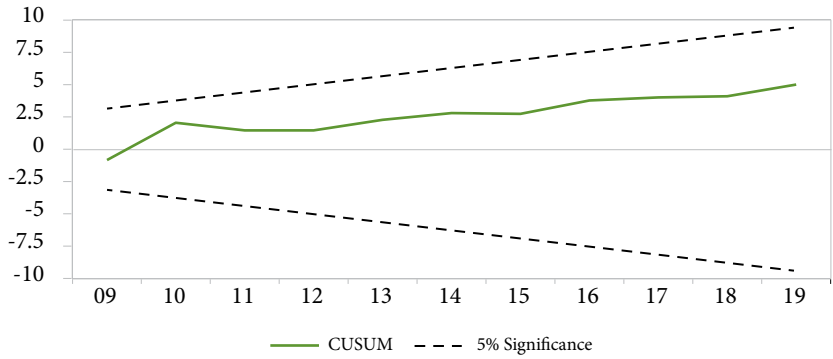

FIGURE 2 Cusu"m Stability Test Result

and significant effects on real gross domestic product. Finally, the result reveals that the exchange rate has a positive and significant effect on real gross domestic product in Nigeria.

The robustness tests for the estimated regression model are represented in table 7 and it is concluded that the regression passed the robustness tests. The result shows that the residual is normally distributed and has no serial correlation. Also, it is concluded that the result is free from heteroscedasticity, and the model is best fitted and rightly developed.

The stability test is conducted based on the method proposed by Brown et al. (1975). The result of the Cusum test presented in figure 2 reveals that the stability line falls in the acceptance region of 5%, indicating the stability of the regression estimate.

The direction of causality between international trade and economic performance is determined using the Toda-Yamamoto test presented in table 8. The result of the Toda-Yamamoto test presented in table 8 shows that oil exports, non-oil exports, non-oil imports, exchange rate, and inflation rate have a causal relationship with real gross domestic product, while oil imports and gross fixed capital formation do not have a causal

TABLE 8 Toda-Yamamoto Result

Variables	Lag (k)	Lag (k+dmax)	Chi-sq	Prob.	Direction of causality
NON_EXP_GDP does not Granger cause RGDP	2	2+1	14.68257	0.0021	Causal Relationship Exists
OIEXP_GDP does not Granger cause RGDP	2	2+1	9.222076	0.0265	Causal Relationship Exists
NON_IMP_GDP does not Granger cause RGDP	2	2+1	27.68165	0.0000	Causal Relationship Exists
OIMP_GDP does not Granger cause RGDP	2	2+1	4.266963	0.2340	No Causality
GFCF_GDP does not Granger cause RGDP	2	2+1	3.342150	0.3418	No Causality
INF does not Granger cause RGDP	2	2+1	37.56279	0.0000	Causal Relationship Exists
LEXR does not Granger cause RGDP	2	2+1	14.06371	0.0028	Causal Relationship Exists
Overall	2	2+1	131.8512	0.0000	Causal Relationship Exists

relationship with real gross domestic product. Overall, it is found that international trade has a causal relationship with economic performance.

Discussion

Findings in this paper showed that international trade has the potential to significantly enhance the economic growth of Nigeria. It was discovered in the short run that the components of international trade had mixed effects on the economic growth of Nigeria. For instance, it was found that both non-oil exports and non-oil imports significantly enhanced the economic growth of Nigeria, while oil exports insignificantly impacted economic growth. This is supported by the study of Sujová et al. (2021), which revealed that international trade provides an effective mechanism for facilitating economic performance. Moreover, it was reported in the study that oil imports adversely impacted the economic performance of Nigeria in the short run. Adeleye et al. (2015) findings showed that the overreliance of Nigeria on importation harms the economy through the loss of foreign reserves, which contributed to economic destabilisation. These short-run results indicate the structure of Nigeria's economy with reliance on crude oil. Notably, the policy of the government to promote non-oil export and import trade played a significant role in improving the country's economic performance. Moreover, the irrelevant nature of the oil export shows that despite the overreliance on

oil exports, the country has not been able to achieve noteworthy growth in the economy. This could probably result from the continuous depreciation of the Nigerian currency, with implications for the depletion of foreign earnings. Likewise, the negative impact of oil imports points to the excess importation of refined oil products despite Nigeria being a major oil-producing country.

In the long run, it was reported that non-oil exports significantly improved the economic growth of Nigeria. This result demonstrates the significant shift towards the diversification of the economy to non-oil exports. These findings conform with the empirical results of Abendin and Duan (2021), Yameogo and Omojolaibi (2020), Kumar (2012), Manwa and Wijeweera (2016), Yakubu and Akanegbu (2018), Zahonogo (2017), Le (2020), and Celik et al. (2024), who found a positive effect of trade, especially through export on growth. Over the years, reliance on the exportation of oil has been a bane to the progress of the country, with exposure to external shocks; nevertheless, the growth of non-oil sectors such as agriculture, manufacturing, and service sectors underscores the efforts of the government to ensure a balance between oil and non-oil exports. An increase in non-oil exports can help reduce dependence on oil revenue and promote economic stabilisation (Abendin and Duan 2021). This has implications for diversifying the source of foreign earnings. However, it was noted that oil exports insignificantly predict the economic performance of Nigeria in the long run. Remarkably, while oil exports remain an important source of foreign earnings in Nigeria, oil revenue has continued be affected by diverse factors such as overreliance on oil, volatility of price, and challenges within the oil sector.

Although Nigeria has previously experienced an oil boom, the recent fluctuation in oil prices and external shocks have caused major instability in oil revenue. Historically, Nigeria has not been able to adapt to these downturns, with undesirable effects on economic growth. The insignificance of oil exports both in the short run and long run indicates the problems of resource curse for Nigeria, with the country unable to achieve sustainable growth despite its abundance of crude oil. High reliance on oil exports could lead to crowding out investment in other major sectors such as agriculture and manufacturing.

Furthermore, the negative effect of non-oil and oil imports on the economic growth of Nigeria reflects the challenges related to the country's overdependence on foreign goods and services. The negative linkage between import trade (oil and non-oil imports) conformed to the findings

of Makhmutova and Mustafin (2017), Adeleye et al. (2015), and Mogoe and Mongale (2014). For instance, the limited and non-functioning refineries of Nigeria force the country to depend heavily on the importation of refined petroleum products from other countries. This has implications such as the draining of foreign reserves, worsening inflation, and unbalanced trade, which impede the progress of the economy. In addition, the negative effect of non-oil imports reported in this study indicates the high importation of technologies, machinery, and consumer goods. These reflect the underdeveloped nature of Nigeria in terms of industrialisation, innovation, and non-competitiveness of domestic manufacturing and production. This impedes the performance of Nigeria's economy by increasing international borrowings, depreciation of the naira, and exposure of the country to external shocks such as global price volatility, imported inflation, and disruption of the value chain.

Conclusion, Policy Implication and Recommendations

Based on the result of the study, it was concluded that Nigeria is yet to fully actualise the gain from international trade. This is evident, as the country's oil and non-oil imports exceed the value of exports. This disparity has significantly contributed to economic challenges, as the negative impacts of imports on economic growth surpass any benefits realised from exports. For example, the high influx of imports weakens domestic industries and can lead to a fall in domestic production capacity, despite the country's richness in natural resources, including oil, which is the major contributor to earnings from exports. This not only affects the balance of trade but also suppresses economic stability, investment, and economic diversification. Also, as evident in the findings, the high rate of inflation worsens this situation by accelerating the cost of imported goods, with a negative effect on local investors and consumers. In the same vein, exports are cheaper due to high inflation, which further skewed the benefits of trade in favour of imported commodities. With dwindling investment opportunities because of uncertainty and economic inability, the potential for economic growth is further hampered. This leads to a cycle where low levels of domestic investment contribute to sustained economic stagnation, with ultimate adverse effects of the current trade position on the economic growth trajectory of Nigeria.

This study has major implications for the government of Nigeria and other developing countries alike. From a policy perspective, the study

revealed a significant trade imbalance in Nigeria, resulting from the nation's overwhelming reliance on the oil sector for both imports and exports. Notwithstanding oil being Nigeria's largest export commodity, the high focus on bolstering this sector has unconsciously led to the neglect of other vital sectors such as agriculture and manufacturing. This policy misalignment hinders the diversification of the country's export capabilities and impedes potential economic stability and growth. Moreover, poor performance of macroeconomic variables such as inflation rate due to the monetary policies that have not stabilised the economy raises a major concern. The implications of this high inflation include increasing import costs, consequently causing economic instability for consumers and businesses with the creation of a challenging environment to enhance economic activities and growth.

Theoretically, this paper contributed to the empirical study by uncovering the effect of disaggregated international trade on economic performance in a developing country. The study supports other studies that revealed that developing countries that are import- and oil-dependent do not reap benefits from trade. From a theoretical perspective, while this study supports the theory that exports positively impact economic performance, importation was found to hurt economic performance. This indicates the need for more studies on how disaggregated components of international trade impact the economic performance of developing countries. This can lead to the investigation of a more complex relationship between international trade and economic performance as well as the discovery of more insightful results. Moreover, studies should be conducted on how international trade components impact macroeconomic variables such as nflation and unemployment rates.

Findings from this paper underscore the need for a comprehensive economic policies reassessment, aimed at promoting a more balanced and inclusive approach to trade that develops multiple economic resources and sectors for enhancing overall economic growth and stability. First, it is paramount to focus on economic diversification to establish the country as a viable exporter in the international market. It is crucial for government policies to be directed at revitalising the non-oil sector of the economy, with particular emphasis on agriculture. This can be achieved through investment in agricultural innovation and supply chain innovation following the endogenous growth theory that emphasises the role of technological innovation in the trade-growth relationship.

Moreover, there is a need for policies targeted at cutting reliance on imports. This can be realised by promoting domestic production through increasing incentives for local manufacturers, improving infrastructures such as transportation, and boosting domestic productive capacity. The government should prioritise import substitution strategy, foster industrialisation, and support small and medium-scale enterprises. In addition, other untapped resources and special sectors apart from crude oil should be fully explored and harnessed into production capacity to reduce the reliance of the country on importation, and also boost exports. This involves the identification and prioritising of investment in areas such as renewable energy, tourism, and technology, which can bolster production and export capabilities and reduce the country's reliance on oil, as supported by the Heckscher-Ohlin theorem developed by Heckscher (1919) and Ohlin (1933). Considerable efforts and investments should be made to revamp the nation's existing refineries and build more refineries to reduce the importation of petroleum products. Through the replacement of outdated facilities and the construction of new refineries, the nation can reduce its reliance on imported petroleum commodities. Notwithstanding the current involvement of private sectors such as the Dangote Group, in building a refinery in the country, the government should support more private involvement to protect monopolistic tendencies.

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Analysis of the Effect of Eco-Efficiency on Asset Return in Food and Beverage Manufacturing Companies Listed at the Johannesburg Stock Exchange

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This article examines the effect of eco-efficiency on corporate return on assets (ROA). The paper aimed to analyse whether corporate eco-efficiency performance (represented by energy consumption, water consumption, carbon emission and waste generation) affects the performance of ROA. Data on the eco-efficiency and ROA was collected from fourteen food and beverage companies listed in the Johannesburg Stock Exchange for a period of ten years (2012 to 2021). Using the STATA Software, the data was analysed by applying the Generalised Method of Moment (GMM) statistical technique, which enhanced the statistical analysis robustness. Findings from the GMM analysis showed different results. On the one hand, the results indicate that energy and water consumption in the food and beverage companies have a positive (but insignificant) effect on ROA. On the other hand, the results show that waste generation has a negative (but insignificant) effect on ROA; and that carbon emission has a negative and significant effect on ROA.

Keywords: environmental accounting, return on assets, financial performance, eco-efficiency, energy consumption, water consumption, carbon emission, waste generation, sales revenue
JEL *Classification:* Q56, M41, M21

Received 2024/10/03 · Revised 2025/02/08 · Accepted 2025/02/19

Published online 2025/06/30 https://doi.org/10.26493/1854-6935.23.175-200

Introduction

Manufacturing industries are generally seen as the greatest polluter, and as a result, there is a growing concern about environmental problems resulting from their production activities. For instance, in their process of production, energy consumption, sound emission and waste generat-

ed contribute to industry environmental pollution (Gebreeyessus et al. 2021). In addition, numerous challenges, including global warming, air pollution and water scarcity among others, pose significant dangers to environmental preservation (Novera et al. 2024). South Africa is among the countries known for their global environmental sustainability advocacy (Younis et al. 2021). The country joined other nations in developing its national environmental regulations that guide environmental operations of manufacturing industries in the country (Hoffmann 2019; Bag et al. 2021). Nonetheless, industries continue to pollute the environment through carbon emissions, excessive use of water and energy, and unsustainable use of available natural resources, affecting the planet in a negative way (Patnaik 2018; Zelazna et al. 2020; Arzova and Sahin 2023). It therefore becomes necessary to find alternative strategies to overcome the environmental challenges faced by businesses in carrying out production activities (Adhikari and Ozarska 2018; Malek and Desai 2020).

Eco-efficiency is one avenue that can reposition industry operations and activities to minimise the negative environmental impact of businesses (Sala-Garrido et al. 2021; Eder et al. 2021). As industries commit to environmental protection activities such as engagement in activities that promote eco-efficiency, financial performance can be improved (Meutia et al. 2019; Safitri and Nani 2021). This study will examine the effect that eco-efficiency variables (energy consumption, water consumption, carbon emission and waste generation) have on return on assets.

Due to its potential to minimise exhaustion of resources and to lessen pollution, eco-efficiency is considered a practical tool for sustainable development (Matsumoto and Chen 2021). The Paris Agreement was signed at the United Nations Climate Change Conference with the goals to limit global warming by minimising greenhouse gas emissions and to set net zero emission targets within industries' operations (Streck et al. 2016). However, without addressing the issue of industry environmental sustainability by becoming eco-efficient, achieving the objectives of Sustainable Development Goal 12 (SDG 12) will remain a buzzword. Some researchers have tested the relationship between eco-efficiency and financial performance and found positive and negative relationships (Miroshnychenko et al. 2017; Alheet 2019; Chukwuma et al. 2019; Pham et al. 2021). Several studies conducted relating to eco-efficiency in the South African context focused on cleaner production, environmental sustainability commitment, sustainability practices and their impact on financial

performance (Olalekan and Jumoke 2017; Masocha 2019; Dzomonda and Fatoki 2020; Maama et al. 2021).

Yacob et al. (2019) found that reusing water can enhance water conservation in manufacturing companies. Furthermore, other scholars suggest that manufacturing industries can also benefit financially from eco-efficiency practices. For example, Meutia et al. (2019) assert that, if manufacturing companies engage in the production of goods and services that promote environmental protection, thereby enhancing eco-efficiency, they will achieve better financial performance. In addition, Safitri and Nani (2021) postulate that, in carrying out efficiency in the ecological field, companies' profitability can increase. Moreover, Kurnianta and Dianawati (2021) also postulate that the minimisation of emissions, which resembles the application of eco-efficiency, will boost the image of the company in the eyes of the public, which will in turn have an impact on the value of the company, thereby influencing investors to become interested in the company. However, there is no evidence of any study that has analysed the effect of the combined eco-efficiency variables, namely, energy consumption, water consumption, carbon emission and waste generation, on return on assets in the South African context. Hence, this study aims to investigate the effects of eco-efficiency (using these variables) on return on assets (ROA) growth for selected Johannesburg Stock Exchange (JSE)-listed food and beverage manufacturing companies. Given that there is no evidence of a similar study in the South African context, it will therefore pave the way for future studies. In addition, it will add to literature and the body of knowledge on the financial implications of eco-efficiency practices. Moreover, findings of this study may increase society's awareness of the part that some manufacturing companies play in protecting the environment and may improve corporate legitimacy and consumer relations.

The second section provides a review of the theories and related empirical studies. The third section introduces the methodological approach of this study. The fourth section presents and discusses the empirical results. The fifth section discusses the findings, while the sixth section concludes the study.

Theoretical Framework and Literature Review

The theoretical framework is presented, followed by a review of literature on energy consumption and ROA, water consumption and ROA, carbon emission and ROA, and waste generation and ROA.

THE STAKEHOLDER THEORY

The stakeholder theory posits that companies should meet the expectations of their stakeholders as a way of creating value (Huge-Brodin et al. 2020; Tran and Adomako 2021). This theory postulates that business activities and operations should be conceptualised as stakeholder relationships that can serve as ways for creating value (Freeman et al. 2020). One of the ways for creating such value to stakeholders can be engagement in eco-efficiency activities, which might in turn benefit both the stakeholders and the company. Such benefits include, among others, less environmental pollution, customer loyalty, competitive advantage and enhanced financial performance.

We adopted the stakeholder theory because stakeholders, such as consumers, suppliers, shareholders, and the environment can put more pressure on companies to produce eco-friendly products. These pressures are the firms' motivating factors to produce green or environmentally friendly products to meet the demand of these corporate stakeholders. Additionally, to recognise the environment as one of the corporate stakeholders, industries should engage in eco-efficient activities, as the firms' survival is dependent on meeting societal and environmental expectations. In contrast, if manufacturing companies are known for pollutants and cannot implement eco-efficient practices in their processes of production, they might lose green-minded suppliers and customers and that will affect their financial performance.

THE INSTITUTIONAL THEORY

The institutional theory is applied when examining whether companies adopt environmentally friendly practices in their businesses (Berrone et al. 2013; Parada et al. 2020). This theory postulates that the social context from which organisations operate influences firms' behaviour, causing them to adopt related practices and structures (Hinings et al. 2018; Z. Li et al. 2020). In other words, this theory proclaims that firms should adopt green initiatives to gain acceptance from the society within which they operate. This theory further states that developing formal structures in an organisation can be affected by the environment and social surroundings, which are stronger compared with pressures from the market (Ebrahimi and Koh 2021). This implies that, beside social and environmental pressures, there are other institutional pressures causing the organisation to adopt good practices. This study adopted the insti-

tutional theory to elucidate the way in which manufacturing companies utilise natural resources to avoid depletion and pollution and improve eco-efficient practices and achieve a competitive edge and enhance financial performance.

ENERGY CONSUMPTION AND ROA

Energy is needed for contemporary manufacturing although it produces massive emissions; thus, developing and implementing energy conservation strategies to minimise the use of energy in the manufacturing sector have become crucial (L. Li et al. 2020; Clairand et al. 2020). Energy consumption and conservation has become a subject of interest that has resulted in a plethora of studies on the relationship between energy consumption and profitability proxied by ROA. Over the years, different hypotheses and research questions have emerged from researchers, aimed at addressing the effect that energy consumption has on financial performance. These hypotheses and questions suggest a negative, weak, neutral, positive, or strong relationship between the above-mentioned variables.

For example, Mdasha et al. (2024) have found energy efficiency to have a significant positive influence on financial performance proxied by ROA. On the other hand, Makridou et al. (2024) found a negative and insignificant relationship between ESG with energy use as one of the variables, and financial performance with ROA as one of the variables. Regardless of the difference in results from the aforementioned studies, publicly listed manufacturing companies should consider investing in energy efficiency initiatives for reasons other than just compliance, but also for improving operational efficiency and driving positive financial performance. The following hypotheses were developed:

$H1_0$ *There is no significant relationship between energy consumption and return on assets in JSE-listed food and beverage manufacturing companies.*

$H1_A$ *There is a significant relationship between energy consumption and return on assets in JSE-listed food and beverage manufacturing companies.*

WATER CONSUMPTION AND ROA

Manufacturing companies consume huge amounts of water while converting raw material into goods that are ready for consumption (Sharma

et al. 2020; Revollo-Fernández et al. 2020; Chamberland et al. 2020). Rosegrant et al. (2020) and Marulanda-Grisales and Figueroa-Duarte (2021) suggest that manufacturing companies can overcome the challenge of water scarcity by investing in technologies that save water and training the companies' employees on how to use water effectively in the production process. While some researchers suggest strategies for conserving water, others posit that water conservation yields great benefits such as better financial performance.

For example, Emmanuel et al. (2024) found sustainability indicators measured by energy consumption, water consumption, waste management and carbon emission to have an impact on ROA. In addition, Sudha (2020) has found water efficiency to have a positive and significant effect on financial performance, represented by ROA among other variables. In contrast, the study of Khan et al. (2021) found a negative association between green process innovation represented by water efficiency, and financial performance. Azeez et al. (2024) revealed a negative and insignificant relationship between environmental conservation practices and ROA, with waste usage as one of the proxies. However, despite the different directions of relationships found and the costs associated with the creation and execution of water conservation plans, manufacturing firms should not be discouraged, but instead, should invest more in water conservation to minimise water use in an attempt to avoid water scarcity and pollution. The following hypotheses were developed:

$H2_0$ *There is no significant relationship between water consumption and return on assets in JSE-listed food and beverage manufacturing companies.*

$H2_A$ *There is a significant relationship between water consumption and return on assets in JSE-listed food and beverage manufacturing companies.*

CARBON EMISSION AND ROA

Carbon emissions refer to unwanted output resulting from an immoderate use of energy (Lv et al. 2021). In their production processes, manufacturing industries continue to contribute to environmental pollution through huge amounts of carbon emission, posing menaces to the environment such as global warming. These emissions are generated through various sources in the course of using a unit of electricity and

during combustion (Adebayo et al. 2021). Carbon emission reduction as one of the variables of eco-efficiency is presumed to have a relationship with financial performance. Previous researchers have found carbon reduction to have an association with financial performance, although the direction of the relationships is different. For example, the study of Emmanuel et al. (2024) found carbon emission to be one of the sustainability indicators to have an impact on ROA. In addition, Kumari and Patel (2020), Aslam et al. (2021) and Rodríguez-García et al. (2022) suggest that a relationship exists between carbon emission reduction and ROA among other variables. Menicucci and Paolucci (2023) found a positive and significant relationship between environmental management represented by carbon emission and waste reduction and ROA as one of the proxies for financial performance. The study of Azeez et al. (2024) found a negative and insignificant relationship between environmental conservation practices and ROA, with carbon as one of the proxies.

All the aforementioned studies agree that there is a relationship between carbon emission reduction and financial performance, but they disagree on the negative or positive direction of the effect of carbon reduction on financial performance. Notwithstanding the fact that competitive advantage and better financial performance might be achieved through reduced carbon emissions, manufacturing companies need to avoid climatological changes and global warming resulting from their production activities by being socially responsible. The following hypotheses were developed:

$H3_0$ *There is no significant relationship between carbon emission and return on assets in JSE-listed food and beverage manufacturing companies.*

$H3_A$ *There is a significant relationship between carbon emission and return on assets in JSE-listed food and beverage manufacturing companies.*

WASTE GENERATION AND ROA

Waste refers to the rejected materials that have been generated by residential and production activities, which comes at an economic and environmental cost for their treatment and removal (Nazari et al. 2021). La Scalia et al. (2021) assert that an enormous amount of waste is generated in carrying out business activities, causing immense problems in its

treatment and disposal and causing economic losses. Kim et al. (2020) therefore suggest that manufacturing companies can use waste generation as a corporate strategy. While Shirvanimoghaddam et al. (2020) propose reuse and recycle strategies as long-term solutions for reducing waste, Kabirifar et al. (2020) and Kakwani and Kalbar (2020) propose strategies such as reduce, reuse, recycle, reclaim, recover, and restore for managing waste generated. There has been extensive research on the association between waste reduction and financial performance, with varying conclusions about which way the variables should be aligned.

Researchers such as Yu et al. (2020) have found that companies that manage waste through these strategies have improved their financial performance. For example, Menicucci and Paolucci (2023) found a positive and significant relationship between environmental management represented by waste reduction and carbon emission and financial performance represented by ROA. Emmanuel et al. (2024) found waste management to be one of the sustainability indicators that have an impact on ROA. In addition, the study of Azeez et al. (2024) established a relationship between environmental conservation practices and ROA, with waste management as one of the proxies. Baah et al. (2021) found a negative and insignificant association between environmental management, with waste as one of the proxies, and financial performance. The following hypotheses were formulated:

$H4_o$ *There is no significant relationship between waste generation and return on assets in JSE-listed food and beverage manufacturing companies.*

$H4_A$ *There is a significant relationship between waste generation and return on assets in JSE-listed food and beverage manufacturing companies.*

Methodology

This section attempts to determine a probable association between eco-efficiency variables and ROA growth of 14 food and beverage manufacturing companies listed at the JSE, as these companies' production activities contribute to environmental pollution. The researcher planned to use all 16 food and beverage manufacturing companies listed in the JSE at the time the study was conducted. However, 2 of the companies did not have complete year to year data, therefore the researcher used

TABLE 1 Description of Variables

Acronym	Name of the acronym	Measurement of data	Source of data
ROA	Return on assets	In rand amounts per year	Annual integrated reports
ENRCON	Energy consumption	In kilowatts of energy per year	Annual integrated reports
WATCON	Water consumption	In kilolitres of water per year	Annual integrated reports
CAREMM	Carbon emission	In tonnes per year	Annual integrated reports
WASGEN	Waste generation	In kilograms per year	Annual integrated reports
SALREV	Sales Revenue	In rand amounts per year	Annual integrated reports

the 14 compa nies which had complete data for all the variables for all the years to be studi ed. Data for this study was obtained from the published annual integrated reports of a sample of companies for the period 2012–2021(Johannesburg Stock Exchange 2023). This time frame was chosen because it is believed that any amendments to legislation and regulations regarding eco-efficiency may have been effected. The multiple linear regression analysis was used to establish the relationship between eco-efficiency variables and ROA growth and to determine the relationship.

For analysis, the study made use of the model regressions below:

$$ROA_{it} = \alpha_i + \beta_1 \text{ ENRCON}_{it} + \beta_2 \text{ WATCON}_{it} + \beta_3 \text{ CAREMM}_{it} + \beta_4 \text{ WASGEN}_{it} + \beta_5 \text{ SALREV}_{it} + \varepsilon_{it}, \quad (1)$$

where ε is error term, α is constant, β represents coefficients explaining the partial elasticities of explanatory variable, and it the represents company and the t represents the year.

Empirical Results and Discussion

DESCRIPTIVE ANALYSIS

Th ere were 140 annual integrated reports observed for 14 JSE-listed food and beverage manufacturing companies for a period of 10 years, as table 2 demonstrates (2012 to 2021). The mean which explains the central tendency or value in the data set is found to be 11.770 for ROA and 17.968, 13.358, 12.755, 14.730, and 18.298 for energy consumption, water consumption, carbon emission, waste generation and sales revenue, respectively.

TABLE 2 Summary Statistics

	ROA	ENRCON	WATCON	CAREMM	WASGEN	SALREV
Mean	11.770	17.968	13.358	12.755	14.730	18.298
Standard Error	0.935	0.222	0.444	0.159	0.254	0.233
Median	9.020	18.084	13.894	12.701	14.314	17.149
Std Dev	11.057	2.629	5.252	1.876	3.011	2.751
Kurtosis	3.504	−0.064	5.910	2.907	1.086	−0.907
Skewness	1.411	−0.025	−2.310	0.270	0.560	0.603
Range	75.630	11.991	25.824	11.330	15.130	9.173
Minimum	−13.380	12.210	−5.032	6.995	7.837	14.436
Maximum	62.250	24.201	20.792	18.325	22.968	23.609
Count	140	140	140	140	140	140

Descriptive statistics also include standard deviation that provides an estimation of the spread of values around the sample mean, therefore describing the sample. When a standard deviation exceeds the mean, it is considered widely dispersed. Table 2 demonstrates a standard deviation of 11.057 which is below the mean of 11.770 for ROA. This therefore means that ROA is not widely dispersed. In addition, the standard deviation for energy consumption, water consumption, carbon emission, and waste generation were 2.629, 5.252, 1.876, and 3.011, respectively, which were also less than their mean. This is an indication that independent variables as well are not widely dispersed.

CORRELATION MATRIX

This section illustrates the correlation matrix. The correlation matrix determines the association between an independent variable and its corresponding values, as well as the relationship among independent variables (Gogtay and Thatte 2017). Table 3 presents the correlation matrix.

Table 3 shows that energy consumption has a positive yet extremely weak correlation with ROA, shown as 0.093. In addition, water consumption is positively correlated with ROA, shown as 0.177, although the correlation is weak. The correlation between carbon emission and ROA is also positive but weak, shown as 0.146. Results further revealed a positive yet weak correlation between waste generation and ROA, shown as 0.151. Lastly, sales revenue showed a negative and weak correlation with ROA, shown as −0.219.

TABLE 3 Pearson Correlation

	ROA	ENRCON	WATCON	CAREMM	WASGEN	SALREV
ROA	1					
ENRCON	0.093	1				
WATCON	0.177	−0.148	1			
CAREMM	0.146	0.181	−0.075	1		
WASGEN	0.151	0.251	−0.120	0.235	1	
SALREV	−0.219	0.039	0.173	−0.044	0.004	1

TABLE 4 Unit Root Test for Stationarity

Panels	ENRCON	WATCON	CAREMM	WASGEN	SALREV
P-Value	0.0000	0.0946	0.0000	0.0000	0.0000

UNIT ROOT TEST

The study uses the Levin-Lin-Chu unit root test to test the stationarity of the panels used in the analysis. The results are presented in table 4. Panels are non-stationary according to the null hypothesis, while panels are stationary according to the alternative. The significance level is set at 0.05 (5%). Any value under 5% is deemed significant, leading to the acceptance of the alternative hypothesis and the rejection of the null hypothesis.

Table 4 demonstrates that p-values for all panels except for water consumption are below 5%. According to the prevalence of support for the alternative hypothesis that the panels are stationary, the null hypothesis should be rejected. The existence of stationarity implies that there is no unit root, which is preferred because the data set that contains unit root usually leads to misleading interpretations (Brooks 2019).

COINTEGRATION TESTS

The Pedroni panel cointegration test employs eleven statistics to test the alternative hypothesis of cointegration among the variables in the estimated model against the null hypothesis of no cointegration (Gómez Rodríguez et al. 2022). Seven panels are classified as statistics while four are classified as weighted statistics. Table 5 shows results for eleven statistics.

The critical value is set at 5%. Cointegration is acknowledged by the alternative hypothesis, whereas the null hypothesis asserts that it is not. In the case the value is below 0.05, the cointegration alternative hypothesis is accepted. Reading from table 5, six statistics out of eleven are less than 0.05. Predominance makes it impossible to accept the null hypothesis

TABLE 5 Summary of Pedroni Panel Cointegration Test

Panel	Probability	
	Statistics	Weighted statistics
Panel		
Panel v-Statistics"	0.9882	0.9683
Panel rho-Statistics"	1.0000	0.9999
Panel PP-Statistics"	0.0003	0.0001
Panel ADF Statistics"	0.0384	0.0096
Group		
Group rho-Statistics	1.0000	-
Group-PP-Statistics	0.0000	-
Group ADF Statistics	0.0102	-

that supports non-cointegration. Therefore, it is concluded that there is a long-term relationship as the alternative hypothesis supporting cointegration is accepted.

DIAGNOSTIC TESTS

Diagnostic tests are necessary because panel data models can produce inaccurate results, especially when there is failure to evaluate the implications of threats resulting from failure to pay attention to regression assumptions on model findings. In line with other studies such as those of Mogashwa (2023) and Rahman and Anis (2023), the researcher performed diagnostic tests on panel data to identify existing abnormalities as well as misspecifications that could cause estimators to be unreliable and biased. In this study, the researcher checked for heteroscedasticity, the Wooldridge test for autocorrelation and the Jarque-Bera test in collaboration with the kurtosis for normality testing.

VAR RESIDUAL HETEROSCEDASTICITY TESTS

The study used the VAR residual heteroscedasticity tests to check if the data is not affected by heteroscedasticity. The VAR residual heteroscedasticity tests have a null hypothesis of heteroscedasticity pitted in contradiction to the alternative hypothesis of homoscedasticity. It is worth noting that the desired outcome is homoscedasticity in the estimated model, and that is achieved when the computed probability value is above 0.05. However, reading from the results in table 6, the null hypothesis of heteroscedasticity is accepted given that the computed probability value is less than 0.05.

TABLE 6 Results of Heteroscedasticity

Test name	Probability value	Decision
Heteroscedasticity with Cross Terms ROA	0.0000	Accept Null

TABLE 7 Wooldridge Test Results in Panel Data

F(1.13)	12.333
Prob > F	0.0033

AUTOCORRELATION TESTS

If the p-value exceeds 0.05, the null hypothesis is accepted. Conversely, if the p-value is below 0.05, it is rejected. The null hypothesis posits the absence of first-order autocorrelation and is contradicted by the alternative hypothesis claiming the existence of such autocorrelation. The p-value is 0.0033 which is less than 0.05, making the alternative hypothesis of autocorrelation to be accepted. Consequently, the null hypothesis suggesting the absence of first-order autocorrelation is rejected.

NORMALITY TESTS

Figure 1 presents normality tests results.

For normal distribution of results, the probability value of the Jarque-Bera should be insignificant and Kurtosis should take a value of approximately 3. Reading from figure 1 it is revealed that the residuals are not normally distributed.

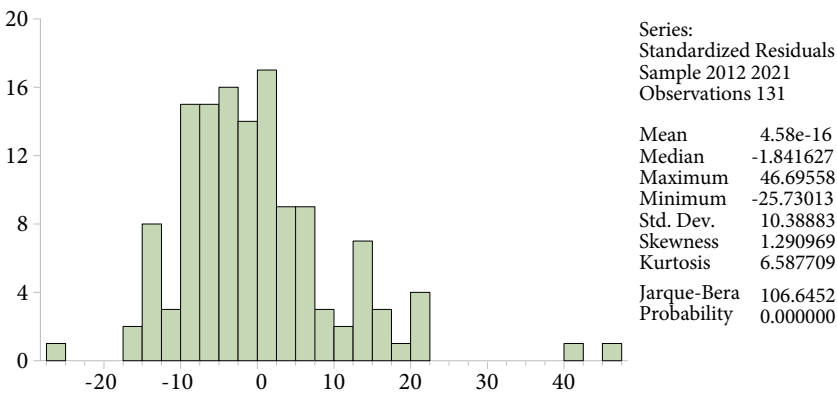

FIGURE 1 Normality test results

TABLE 8 Hausman Test

	Coefficients (b) FE	(B) RE	(b-B) Difference	Standard Error
ENRCON	-.1219149	.0545564	-.0673586	.0947721
WATCON	1.142282	.6063437	.5359385	.5713364
CAREMM	.1527403	.3672574	-.2145171	.1984118
WASGEN	-.587264	-.2323592	-.3549048	.1984118
SALREV	-.8578007	-.9909188	.133118	.8665627

NOTE b = consistency with the Ho and Ha, B = inconsistency with the Ha and efficient within Ho, Test: Ho: the null hypothesis is accepted, $chi^{2(3)}$ = (b-B)'[(V_b-V_B).^(−1)](b-B) = 3.75, Prob:>chi^2 = 0.5857

HAUSMAN TESTS

Hausman distinguishes between FE and RE models in panel data. Table 8 presents the Hausman test results.

If the p-value is less than 0.05, it is appropriate to reject the null hypothesis. If the p-value exceeds 0.05, it is appropriate to accept the null hypothesis. According to the alternative hypothesis, the fixed effects model is preferred, while the null hypothesis advocates for the random effects model. Hausman test results show a p-value of 0.5857, suggesting that the random effects model is preferred.

RANDOM EFFECT RESULTS

The findings indicate that there is a negative and statistically insignificant relationship between energy consumption and the dependent variable (ROA). On the other hand, water consumption is positively related to ROA, but the relationship is also statistically insignificant. Carbon emission is positively and yet insignificantly related to ROA while waste generation is negatively and insignificantly associated with ROA. Sales revenue as a controlling variable has an insignificant negative impact on ROA.

Although RE was preferred, there were problems of abnormality and heteroscedasticity in panel data which are not catered for in RE. The analysis was then extended to GMM for robustness of the analysis and to cater for abnormality and heteroscedasticity.

TABLE 9 Random Effect Results

	ROA
ENRCON	−0.055 (0.321)
WATCON	0.606 (0.376)
CAREMM	0.367 (0.596)
WASGEN	−0.232 (0.357)
SALREV	−0.991 (0.688)
_cons	21.521 (16.123)
Number of obs	140
Number of groups	14
R-sq	0.1313
Prob>chi2	0.4256
Prob>F	"0.0386
Prob>chibar2	0.0000

EXTENDED ANALYSIS USING GENERALISED METHODS 4OF MOMENTS

GMM is renowned for eliminating all indigeneity from the panel model, taking into consideration unobserved time-invariant country-specific effects (Barros et al. 2020). Despite RE being a preferred model over FE as revealed by Hausman tests, it holds some limitations. For instance, it is assumed that the RES are normally distributed; however, this is not always the situation. In this study, normality was violated as the residuals were not normally distributed. In addition, reading from the VAR tests for heteroscedasticity results in table 6, it shows that the panel is heteroscedastic, which is not preferred. To counter these problems of abnormality and heteroscedasticity in panel data, the study employs GMM which has an advantage of handling serial correlation, heteroscedasticity, and non-normal distribution problems (Xaisongkham and Liu 2022). Moreover, this estimator is believed to eliminate standard errors and is more robust to heteroscedasticity in panel data (Akinbode and Bolarinwa 2020). GMM provides a straightforward way to test the specification of the model and therefore provide a high level of reliability.

GENERALIZED METHOD OF MOMENTS RESULTS

This section presents GMM results.

Results in table 10 show that energy consumption is positively and insignificantly related to ROA. Water consumption is also positively related to ROA. This relationship is statistically insignificant. However, the results show that carbon emission and waste generation are negatively

TABLE 10 GMM Results

	ROA
Dependent (constant)	0.251** (0.115)
ENRCON	0.384 (0.424)
WATCON	1.454 (1.126)
CAREMM	−1.469* (0.866)
WASGEN	0.735 (0.489)
SALREV	−0.463 (1.909)
_cons	20.292 (39.014)
Number of obs	140
Number of groups	14
R-sq	0.0471
Prob>chi2	0.0295
Prob>F	0.0462
Prob>chibar2	0.0235

NOTES Standard errors are shown in parenthesis, while *, **, *** represent significance at 1%, 5%, and 10% levels, respectively.

associated with ROA. The relationship between carbon emission and ROA is statistically significant while for waste generated and ROA, the relationship is insignificant. The control variable, sales revenue, has a negative and insignificant impact on ROA.

Discussion Findings

Energy Consumption and ROA

Results show that energy consumption is positively yet insignificantly associated with ROA. Despite the insignificant relationship revealed from GMM, these results are in line with those of Mdasha et al. (2024), which found energy consumption to have a positive influence on financial performance, although the influence in this study was insignificant. Furthermore, these results are in agreement with the stakeholder theory which posits that companies should meet the expectations of their stakeholders as a way of creating value. Conserving energy can be used as one of the strategies for creating such value to stakeholders, which will in turn benefit both the stakeholders and the company in the form of less environmental pollution, increased customer loyalty, competitive advantage, and enhanced financial performance. Additionally, the results agree with the institutional theory which postulates that companies should engage in green production in the pursuit of attaining a sustained competitive advantage and greater financial performance. In contrast,

Makridou et al. (2024) found that attaining energy efficiency negatively and insignificantly influence financial performance represented by ROA.

The null hypothesis, $H1_o$, stated that there is no significant relationship between energy consumption and return on assets (ROA), whereas the alternative hypothesis, $H1_a$, proposes the opposite. Although the results show a positive effect of energy consumption on ROA, the acceptance of the null hypothesis is warranted given that the relationship is statistically insignificant. Despite the insignificant relationship found between energy consumption and financial performance, food and beverage manufacturing companies need to guard the natural environment against pollution and degradation to protect human health and also ensure that both the current and the future generation benefit. Furthermore, some goals, specifically for social and economic development, hinge on the health of ecosystems and natural resources.

WATER CONSUMPTION AND ROA

Water consumption is also positively and insignificantly related to ROA. The findings in this study align with those of Sudha (2020), who found water efficiency to have a significant positive effect on financial performance represented by ROA. Furthermore, these results support the stakeholder theory which advocates and proposes strategies on how a company ought to be managed to meet expectations of its stakeholders. This theory posits that excessive use of water causes serious problems to the environment such as pollution and water scarcity, which will negatively affect the stakeholders. Additionally, these results support the institutional theory as used by some researchers such as Gupta and Gupta (2021) and Yuan and Cao (2022). The results further support those of Emmanuel et al. (2024) which found water consumption as one of the sustainability indicators to have a positive yet insignificant relation with ROA. However, Khan et al. (2021) revealed a negative association between green process innovation represented by water efficiency among other variables, and financial performance represented by ROA. Moreover, Azeez et al. (2024) found a negative effect of environmental compliance on ROA, with water saving as one of the variables. The null hypothesis, $H2_o$, claims that there is no significant relationship between water consumption and return on assets (ROA), whereas the alternative hypothesis, $H2_a$, proposes otherwise. The null hypothesis is accepted given that the relationship between water consumption and ROA is statistically insignificant.

CARBON EMISSION AND ROA

GMM results further revealed that carbon emission is negatively and significantly related to ROA. These results support those from the study of Kumari and Patel (2020), who found a negative association. These results are also in agreement with the study of Azeez et al. (2024) which found a negative relationship between environmental conservation practices and ROA, with carbon emission reduction as one of the proxies. The findings are different from those of Emmanuel et al. (2024) which found carbon emission as one of the sustainability indicators to have a positive yet insignificant relation with ROA. Moreover, the stakeholder theory postulates that, for companies to maintain good relationships with companies' stakeholders, they should meet their expectations and treat them in the best manner, and carbon reduction can be among the strategies for creating such value.

The null hypothesis, $H3_o$, of no significant relationship between carbon emission and return on assets (ROA), is accepted given that the relationship between carbon reduction and ROA is negative and statistically insignificant. Besides the economic benefits that companies stand to gain, the environment should stand a chance of being free from pollution and degradation, thereby not making the next generation face social, economic, and environmental assets that are degraded, and therefore, diminished wealth.

WASTE GENERATION AND ROA

Results further show that waste generation is negatively and insignificantly related to ROA. The results agree with those of Baah et al. (2021) which found environmental performance to be negatively and insignificantly associated with financial performance. These results are further in agreement with the study of Azeez et al. (2024) which found a negative and insignificant relationship between environmental conservation practices and ROA, with waste management as one of the proxies. However, the findings are different from those of Emmanuel et al. (2024) which found waste generation as one of the sustainability indicators to have a positive yet insignificant relationship with ROA. The null hypothesis, $H4_o$, of no significant relationship between waste generation and ROA, is accepted given that the relationship between waste generation and ROA is negative and statistically insignificant. Despite the insignificant relationship found between the aforementioned variables, food and

beverage manufacturing companies should control the ways in which natural resources are utilised to avoid depletion and pollution, and improve eco-efficient practices in order to gain competitive advantage and enhance financial performance. In addition, different needs of different stakeholders, inclusive of the natural environment, should be addressed.

Conclusion

This paper aimed to analyse the effect of eco-efficiency (represented by energy consumption, water consumption, carbon emission and waste generation) on corporate return on assets (ROA). On the one hand, findings from the regression outputs show that two independent variables, namely energy consumption and water consumption, have a positive (although insignificant) effect on companies return on assets. On the other hand, the other two independent variables, carbon emission and waste generation, including the control variable, sales revenue, showed an insignificant and negative effect on return on assets.

Based on the results, this paper therefore concludes that energy consumption and water consumption in the South African food and beverage manufacturing sector may positively affect the return on assets growth. Furthermore, based on the results, the paper shows that carbon emission and waste generation may have a negative effect on the food and beverage companies' return on assets. At the theoretical level, this study contributes to the gap in literature analysing the effect of eco-efficiency variables on return on assets and other financial indicators for the food and beverage manufacturing sector. At the practical level, it is believed that the results of this study will motivate manufacturing industries to engage in eco-efficiency practices and to improve existing environmental investments and practices. Additionally, the results will assist with instilling thoughts of engaging in eco-efficiency practices in companies that engage in unsustainable business practices so that they contribute towards the achievement of SDG 12. Moreover, the study results provide insight for food and beverage manufacturing companies managers who pursue eco-efficiency practices while attaining greater financial performance. Commitment to eco-efficiency is viewed positively by companies' stakeholders such as green-minded consumers and investors that will likely associate with the green company, leading to great financial yields. The results further confirmed the stakeholder theory and the institutional theory. The stakeholder theory encourages companies to address the needs and interests of different stakeholders and eco-efficiency

is one of the ways of catering for such interests, whereas the institutional theory influences firms to adopt green practices. Given that at least two eco-efficiency variables out of the four used in this study revealed a positive effect on financial performance in the 10 years covered in this study, it is therefore believed that if manufacturing companies continue to minimise the use of energy and water and reduce carbon emission and waste generation, financial performance might be positively and significantly affected.

This study focused on examining the effect of eco-efficiency variables on ROA of JSE-listed food and beverage manufacturing companies and therefore results were limited to these companies only. The period of study was from 2012 to 2021; as such, the study was limited to 10 years. In addition, this study was limited to four eco-efficiency variables and only one financial performance variable, ROA. The study used only GMM to analyse secondary data from published annual integrated reports of food and beverage manufacturing companies.

The paper recommends future research on the effect of eco-efficiency variables used in this paper on other corporate performance metrics. Future research may also extent the time frame as the 10 years used in this paper might have been the companies' period of investment in eco-efficiency, which might have led to the negative effect of some eco-efficiency variables on ROA. In addition, future researchers may use methods such as Ordinary Least Square (OLS) or Auto Regressive Distributed Lag (ARDL) among others, to confirm the results obtained by this study. Future researchers can extend their focus to other countries as the study focused on companies listed in the Johannesburg Stock Exchange in South Africa.

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Impact of CSR, Green Finance and Green Innovation on Environmental Performance of Banks in India

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In an era of growing environmental challenges, the role of banks in promoting sustainability is critical. This study examines how Corporate Social Responsibility (CSR), green finance, and green innovation influence the environmental performance of Indian banks. Guided by legitimacy theory and the natural resource-based view, survey data from 379 bank employees were analysed using structural equation modelling. The results reveal that robust CSR initiatives, effective green finance practices, and innovative green strategies significantly enhance banks' environmental performance. These findings contribute to theoretical understanding and offer practical insights for improving sustainability in the banking sector. The study recommends that banks in emerging economies strengthen internal resources by investing in CSR, adopting green finance, and fostering green innovation to boost environmental performance. Such efforts align with global sustainability goals, positioning banks as key players in environmental protection and responsible finance.

Keywords: corporate social responsibility, green finance, green innovation, environmental performance of banks, structural equation modelling
JEL *Classification:* Q56, M14, G21, O32

Received 2025/01/31 · Last revised 2025/04/18 · Accepted 2025/05/11

Published online 2025/06/30 https://doi.org/10.26493/1854-6935.23.201-231

Introduction

Banks, as major players in the financial world, play a crucial role in promoting environmentally sustainable practices. Their green finance efforts – which span economic, social and environmental aspects – combined

with innovative green strategies, are essential in boosting their overall environmental performance (Guang-Wen and Siddik 2022; Chen et al. 2022; Zheng et al. 2021a). These efforts are designed to strike a balance between economic growth and environmental protection, highlighting a rising awareness that sustainability should be at the core of every business strategy. By merging green finance with innovative environmental strategies, banks have a unique opportunity to address ecological challenges head-on. Incorporating ethical values into their everyday operations enables financial institutions to effectively navigate the ever-changing landscapes of economics and finance while pushing forward initiatives that prioritize environmental responsibility (George et al. 2023). Additionally, actively participating in Corporate Social Responsibility (CSR) programmes and channelling funds into eco-friendly projects are essential steps toward enhancing environmental performance and promoting sustainable growth (Salim et al. 2023). Integrating CSR into environmental performance management systems can drive the transition toward sustainability, helping businesses create long-term value and ultimately improve their environmental outcomes (Atangana et al. 2023).

Despite the clear significance of green finance and green innovation, there is still a lack of extensive research on these topics, particularly in the banking sector of emerging economies such as India (Ramesh and Mendes 2015; Kraus et al. 2020; Ajibike et al. 2023). This gap in research is concerning as it limits our understanding of how CSR practices, green finance, and green innovation affect banks' environmental performance. Without thorough empirical studies on these connections, stakeholders lack essential insights needed to promote sustainable practices in the banking sector, thereby hindering progress toward environmental preservation and economic development.

To address this gap, the study aims to explore how CSR practices, green finance, and green innovation interact and influence the environmental performance of banks in India (Bihari and Pradhan 2011) (see figure 1). By offering valuable insights, the research aims to guide strategic decision-making, promoting both environmental sustainability and economic growth within the banking sector. To bridge the identified research gap, the study is centred on the following research question:

> *Do CSR practices, green finance elements (social, economic, and environmental dimensions), and green innovation have any impact on environmental performance of selected banks in India?*

Using a carefully crafted questionnaire and structural equation modelling, this study aims to clarify how these factors influence environmental sustainability. It also examines the direct impact of CSR practices, green finance and green innovation initiatives on environmental performance, offering deeper insight into the key mechanisms that drive sustainability in the banking sector (Prasad et al. 2019).

The study's findings are expected to provide both theoretical and practical insights. Empirical evidence from Indian banks will add to the existing research on CSR, green finance, green innovation, and environmental performance, particularly in the context of emerging economies. By showcasing the positive effects of green finance and innovation on environmental outcomes, the study aims to guide banking managers in making strategic decisions that maximize the use of internal resources to strengthen sustainability efforts. Ultimately, this research seeks to enhance understanding of the pathways toward environmental sustainability in the banking sector, supporting informed policy development and industry initiatives.

Unlike other industries that directly impact the environment through emissions and resource consumption, banks drive sustainability through financial decisions. As intermediaries, they fund green projects, incentivize eco-friendly practices, and integrate environmental risks into investments, shaping entire industries. This financial influence positions banks as key enablers of sustainability rather than just participants. Given their critical role in financing sustainable development, studying how banks integrate green finance, CSR, and innovation is essential for understanding environmental performance drivers and shaping effective sustainability policies.

This study is distinct from previous research in several ways. Unlike existing studies that primarily focus on the effects of CSR, green finance, and green innovation on firm performance and sustainability performance (Abbas et al. 2019; Zheng et al. 2021a), this research investigates their impact specifically on the environmental performance of both private and public sector banks in India – an area largely overlooked in the context of emerging economies. Additionally, prior studies on this subject have yielded inconsistent and inconclusive findings, necessitating further exploration of the relationship between CSR, green finance, green innovation, and environmental performance within banking institutions. To address this gap, the present study proposes and tests a comprehensive research model grounded in legitimacy theory and re-

source-based view theory, integrating the concept of green finance to provide a more holistic understanding of how these factors interact to shape environmental outcomes in the banking industry.

The structure of this study is as follows. Section 2 provides the theoretical background and literature review. Section 3 outlines the development of the research hypotheses. Section 4 describes the research methodology employed. Section 5 presents and analyses the empirical results. Section 6 offers a comprehensive discussion of the findings. Finally, Section 7 concludes the study by summarizing key insights, highlighting theoretical and practical implications, and identifying limitations and directions for future research.

Theoretical Background and Literature Review

THEORETICAL BACKGROUND OF THE STUDY

Legitimacy theory emphasizes the need for organizations to align their values and actions with societal norms to sustain their legitimacy. To achieve this, businesses adopt CSR initiatives, ensuring they comply with both legal and ethical standards while fulfilling stakeholder expectations for social and environmental accountability (Dowling and Pfeffer 1975). Green finance helps organizations manage their environmental impact by reducing energy use and lowering their carbon footprint, thereby reinforcing their legitimacy. Likewise, green innovation promotes sustainability by developing and implementing eco-friendly technologies, meeting societal expectations and supporting environmental protection efforts (Kölbel and Busch 2021). Leveraging CSR, green finance, and green innovation, organizations can secure and maintain their legitimacy, crucial for achieving environmental sustainability, as emphasized by the legitimacy theory (Chen et al. 2022; Ferreira et al. 2014). Banks wield substantial influence on sustainability, and their endeavours to contribute to societal betterment are communicated to uphold and reinforce their reputation and customer relationships (Matute-Vallejo et al. 2011; McDonald and Rundle-Thiele 2008).

Furthermore, the resource-based view theory posits that an organization's resources and capabilities drive competitive advantage (Hart 1995; Barney 1991). The natural resource-based view expands on this idea within the framework of environmental sustainability, proposing that tackling environmental challenges can lead to long-term competitive advantages. By utilizing environmental resources effectively and im-

plementing pollution prevention strategies, organizations can enhance their sustainable performance (Singh et al. 2020). The resource-based view highlights the importance of incorporating CSR practices across environmental, social, and economic dimensions to effectively evaluate organizational performance. This approach aligns with societal expectations while also strengthening the organization's competitive position (Sánchez-Infante Hernández et al. 2020). Furthermore, in line with the resource-based view, banking institutions can use CSR initiatives to set themselves apart from competitors and enhance their public image (Gangi et al. 2019). Strategic CSR practices create a mutually beneficial scenario where banks adopt socially responsible approaches to enhance their market positioning, bolster long-term profitability (Bénabou and Tirole 2010), and ensure long-term sustainability (Kolk 2016).

Existing research has applied various theories, such as stakeholder theory and the ability-motivation-opportunity theory, to explore the connections between CSR, green finance, green innovation, and environmental performance. This study adopts a framework based on legitimacy theory and the natural resource-based view to examine how CSR, along with green finance (covering economic, social and environmental dimensions) and green innovation, affects environmental performance. By combining these theoretical perspectives, the research aims to offer valuable insights into how organizations can harness CSR, green finance, and green innovation to promote environmental sustainability, advancing both academic understanding and practical applications in the field.

INDIAN BANKING AND SUSTAINABILITY

The banking sector is considered essential in advancing sustainable development, serving as a key catalyst for inclusive economic growth within a nation (United Nations Environment Programme Finance Initiative 2016). Over the past decades, the integration of sustainability into banking has gained momentum. Banks can integrate sustainability in two key ways. First, through CSR, they can incorporate environmental and social responsibility into their daily operations. This includes initiatives like zero waste policies, paperless banking, energy-efficient practices, financial inclusion programmes, financial literacy efforts, and community welfare projects, all of which contribute to both environmental and social well-being. Second, banks can embed sustainability into their core strategy by leveraging green finance and green innovation. This means incorporating environmental and social impact criteria into financing

decisions, developing sustainable financial products, and promoting eco-friendly loans, digital banking, and remote financial services (United Nations Environment Programme and the World Bank Group 2017). Indian banks are also increasingly acknowledging their crucial role in driving sustainable development (Kumar and Prakash 2019).

Green finance has become a crucial strategy for Indian banks in supporting sustainable development. By directing financial resources toward projects that promote efficient resource management and environmentally friendly technologies, banks play a key role in mitigating environmental challenges. Recognizing the financial risks associated with climate change, the Reserve Bank of India has introduced a draft disclosure framework to guide regulated entities in managing climate-related risks. While India's economy is among the fastest-growing globally (International Monetary Fund 2024), this rapid expansion has come at an environmental cost, with rising pollution levels and increased carbon emissions (Thapliyal et al. 2025). According to Deb and Kohli (2022), India ranks as the third-largest carbon emitter, highlighting the urgent need for sustainable interventions. In response, the Indian government has set ambitious sustainability targets, including achieving net-zero emissions by 2070 and reducing CO_2 emissions by 50% by 2050 (Emir et al. 2024). Meeting these goals will require substantial financial investments, positioning banks as critical facilitators in bridging the funding gap and accelerating India's transition toward a greener, more sustainable economy.

Additionally, Indian banks are increasingly leveraging CSR initiatives to enhance their environmental performance. For instance, State Bank of India has implemented green banking practices, including the installation of wind farms to generate renewable energy, thereby reducing its carbon footprint. Similarly, YES Bank has been proactive in financing renewable energy projects and promoting sustainability through its CSR activities (YES BANK 2022). These initiatives not only demonstrate the banks' commitment to environmental stewardship but also contribute to improved environmental performance by integrating sustainable practices into their operations.

Besides this, Indian banks are also increasingly adopting green innovation strategies to enhance their environmental performance. A study by Thapliyal et al. (2025) highlights that green banking practices, such as developing green products, implementing eco-friendly internal processes, and engaging in green corporate social responsibility, have significantly improved the environmental performance of banks in Uttarakhand. Sim-

ilarly, research by Gulzar et al. (2024) indicates that operational aspects of green banking, including energy-efficient operations and digital banking services, substantially contribute to environmental sustainability in both private and public sector banks across India. These initiatives not only demonstrate the banks' commitment to environmental stewardship but also position them as key players in promoting sustainable development within the financial sector.

In India, research examining the impact of CSR, green finance, and green innovation on banks' environmental performance is gaining momentum. For example, a study explored the effect of green finance on the environmental performance of Indian banking institutions, emphasizing the role of sustainable financing in enhancing environmental outcomes (Kothiyal and Tripathi 2023). While studies in other emerging economies, such as Bangladesh, have demonstrated that CSR and green finance positively impact environmental performance, with green innovation acting as a significant mediator, similar comprehensive analyses within the Indian banking sector are limited (Guang-Wen and Siddik 2022). Given India's ambitious sustainability goals and the banking sector's pivotal role in financing eco-friendly projects, investigating these relationships in the context of Indian public and private banks is both timely and essential. Such research would provide valuable insights into how these factors collectively enhance environmental performance, guiding policy formulation and strategic initiatives toward sustainable development.

EXISTING LITERATURE ON GREEN INNOVATION AND ENVIRONMENTAL PERFORMANCE

Environmental performance reflects how a company's operations affect the natural environment, including areas such as waste reduction, energy efficiency, and compliance with environmental regulations. An important factor in assessing environmental performance is the efficient use of materials, which involves incorporating eco-friendly components and minimizing resource consumption (Klassen and Whybark 1999; Tung et al. 2014). It involves ongoing, proactive management practices that focus on conserving natural resources while improving business efficiency, going beyond simple compliance with environmental regulations (Shaumya and Arulrajah 2017). The banking sector is widely recognized as one of the highly regulated economic domains, characterized by standardized services offered by a relatively limited number of market players. This underscores the critical imperative for banks to

adopt a customer-oriented approach (Alrubaiee 2012; Liu and Wu 2007; Tulcanaza-Prieto et al. 2020). Evaluating environmental performance in the banking industry includes initiatives like cutting back on paper use, lowering carbon emissions, and educating employees about energy efficiency and environmental preservation (Zhang et al. 2022). Environmental performance is not simply protecting the environment within an organizational culture; instead, it includes the proactive and continuous management of activities aimed at specific and long-term goals of conserving natural resources while enhancing business productivity (Shaumya and Arulrajah 2017).

In response to growing environmental concerns worldwide, many companies have adopted eco-friendly practices, with green innovation becoming a crucial strategy to improve their environmental performance. Green innovation involves enhancing products and procedures to make them more environmentally friendly, achieved through measures such as choosing eco-friendly materials and employing eco-design concepts (Albort-Morant et al. 2016). Exploration-based green innovation aims to develop entirely new methods and technologies to have a positive impact on the environment while promoting sustainability (Hart 1995; Hart and Dowell 2011). Companies that exhibit green innovativeness often achieve significant growth and outperform competitors by meeting customer demands effectively while enhancing intangible values and assets (Albort-Morant et al. 2018; Allameh 2018; Del Giudice et al. 2018). Green innovation is closely correlated with a company's environmental management strategies and serves as a catalyst for enhancing environmental performance, making it a strategic approach for fostering sustainable advancement across industries (Adegbile et al. 2016; Kammerer 2009; Chen et al. 2006). Additionally, green innovation has become a strategic tool for promoting the sustainable development of industries, leading to significant improvements in environmental conditions (Chang 2011). Research indicates that green innovation is essential for promoting sustainability and driving environmentally responsible practices within organizations, especially in the financial sector (Srouji et al. 2023).

Incorporating green innovation into business operations not only promotes environmental sustainability but also strengthens competitiveness. Companies that implement green innovation successfully can adapt to shifting customer preferences while reducing their environmental footprint. Green innovation serves as a strategic driver, helping organizations innovate and respond to changing market conditions while

supporting environmental conservation. By cultivating a culture centred on both sustainability and innovation, businesses can improve their environmental performance, secure a competitive advantage, and make a meaningful contribution to environmental well-being (Chang 2011). In conclusion, green innovation offers a forward-thinking solution to environmental challenges, providing businesses with opportunities to pursue sustainable growth while reducing their ecological impact.

GREEN FINANCE AND ENVIRONMENTAL PERFORMANCE

Green finance has emerged as a strategic approach for banks to enhance their environmental performance by allocating capital to initiatives that promote sustainable management of natural resources and encourage energy-efficient technologies. This involves financing projects such as renewable energy developments, green buildings, and clean transportation systems, all aimed at mitigating climate change impacts. Recent studies have underscored the substantial and positive influence of banks' green financing on their environmental performance (Gulzar et al. 2024). For instance, research indicates that green banking practices, including green financing, significantly contribute to the environmental performance of banks. Furthermore, the implementation of green banking practices, encompassing employee-related, operational, and customer-related initiatives, has been found to positively impact banks' environmental performance (Sohail et al. 2023). These findings suggest that banks' commitment to green finance not only supports environmental sustainability but also enhances their own environmental performance metrics.

Several studies have explored the relationship between green finance and environmental performance in the banking sector across different regions. Research by Zhang et al. (2022) found that green finance initiatives, such as investment in renewable energy and eco-friendly infrastructure, significantly improve banks' environmental performance by reducing carbon footprints and promoting sustainable economic activities. Similarly, Dai et al. (2022) highlighted that those banks incorporating green finance practices, such as financing clean energy projects and issuing green bonds, tend to report better environmental outcomes due to stricter environmental risk assessments and sustainability-oriented financial products. In the context of developing economies, Hussain et al. (2024) analysed the role of green finance in South Asian banking institutions and found a strong correlation between green financing and improved environmental performance, emphasizing the need for reg-

ulatory policies to encourage sustainable banking practices. Moreover, Taneja and Özen (2023) conducted an empirical study on Indian banks, revealing that while some financial institutions have adopted green finance mechanisms, the sector still faces challenges in fully integrating sustainability considerations into lending and investment decisions. These studies collectively indicate that green finance plays a crucial role in enhancing environmental performance, yet further research is needed to understand its impact in diverse banking contexts, particularly in emerging economies like India.

Hypotheses Development

CSR PRACTICES AND ENVIRONMENTAL PERFORMANCE

Corporate Social Responsibility, as defined by Mocan et al. (2015), encompasses strategies adopted by business organizations to operate in an ethically and socially responsible manner, with a focus on community well-being. Moreover, companies investing in CSR initiatives are more likely to achieve cost reductions, improved quality, flexibility, delivery, and long-term sustainability (Famiyeh 2017). In light of increasing environmental awareness, it becomes imperative to examine the relationship between the implementation of CSR initiatives and environmental performance (Suganthi 2020). Similarly, research on business firms in Pakistan indicated a positive impact of CSR on sustainable performance (Abbas et al. 2019), while Anser et al. (2020) observed significant positive effects of CSR commitments on both social and environmental performance. Based on the literature review, certain studies show the relationship between CSR and financial performance, yet other studies are needed to investigate the link between CSR and environmental performance. Therefore, the following hypothesis is proposed:

H1 *CSR practices have a significant positive impact on environmental performance.*

ECONOMIC DIMENSION OF GREEN FINANCE AND ENVIRONMENTAL PERFORMANCE

According to the International Finance Corporation reports, green finance is defined as the 'financing of investments that yield environmental gains', playing a crucial role in promoting investment in eco-friendly projects at the corporate level (Falcone and Sica 2019). Green finance

encompasses three aspects – economic, environmental, and social, often referred to as the triple bottom line (Arulrajah and Senthilnathan 2020). Previous research has characterized green finance as advancing the economic, social, and environmental aspects of financial services, significantly impacting the growth of green economy and businesses (Zhou et al. 2020). Additionally, Guang-Wen and Siddik (2022) found that the economic, social, and environmental aspects of green finance have a positive impact on the environmental performance of financial institutions in Bangladesh. Therefore, we have proposed the following hypothesis:

H2 *The economic dimension of green finance has a significant positive impact on environmental performance.*

SOCIAL DIMENSION OF GREEN FINANCE AND ENVIRONMENTAL PERFORMANCE

The social aspect of green finance entails banks financing various green projects to enhance their reputation, build trust, satisfy customers, and provide additional benefits to employees (Zheng et al. 2021b). A study conducted in China concluded that green finance significantly influences corporate social responsibility, thereby contributing to sustainable performance (Olateju and Olateju 2023). Similarly, Zheng et al. (2021a) found a favourable relationship between the social aspect of green finance and the sustainable performance of financial institutions in Bangladesh. Moreover, Guang-Wen and Siddik (2022) found that the social dimension of green finance significantly influences the environmental performance of banks. Therefore, we have proposed the following hypothesis:

H3 *The social dimension of green finance has a significant positive impact on environmental performance.*

ENVIRONMENTAL DIMENSION OF GREEN FINANCE AND ENVIRONMENTAL PERFORMANCE

To promote long-term sustainability, the environmental aspect of green finance focuse7s on reducing greenhouse gas emissions from financial activities, evaluating environmental impacts faced by clients, and reducing energy consumption (Zheng et al. 2021b). Guang-Wen and Siddik (2022), Zheng et al. (2021a) and Raihan (2019) also found a positive re-

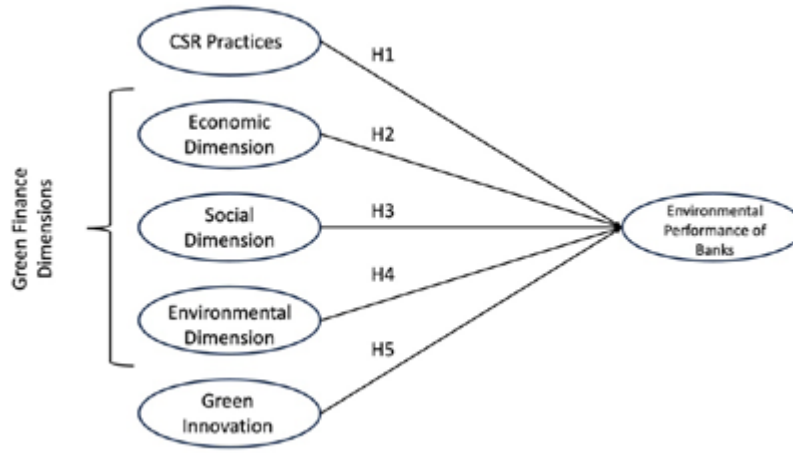

FIGURE 1 Conceptual Framework

lationship between the environmental aspect of green finance and the environmental performance of financial institutions. Existing research indicates that an increase in green finance and financial innovation leads to a decrease in CO_2 and greenhouse gas emissions, thereby enhancing environmental performance (Hoang and Tuan 2023). Therefore, we have proposed the following hypothesis:

H4 *The environmental dimension of green finance has a significant positive impact on environmental performance.*

GREEN INNOVATION AND ENVIRONMENTAL PERFORMANCE

Green innovation encompasses technological advancements aimed at reducing waste, water and air pollution, energy consumption, and addressing other environmental concerns. Li et al. (2020) emphasize that global warming poses a significant threat that requires collective action worldwide. Green innovation focuses on minimizing waste, mitigating pollution, and implementing environmental management systems (Song and Yu 2018). A study conducted in a manufacturing firm in Malaysia reported a significant impact of green innovation on environmental performance (Kraus et al. 2020). Similarly, Chiou et al. (2011) found that green innovation significantly affects environmental performance. However, the relationship between green innovation and environmental performance warrants further research (Kraus et al. 2020). Furthermore, the

relationship between green innovation and environmental performance is still under-researched. Therefore, the following hypothesis is proposed:

H5 *Green Innovation has a significant positive impact on environmental performance.*

Research Methodology

A structured questionnaire was designed to collect primary data, focusing on analysing the CSR practices, green finance dimensions, green innovation, and environmental performance of public and private sector banks. The experts from banks and researchers who are actively conducting research on CSR and green finance initiatives in the banking sector helped to prepare a comprehensive questionnaire. The questionnaire comprised 22 items graded on a 5-point Likert scale (see table 1).

The survey was conducted using a structured questionnaire distributed to employees of public and private sector banks actively engaged in CSR activities and green initiatives. Purposive sampling was employed, targeting employees from four public and four private banks based on their involvement in CSR and green finance projects (see table 2). Data collection occurred both online (329 questionnaires) and offline (50 questionnaires). Offline data were gathered through personal visits to bank branches in Delhi NCR regions, including Delhi, Aligarh, Ghaziabad, and Noida. Around 50 bank branches were visited during offline data collection, made directly from employees of these public and private sector banks. As per the objective of this study, only those employees who were working at the manager level or higher position at these bank branches were contacted. Generally, management level employees are responsible for making decisions on CSR activities, thus the most suitable persons to respond to the questionnaire must be from the managerial level or higher within the banks. Online questionnaires were emailed to the nearly 100 Human Resources departments (HRS) of these banks in major cities such as Mumbai, Chennai, Kolkata, and Bangalore, requesting them to fill out the questionnaire in Google Forms and ask other employees to respond to the questionnaire. Nearly 340 responses were received back on the Google form, out of which 329 were found fit for analysis, as 11 responses were not properly filled out and were therefore discarded from final data analysis. A total of 379 samples – 50 from offline and 329 from online sources – were collected for final data analysis and interpretation of results.

TABLE 1 Items of the Study

Construct	Items
CSR Practices (CSR) (Currás-Pérez et al. 2018; Kraus et al. 2020)	CSR1 – Our bank is creating a balance between work and family life for employees CSR2 – Our bank ensures work safety CSR3 – Our bank is working on charitable and social projects CSR4 – Our bank is establishing renewable energy sources CSR5 – Our bank is implementing activities that promote environmental responsibility
Economic Dimension of Green Finance (ECOD) (Guang-Wen and Siddik 2022)	ECOD1 – Our bank focuses on reducing overall risk ECOD2 – Our bank focuses on increasing revenues and saving operating costs ECOD3 – Our bank focuses on generating more economic benefit ECOD4 – Our bank focuses on creating more competitive advantage
Social Dimension of Green Finance (SOCD) (Guang-Wen and Siddik 2022)	SOCD1 – Our bank provides employee benefits, such as health and safety SOCD2 – Our bank is enhancing brand awareness, trust and image of the institution SOCD3 – Our bank is engaging local community in development programmes'
Environmental Dimension of Green Finance (ENVD) (Dai et al. 2022)	ENVD1 – Our bank is investing more in renewable energy sectors ENVD2 – Our bank is investing more in energy efficiency sectors ENVD3 – Our bank is investing more in green sector development
Green Innovation (GI) (Kraus et al. 2020; Khan et al. 2019)	GI1 – Our bank is using green technology GI2 – Our bank is practicing green banking activities GI3 – Our bank is offering customer services online
Environmental Performance of Banks (EPB) (Wang et al. 2021; Guang-Wen and Siddik 2022)	EPB1 – Our bank is lowering the carbon footprint from banking activities EPB2 – Our bank is reducing energy consumption from banking activities EPB3 – Our bank is enhancing banks' adherence to environmental regulations EPB4 – Our bank is promoting environmentally friendly technologies

IBM SPSS version 23.0 and AMOS version 26.0 were utilized for data analysis, employing Structural Equation Modelling (SEM) to assess relationships among variables. A two-step analysis approach was adopted, first evaluating the measurement model's fit and then testing proposed hypotheses within the structural model. Descriptive statistics and confirmatory factor analysis were conducted prior to the SEM analysis to ensure robustness. This methodological approach aimed to comprehen-

TABLE 2 Banks' CSR Spending 2023

Bank Name	CSR Spending 2023
State Bank of India (SBI)	Rs. 3167.6 million
Punjab National Bank (PNB)	Rs. 113.9 million
Union Bank of India (UBI)	Rs. 164.2 million
Bank of Baroda (BOB)	Rs. 135.0 million
HDFC Bank	Rs. 8208.9 million
Axis Bank	Rs. 2019.2 million
ICICI Bank	Rs. 4630.0 million
Kotak Mahindra Bank	Rs. 1879.5 million

TABLE 3 Demographic Profile of Respondents

Gender	Male	237	62.5%
	Female	142	37.5%
Age	Less than 30	112	29.5%
	31–40	157	41.4%
	41–50	80	21.1%
	50 and above	30	8.0%
Education	Bachelor's Degree	186	49.0%
	Master's Degree	108	28.5%
	Doctoral Degree	42	11.1%
	Other	43	11.4%
Work Experience	5 years or less	120	31.6%
	6–10 years	157	41.4%
	10 years or longer	102	27.0%
Job posts	Bank Manager	135	35.6%
	Credit Analyst	111	29.2%
	Investment Banker	79	20.8%
	Others	54	14.4%
Bank Branch	Offline survey via branch visits: Delhi NCR regions (i.e. Delhi, Aligarh, Ghaziabad, and Noida). Online survey via Google Form (bank branches from Mumbai, Chennai, Kolkata, and Bangalore)		

sively evaluate both the measurement and structural aspects of the research model.

The final sample comprised 379 valid responses from different branches of selected banks, after excluding incomplete questionnaires. This approach enabled a diverse representation of bank employees across different locations and positions within the organizations. Demographic details included gender, age, education, etc. (see table 3).

Empirical Results

The study utilized confirmatory factor analysis (CFA) to assess the underlying factors (see table 4). All the items factor loadings of the CFA and SEM model are above the accepted limit, i.e. ≥ 0.5. Descriptive statistics revealed mean scores of questionnaire items ranging from 3.24 to 4.13, indicating a consensus among respondents, while uniform standard deviation values suggested consistency among components. Additionally, skewness and kurtosis values indicated normality in the dataset, mitigating prediction issues due to data variance (see table 4). Common method bias (CMB) concerns were addressed via Herman's single-factor test, which revealed that the first factor accounted for 33.21% of the total variance, below the 50% threshold, thus affirming the absence of common method bias (Podsakoff et al. 2003). Overall, the study ensured data validity through rigorous exploratory factor analysis and effectively addressed potential biases, establishing a robust foundation for subsequent analyses.

In evaluating the measurement model, reliability analysis using Cronbach's alpha (CA) surpassing the threshold of 0.7 and composite reliability (CR) indicated values ranging from 0.85 to 0.92, affirming the scale's reliability (see table 6). Average variance extracted (AVE) values, crucial for assessing convergent validity, ranged from 0.66 to 0.76, exceeding the recommended 0.5 threshold. Construct discriminant validity was confirmed by comparing the square roots of AVE values with off-diagonal correlation coefficients (Fornell and Larcker 1981). First-order confirmatory factor analysis (CFA) yielded satisfactory fit indices for both measurement and structural models, meeting criteria such as CMIN/DF, GFI, CFI, AGFI, NFI, and RMSEA, as outlined in previous literature (Hair et al. 2011). Overall, the study confirmed the validity and reliability of the measurement model through robust analyses and fit indices, providing a solid foundation for further investigations (see table 5).

This study investigated the interplay between CSR practices, green finance dimensions, green innovation, and the environmental performance of banks in India. Regression analysis was employed to assess the proposed structural model, with the regression coefficients (β) indicating the strength and direction of relationships at specific significance levels (ρ values) (see table 7). The findings revealed significant positive effects of CSR practices ($H_{1:}$ $\beta = 0.36$, at ρ value 0.001), Economic Dimension (ECOD) ($H_{2:}$ $\beta = 0.56$, at ρ value 0.001), Social Dimension (SOCD) ($H_{3:}$ $\beta = 0.48$, at

TABLE 4 Descriptive Statistics and Factor Loadings

Variables	Items	Factor Loading ≥ 0.5		Descriptive Statistics			
		CFA	SEM	Mean	Std. Div.	Skewness	Kurtosis
CSR Practices	CSR1	0.91	0.89	3.34	1.16	−0.30	−0.67
	CSR2	0.88	0.86	3.49	1.17	−0.68	−0.34
	CSR3	0.87	0.85	3.24	1.19	−0.30	−0.75
	CSR4	0.84	0.83	3.63	1.15	−0.75	−0.12
	CSR5	0.86	0.87	3.57	1.18	−0.64	−0.36
Economic Dimension	ECOD1	0.83	0.82	3.48	1.09	−0.60	−0.16
	ECOD2	0.84	0.81	3.78	1.13	−0.87	0.14
	ECOD3	0.90	0.88	3.80	1.11	−0.88	0.21
	ECOD4	0.86	0.84	3.93	1.12	−1.08	0.60
Social Dimension	SOCD1	0.83	0.81	3.61	1.12	−0.61	−0.26
	SOCD2	0.87	0.83	3.74	1.06	−0.81	0.22
	SOCD3	0.82	0.79	3.66	1.02	−0.78	0.46
Environmental Dimension	ENVD1	0.88	0.88	3.73	1.10	−0.98	0.45
	ENVD2	0.84	0.81	3.82	1.10	−1.08	0.68
	ENVD3	0.87	0.84	3.63	1.12	−0.84	0.12
Green Innovation	GI1	0.93	0.90	4.13	1.08	−1.33	1.24
	GI2	0.89	0.85	4.06	1.11	−1.17	0.70
	GI3	0.81	0.78	3.73	1.16	−0.63	−0.50
Environmental Performance of Banks	EPB1	0.74	0.71	3.61	1.06	−0.63	−0.04
	EPB2	0.79	0.77	3.60	1.19	−0.56	−0.64
	EPB3	0.82	0.80	3.61	1.11	−0.56	−0.39
	EPB4	0.81	0.79	3.49	1.17	−0.48	−0.53

NOTES CFA= Confirmatory Factor Analysis; SEM= Structural Equation Modelling.

TABLE 5 Model Fit Indices for Both Measurement & Structural Model

Model Fit Indices	Measurement Model Values	Structural Model Values	Threshold Limit	Reference
CMIN/DF	1.53	1.87		(Hair et al. 2011)
CFI	0.95	0.91		
GFI	0.97	0.94		
AGFI	0.83	0.80		
NFI	0.97	0.92		
RMSEA	0.04	0.05		

NOTES CMIN/DF – Chi-square Minimum/Degree of Freedom; CFI – Comparative Fit Index; GFI – Goodness of Fit Index; AGFI – Adjusted Goodness of Fit Index; NFI – Normed Fit Index; RMSEA – Root mean square error of approximation.

TABLE 6 Convergent and Discriminant Validity

Items	CA	CR	AVE	GI	CSR	ECOD	SOCD	ENVD	EPB
GI	0.94	0.85	0.66	0.81					
CSR	0.86	0.92	0.70	0.34	0.84				
ECOD	0.81	0.89	0.67	0.21	0.28	0.82			
SOCD	0.89	0.85	0.66	0.16	0.20	0.12	0.81		
ENVD	0.91	0.90	0.76	0.19	0.25	0.08	0.52	0.87	
EPB	0.78	0.89	0.68	0.59	0.58	0.39	0.35	0.38	0.82

NOTE CA – Cronbach's Alpha; CR – Composite Reliability; AVE – Average Variance Extracted; GI – Green Innovation; CSR – Corporate Social Responsibility; ECOD – Economic Dimension; SOCD – Social Dimension; ENVD – Environmental Dimension; EPB – Environmental Performance of Banks.

TABLE 7 Hypotheses Testing Summary

Hypotheses	Path direction	β	t-values	ρ	Remarks
H1	CSR → EPB	0.36	2.386	<0.001	Accepted
H2	ECOD → EPB	0.56	5.057	<0.001	Accepted
H3	SOCD → EPB	0.48	3.506	<0.05	Accepted
H4	ENVD → EPB	0.61	7.459	<0.05	Accepted
H5	GI → EPB	0.31	2.690	<0.001	Accepted

NOTES β represents standardised regression weight, and ρ represents the probability. GI – Green Innovation; CSR – Corporate Social Responsibility; ECOD – Economic Dimension; SOCD – Social Dimension; ENVD – Environmental Dimension; EPB – Environmental Performance of Banks.

ρ value 0.05), Environmental Dimension (ENVD) ($H_{4:}$ $\beta = 0.61$, at ρ value 0.05), and Green Innovation (GI) ($H_{5:}$ $\beta = 0.31$, at ρ value 0.001) on the Environmental Performance of Banks (EPB). Additionally, the dimensions of CSR practices, green finance, and green innovation collectively explained 79% of the variance in environmental performance, denoted by an R^2 value of 0.79, indicating a substantial impact (Kala Kamdjoug et al. 2021). Overall, the study underscores the significant influence of these constructs on the environmental performance of banks in India.

Discussion

To evaluate the impact of CSR practices, green finance and green innovation, this study compares the results of previous studies with the findings shown in figure 2.

We framed H1 to explain whether CSR practices positively correlate with the environmental performance of banks. The study's results sup-

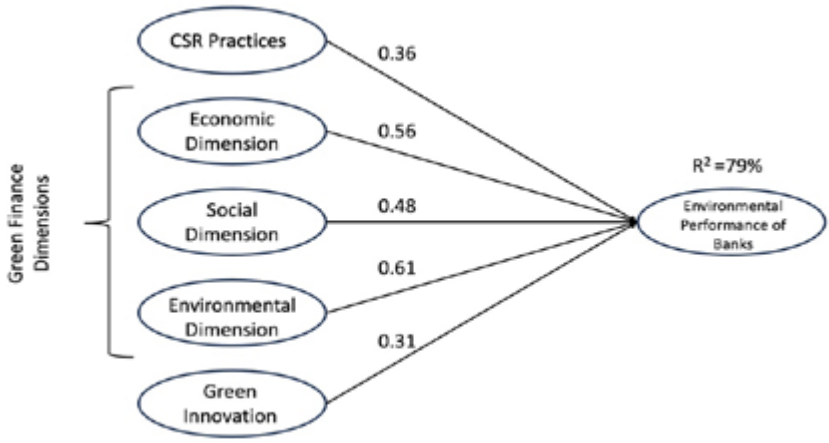

FIGURE 2 Structural Model

ported the hypothesis, aligning with previous studies of a similar nature (Guang-Wen and Siddik 2022; Ait-Sidhoum and Serra 2017; Bamgbade et al. 2018). The study's findings imply that increased societal expectations for sustainability, the commitment of banks towards sustainable activities, and regulatory frameworks promoting sustainability improve environmental performance, along with several other business benefits. Furthermore, the empirical findings align with the legitimacy theory, which posits that banking institutions spend on and employ CSR activities due to societal pressure and regulatory norms, compelling organizations to embrace CSR practices to promote environmental sustainability and social approval (Guang-Wen and Siddik 2022). In addition, this outcome also aligns with natural resource-based view theory, which proposes that organizations can attain lasting competitive advantage by addressing environmental concerns. This finding is corroborated by recent research indicating that CSR-driven sustainability policies lead to enhanced environmental and financial performance, creating competitive differentiation (Guang-Wen and Siddik 2022).

The study's findings support H2, confirming that the economic dimension of green finance positively correlates with the environmental performance of banks. The findings are in accordance with previous research (Cai and Song 2024; Guang-Wen and Siddik 2022). For example, a study on Indian banks found that green financing and environmental performance are positively related, with green initiatives significantly

impacting the environment (Kothiyal and Tripathi 2023). The economic aspect of green finance enables the allocation of capital toward sustainable projects, which contributes to lowering the carbon footprint of banks' investment portfolios and promotes cleaner, eco-friendly operations. This not only enhances environmental outcomes but also bolsters long-term organizational sustainability. Hence, green finance serves as a strategic economic tool, enabling banks to simultaneously achieve financial returns and environmental objectives by investing in resilient and sustainable business models.

We proposed H3 to examine the link between the social dimension of green finance and the environmental performance of banks. The results confirm this hypothesis, indicating that the social aspect of green finance has a positive impact on environmental performance. This finding aligns with prior research in the field (Guang-Wen and Siddik 2022; Wang et al. 2022). This suggests that banks investing in socially responsible initiatives, such as improving access to green energy in underserved communities, not only tackle environmental challenges but also promote social inclusion and equity. As a result, the social aspect of green finance drives banks to move beyond basic regulatory compliance and take an active role in contributing to societal well-being. Recent studies further highlight that socially responsible investment practices strengthen stakeholder trust and enhance long-term sustainability.

The results supported H4, suggesting that the environmental dimension of green finance positively impacts the environmental performance of banks. This finding corroborates with previous studies (Guang-Wen and Siddik 2022, 2023). The findings suggest that the environmental dimension of green finance drives the adoption of green technologies and eco-friendly practices, fostering the development of innovative solutions within the banking sector and improving sustainable performance. This outcome is consistent with legitimacy theory, which asserts that companies seek to maintain legitimacy by aligning their principles, policies, and strategies with societal values. Additionally, the results support the natural resource-based view, which emphasizes that organizations address environmental challenges to gain a competitive advantage and improve performance. This theory highlights the importance of leveraging natural resources, such as sustainability and green innovation, to create economic value and stand out from competitors (Bals and Rosca 2022). As a result, banks that invest in environmentally sustainable initiatives can be seen as utilizing resources to enhance their competitive advantage.

The study's findings support H5, which suggests that green innovation positively correlates with the environmental performance of banks. The finding aligns with previous studies (Kraus et al. 2020; Lestari and Sunyoto 2023). The result suggests that banks, to enhance their sustainability efforts further, must promote the development and implementation of sustainable solutions, set standards and targets for the enhancement of environmental performance, invest and embrace energy-efficient technologies, and provide training and awareness to employees regarding the importance of sustainability in each aspect. Additionally, financial technology (FinTech) adoption has been found to significantly influence green finance, green innovation, and sustainability performance in banks, indicating the necessity of integrating digital transformation with sustainability efforts (Dai et al. 2022).

Conclusion

Extensive research has been conducted globally to determine the association among CSR, green finance, green innovation, and firms' financial and sustainable performance (Nabil 2023; Saher, Zafar, and Siddique 2023; Ben Saad and Belkacem 2021). However, the existing literature regarding the association remains inconclusive and under-researched (Guang-Wen and Siddik 2023; Bahta et al. 2020; Kraus et al. 2020). As a result, the present study utilized SEM to determine the association between CSR practices, green finance dimensions (economic, social, and environment), green innovation, and environmental performance among Indian banks by proposing five hypotheses.

The hypotheses and the conceptual model were analysed based on the data collected from Indian banks. As per the outcomes of the study, it is revealed that the explanatory power of the conceptual model is strong when it comes to determining the influence of CSR, green finance dimensions, green innovation, and environmental performance of banks. The results of this study add to the body of existing research and support the evidence suggesting that CSR, green finance, and green innovation exert an influence on organizations' environmental performance. Additionally, this study offers significant theoretical and practical implications for the banking sector to enhance their environmental performance. Lastly, this study has provided novel insights into how the integration of CSR, green finance, and green innovation could substantially influence the environmental performance of banks.

THEORETICAL IMPLICATIONS

This study adds to the existing body of knowledge on environmental performance in Indian banks by introducing a conceptual framework that integrates legitimacy theory and the natural resource-based view (RBV). Drawing from RBV, which emphasizes sustainable practices, resource conservation, and pollution control as means to achieve competitive advantage, the study offers insights into how CSR practices, green innovation, and various dimensions of green finance contribute to enhanced environmental performance. It is one of the first studies to apply both legitimacy theory and RBV simultaneously to examine environmental performance in the Indian banking sector.

Additionally, the research investigates areas that have received limited attention in previous studies, including the influence of the economic dimension of green finance on CSR practices, the role of the environmental dimension of green finance in driving green innovation, and the mediating effects of CSR and green innovation on the relationship between green finance and environmental performance. The conceptual model developed in this study accounts for 79% of the variance in environmental performance, indicating strong predictive capability.

The findings highlight that integrating CSR initiatives, green finance, and green innovation is not merely a response to regulatory requirements but a strategic approach to achieving sustainable competitive advantage. The study also encourages future research to explore how these variables interact in different economic and regulatory settings to enhance the applicability and relevance of the results across various contexts.

PRACTICAL IMPLICATIONS

Financial institutions can improve their environmental performance by implementing and promoting green finance initiatives that support eco-friendly projects. At the same time, integrating green innovation into banking operations, technologies, services, and strategies can further strengthen sustainability efforts. The study emphasizes the partial mediating role of CSR practices and green innovation in the relationship between green finance and environmental performance. This finding suggests that supporting a range of environmentally sustainable projects can enhance both internal and external environmental performance in the banking sector, aligning with the country's Sustainable Development Goals.

The study provides practical insights for stakeholders working to advance environmental sustainability in the financial sector. Bank managers and policymakers can use these findings to reinforce CSR commitments, promote green initiatives, incorporate sustainability criteria, and raise awareness about the importance of CSR activities. Additionally, developing systems for regular monitoring and reporting on CSR practices can further support environmental sustainability initiatives within the industry. Furthermore, central banks and governments could incentivize socially responsible approaches and activities, thereby contributing to the country's long-term development goals. Banking institutions can enhance training programmes to equip employees with skills related to sustainability practices and green technologies. Additionally, partnerships with international organizations can help banks access innovative green funding sources and implement globally recognized sustainability standards.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

Despite the contributions of this study, several limitations have been identified, which provide avenues for future research. One key limitation is the use of a survey approach, which poses challenges in terms of generalizability and applicability to a broader population. Moreover, this study focuses exclusively on the banking sector to assess the impact of CSR practices, green finance dimensions, and green innovation on environmental performance. Consequently, the statistical findings are specific to banks in India. Future research is encouraged to explore these relationships in other industries, such as transportation, healthcare, tourism, and other sectors, using diverse and more extensive samples.

Additionally, the study's environmental performance measurement could be expanded in future research by incorporating other factors, such as Green Human Resource Management practices, environmental management strategies, and broader aspects of social responsibility. The study was also limited by the response rate, with only 379 responses from bank employees available for analysis, partly due to restricted access. Future researchers with established networks within the banking sector may be able to secure a larger sample size, potentially leading to different outcomes.

Finally, the study employed a cross-sectional research design, which may limit the reliability and robustness of the findings. Future studies are

recommended to adopt a longitudinal research design to provide deeper insights and improve the reliability of the results over time.

Acknowledgement

We acknowledge the use of Grammarly for assisting with grammar and language refinement throughout this work.

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Vpliv demografskih dinamik na varčevanje gospodinjstev v Južni Afriki pred pandemijo covida-19

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Pričujoči članek preučuje vpliv demografskih dinamik na varčevanje gospodinjstev v Južni Afriki pred pandemijo covida-19, in sicer v vseh devetih provincah Južne Afrike. Raziskava je uporabila metodo PARDL (iz angl. *panel autoregressive distributed lag*) in Dumitrescu-Hurlinovo metodo panelne vzročnosti. Rezultati so pokazali dolgoročno povezavo med demografskimi dinamikami in varčevanjem gospodinjstev v Južni Afriki. Ugotovljeno je bilo, da ima delovno sposobno belo prebivalstvo pomemben vpliv na varčevanje gospodinjstev tako na dolgi kot na kratki rok, medtem ko imata delovno sposobni skupini temnopoltih in mešane rase pomemben vpliv le na dolgi rok. Po drugi strani pa delovno sposobno prebivalstvo azijskega/indijskega porekla nima vpliva na varčevanje gospodinjstev niti na dolgi niti na kratki rok. Dumitrescu-Hurlinova analiza panelne vzročnosti je pokazala obojesmerno vzročnost med skupinami azijskega/indijskega in temnopoltega prebivalstva ter prebivalstva mešane rase in varčevanjem gospodinjstev, medtem ko je bila enosmerna vzročnost ugotovljena med belo populacijo in varčevanjem gospodinjstev.

Ključne besede: demografija, delovno sposobno prebivalstvo, starejše prebivalstvo, hipoteza življenjskega cikla, varčevanje gospodinjstev, panelna ARDL, Dumitrescu-Hurlinova panelna vzročnost
Klasifikacija JEL: J1; E2; C0
Managing Global Transitions 23 (2): 121–146

Mednarodna trgovina in gospodarska rast v državi, odvisni od nafte: primer Nigerije

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Pričujoči članek preučuje vpliv razčlenjene mednarodne trgovine na gospodarsko rast Nigerije. Podatki in izbrani model so bili analizirani z uporabo metod ARDL (iz angl. *Autoregressive Distributed Lag*) in Toda-Yamamoto. Ugotovljeno je bilo, da tako izvoz naftnih kot nenaftnih proizvodov spodbuja gospodarsko rast. Medtem pa uvoz naftnih in nenaftnih proizvodov gospodarsko rast zavira. Nadalje so rezultati vzročnosti pokazali, da obstaja obojesmerna vzročnost med izvozom (naftnim in nenaftnim) ter nenaftnim uvozom in gospodarsko rastjo,

medtem ko ni bilo ugotovljene vzročnosti med naftnim uvozom in gospodarsko rastjo. Zato bi morala vlada dati prednost izvozno usmerjeni politiki za spodbujanje gospodarske uspešnosti v Nigeriji. Ugotovitve poudarjajo potrebo po diverzifikaciji gospodarstva za doseganje višje gospodarske rasti in dolgoročne trajnosti. Članek bogati literaturo o povezavi med mednarodno trgovino in gospodarsko rastjo v Nigeriji z ustrezno razčlenitvijo trgovinskih komponent, ki odražajo gospodarsko strukturo nigerijskega gospodarstva. Poleg tega prinaša nova empirična spoznanja o povezavi med trgovino in rastjo v državi v razvoju, ki je odvisna od nafte.

Ključne besede: mednarodna trgovina, gospodarska uspešnost, trgovinska politika, države v razvoju, ARDL, Toda-Yamamotoo
Klasifikacija JEL: B17, F13, B23, O47
Managing Global Transitions 23 (2): 147–174

Analiza vpliva okoljske učinkovitosti na donosnost sredstev v podjetjih za proizvodnjo hrane in pijač, kotirajočih na borzi v Johannesburgu

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Pričujoči članek preučuje vpliv okoljske učinkovitosti na donosnost sredstev podjetij (angl. return on assets – ROA). Njegov namen je bil analizirati, ali uspešnost podjetij na področju okoljske učinkovitosti (predstavljena z rabo energije, s porabo vode, z emisijami ogljika in nastajanjem odpadkov) vpliva na donosnost sredstev (ROA). Podatki o okoljski učinkovitosti in ROA so bili zbrani za 14 podjetij iz sektorja hrane in pijač, ki kotirajo na borzi v Johannesburgu, za obdobje desetih let (2012–2021). Podatki so bili analizirani z uporabo programske opreme STATA in statistične metode GMM (iz angl. *Generalised Method of Moment*), ki je povečala robustnost analize. Ugotovitve analize GMM so pokazale različne rezultate. Ti po eni strani kažejo, da imata poraba energije in vode v podjetjih za proizvodnjo hrane in pijač pozitiven (vendar statistično nepomemben) vpliv na ROA. Po drugi strani pa kažejo, da ima nastajanje odpadkov negativen (vendar statistično nepomemben) vpliv na ROA, medtem ko imajo emisije ogljika negativen in statistično pomemben vpliv na ROA.

Ključne besede: okoljsko računovodstvo, donosnost sredstev, finančna uspešnost, okoljska učinkovitost, poraba energije, poraba vode, emisije ogljika, nastajanje odpadkov, prihodki od prodaje
Klasifikacija JEL: Q56, M41, M21
Managing Global Transitions 23 (2): 175–200

Vpliv družbene odgovornosti podjetij, zelenega financiranja in zelene inovativnosti na okoljsko uspešnost bank v Indiji

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V času naraščajočih okoljskih izzivov je vloga bank pri spodbujanju trajnosti ključna. Pričujoča raziskava preučuje, kako družbena odgovornost podjetij (angl. *Corporate Social Responsibility* – CSR), zeleno financiranje in zelene inovacije vplivajo na okoljsko uspešnost indijskih bank. Na podlagi teorije legitimnosti in naravnih virov kot konkurenčne prednosti so bili podatki iz ankete med 379 bančnimi zaposlenimi analizirani z uporabo modeliranja strukturnih enačb. Rezultati kažejo, da močne pobude CSR, učinkovite prakse zelenega financiranja in inovativne zelene strategije pomembno izboljšajo okoljsko uspešnost bank. Ugotovitve prispevajo k teoretičnemu razumevanju in ponujajo praktične vpoglede za izboljšanje trajnosti v bančnem sektorju. Na podlagi raziskave priporočamo, da banke v državah v razvoju okrepijo notranje vire z vlaganjem v CSR, s sprejetjem zelenega financiranja in spodbujanjem zelenih inovacij za izboljšanje okoljske uspešnosti. Takšna prizadevanja so skladna z globalnimi cilji trajnostnega razvoja in banke izpostavljajo kot ključne akterje pri varovanju okolja ter odgovornem financiranju.

Ključne besede: družbena odgovornost podjetij, zeleno financiranje, zelene inovacije, okoljska uspešnost bank, modeliranje strukturnih enačb
Klasifikacija JEL: Q56, M14, G21, O32
Managing Global Transitions 23 (2): 201–231