

Environmental Consequence of Financial Development and Institutional Quality in Emerging Markets: A Complementarity Hypothesis

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ABSTRACT

Environmental quality is a topical issue in emerging economies due to their high growth potential. Literature suggests that the impact of financial development on the environment could be negative or positive. On the one hand, this study examined the impact of financial development on the environment quality in the BRICS bloc. On the other hand, this study determined the moderating effect of institutional quality on the environmental consequence of financial development. Based on the results of the panel autoregressive distributed lag model (ARDL), we found that economic growth has a positive effect on the ecological footprint in the short and long run, thereby worsening the environment. In addition, financial development and institutional quality do have a reducing long-run and short-run impact on the ecological footprint respectively. Moreover, we showed that financial development moderates the environmental consequence of institutional quality in the long run while institutional quality moderates the environmental consequence of financial development in the short run. We therefore conclude that financial development and institutional quality form symbiotic relationships to engender favourable environmental outcomes. This suggests that financial development and institutional quality are complements as far as the attainment of environmental quality is concerned. Therefore, the goals of achieving good governance or institutional quality and a higher level of financial development must be pursued synchronously in the BRICS.

Keywords: financial development, environmental quality, institutional quality, emerging markets.

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1. INTRODUCTION

The BRICS countries, which include Brazil, Russia, India, China, and South Africa, are regarded as the world's top five emerging economies (International Monetary Fund, 2021). Its members account for 41% of the global population, 24% of the global gross domestic product (GDP), and more than 16% of global trade (Sichoongwe, 2022). For the last 50 years, the burning of fossil fuels (coal, oil, and natural gas) by automobiles and industries has resulted in carbon emissions which are the major contributor to greenhouse gas emissions and climate change (Shivanna, 2022). This resulted in environmental degradation. Climate change poses severe danger to human existence, including food

shortage, wildlife extinction, and harsh weather (Hussain *et al.*, 2020). Climate change has become more catastrophic because of economic growth and industrialisation. The environment, atmosphere, and planet's ecosystem are in a state of great stress and catastrophe (Waheed *et al.*, 2018).

The increasing carbon footprint of most nations has been traced to the expansion in the GDP. The consolidated GDP of the BRICS nations reached 17 trillion US Dollars in 2014, equating to approximately 22% of the world economies (Mohanty and Sethi, 2022). In 2018 the nominal GDP of BRICS nations was 18.6 trillion US Dollars, equating to more than 23% of the world economies (Ahmed, 2020). Tian *et al.* (2020) confirm that the growth of BRICS nations' economic development puts pressure on the environment as it results in carbon dioxide emissions and resource consumption. The economic development model of the BRICS countries is characterised by high pollution and energy consumption, as well as large-scale investments in traditional energy sources and excessive mineral resource exploitation. As a direct result of this paradigm, carbon emissions and pollution have increased (Zhao *et al.*, 2021).

Institutional quality (IQ) is a critical aspect of environmental improvement. It has been argued that IQ tends to mitigate the negative environmental repercussions of economic expansion, energy consumption, and financial development (FD) (Hunjra *et al.*, 2020). It has been discovered in the literature that when FD is utilised for capitalisation rather than clean energy, it results in higher environmental degradation. In other words, financial prosperity can create pollution by encouraging industrial activity (Wang, Cardon, Liu & Madni, 2020). However, Tamazian Chousa, and Vadlamannati (2009) and Abaidoo and Agyapong (2022) posit that strong institutions benefit the environment while weak institutions harm it. It is noteworthy that the effect of institutions on the environment may be direct and indirect. For example, strong institutions could influence the impact of FD on the environment. Even though institutional failure may affect the relationship between FD and EQ, this subject has been thinly investigated.

The BRICS bloc provided an ideal sample for the study considering their fast pace of growth which is associated with high carbon dioxide production. For example, they jointly contributed approximately 32% and 38% of the world's GDP (Statista, 2024) and carbon dioxide production (Wang & Huang, 2023). BRICS nations have pursued vital financial and monetary initiatives in recent years. These include the development of BRICS New Development Bank and common currency agenda. However, financial development may exacerbate the environmental condition without adequate governance and environmental policies. BRICS nations experience a high rate of institutional disturbance and corruption (Cynthia, Armijo & Katada, 2017). Effective institutional policy, governance and political system are prerequisites to overcoming environmental damage in the BRICS nations (Stiftung, Azahaf, & Schraad-Tischler, 2012). Consequently, this study investigated the moderating effect of institutional quality on the impact of financial development on the environment in the BRICS bloc. The subsequent sections are the literature review, research methodology, results and conclusions.

2. LITERATURE REVIEW

Financial development (FD) is defined as the increase in the quantity, quality, and importance of financial intermediary services (Choong and Chan, 2011). FD is said to

occur where the financial sector¹ eases the impacts of information, enforcement, and transaction costs and ensures effective provision of its important functions in the economy (World Bank, 2024). Johnson *et al.* (1997) define environmental quality as “properties and characteristics of the environment, either generalized or local, as they impinge on human beings and other organisms. In general, EQ describes varied features, namely air and water purity or contamination, noise, access to open space, and the visual effects of buildings, and the latent impacts of such features on physical and mental health (attendant with human activities)”. Moreover, institutional quality is defined in terms of good governance expressed as an assortment of governance working variables such as “corruption control, government effectiveness, regulatory quality, rule of law and voice and accountability, Political Stability and Absence of Violence/Terrorism” (Abaidoo & Agyapong, 2022; Khan 2022, World Bank, 2024).

Theoretically, FD may affect the environment via *household effect*, *business effect*, and *wealth effect* (Acheampong, 2019). In the first instance, *household effect* explains that access to cheap credit leads to the acquisition of energy-consuming items by the households and environmental degradation respectively. In the second instance, *business effect* suggests that FD could result in the degradation or improvement depending on whether businesses use their access to finance on business expansion or environmental-friendly technology. Yao, *et al.* (2021) contend that financial development finances technological advancements that utilise less energy input and more productivity, which tends to lower the ecological footprint (EF). Lastly, *wealth effect* contends that FD boosts risk diversification which in turn results in wealth accumulation and economic growth, and subsequently energy use and CO₂ emission (Aluko & Obalade, 2020). In the emerging market context, the theoretical argument for the moderating effect of IQ is rooted in the pollution haven hypothesis (PHH). PHH explains the transfer of heavily polluting industries to underdeveloped or developing countries from developed countries (via FDI, international trade, and globalisation) as multinational companies take advantage of the cheap resources and labour in developing economies (Cole, 2004). The unfavourable environmental consequence is made possible by the weak environmental standards and regulations in developing countries (Levinson & Taylor, 2008).

Thus, one of the most crucial determinants of EQ might be sound environmental policy or institutional quality. As a result, quality institutions and sound legislation will help reduce environmental hazards (Ahmad, *et al.*, 2022). Finance, institutions, growth and environment are interconnected. Obalade (2024) showed that economic growth leads to financial development in BRICS. Economic growth is assumed to be linked to increased environmental deterioration (Sharma, 2008), as increased economic activity may result in more environmental concerns. As a result, good governance and environmental quality represent a political tool for sustainable development aimed at harmonising economic expansion, environmental degradation, and social stability. Abaidoo and Agyapong (2022) found that governance and regulatory quality lead to the development of the financial system in SSA. The financial sector's development can enable greater funding at cheaper costs, including investments in environmental projects that will reduce environmental deterioration (Tamazian, *et al.*, 2009). Also, the growth of global pollution rights in place has been facilitated by the expansion of financial development through an increase in industrialisation. It is necessary to have new technology investments, financial aid and tailored regulations for the long-term progress of the energy sectors.

¹ Financial sector entails financial assets, markets and middlemen and associated legal and regulatory architecture that enable the extension of credits

Significant empirical studies assessed confirmed different determinants of environmental quality. On the one hand, Alper, Alper, Ozayturk and Mike (2023) identified energy use and GDP in Canada, China, Germany, Japan, India, Indonesia, Iran, Korea, Saudi Arabia, and the USA; Khan, Weili and Khan (2022) identified regulatory quality, political instability, law and order in Belt and Road Initiative (BRI) economies; Ibrahim and Ajide (2021) identified FD and regulatory quality; while Dhingra (2023) identified FD in BRICS; Hunjra, *et al* (2020) and Ahmad, *et al.* (2022) identified FD in South Asian economies and selected economies (Argentina, Colombia, Chile, China, Brazil, India, Malaysia, Poland, Mexico, Philippines, Pakistan, Peru, SouthKorea, SouthAfrica, Saudi Arabia, Turkey, and Thailan) respectively, as factors contributing to environmental degradation due to their positive effect on C02 or EF. In addition, Sehrawat, Giri, and Mohapatra (2015) showed financial development, economic growth, and energy consumption contributed to environmental degradation (CO₂ emissions) in India. The findings are supported by Zain (2011).

On the other hand, Amin, Ameer, Yousaf and Akbar (2022) opine that governance, FD, trade and energy consumption reduce CO₂ in China. Furthermore, Dhingra (2023) identified GDP and globalisation in BRICS; Khan, *et al.* (2022) identified government effectiveness, voice and accountability, and corruption control in BRI; Alper *et al.* (2003) identified globalisation; Ahmad, *et al.* (2022) found human capital and IQI; Tamazian, Chousa, and Vadlamannati, (2009) found FD (especially financial liberalisation) in BRICS, as the drivers of environmental quality due to their positive effect negative or reducing effects on C02 or EF. Another tranche of the literature revealed that linear and nonlinear connections will shed more light on the link between FD and the environment. For example, Li, Ozturk, Majeed, and Hafeez (2022) confirmed the long-term effects of financial deepening in enhancing environmental quality in BRICS using a linear model. Furthermore, the non-linear models reveal that positive shocks in financial deepening cause an increase in CO₂ emissions, whereas negative shocks result in a long-term deterioration of CO₂ emissions.

To ascertain the moderating effect of governance and institutional development of the relationship between financial development and environmental quality, numerous studies have examined the interactions among environmental quality, financial development, and institutional quality. In this context, Tamazian and Rao (2009) demonstrate that the environmental improvement in 24 transition economies has been positively impacted by FD and IQ; however, there is no moderating effect. Khan, Weili, and Khan (2022) examined the effect of institutional quality, economic growth, and FD on CO₂ emissions in BRI countries. The finding reveals that voice and accountability, government effectiveness, and political stability moderate the effect of FD on EQ while control of corruption worsens the effect of FD on EQ. Also, Yao, *et al.* (2021) studied the relationship between FD and IQ and their effect on EQ and concluded that FD and its interaction with anti-corruption actions contribute favourably to environmental efficiency in BRICS and N-11 nations.

Table 1: Empirical literature review map

| Authors | Setting | Methods | Measures of EQ and FD | Findings |
|--|--|---|---|---|
| Khan, Weili & Khan (2022) | BRI countries | Panel OLS, fixed effect, two-step GMM | CO ₂ FD: domestic credit to the private sector | Government effectiveness, voice and accountability, and corruption control reduce CO ₂ ; while other IQ components increase it; voice and accountability, government effectiveness, and political stability moderate the effect of FD on EQ while control of corruption worsens the effect of FD on EQ |
| Alper, Alper, Ozayturk & Mike (2023) | Canada, China, Germany, Japan, India, Indonesia, Iran, Korea, Saudi Arabia, USA | ARDL | Ecological footprint | Energy use and GDP deteriorate the environment while globalisation enhances it |
| Dhingra (2023) | BRICS | ARDL | CO ₂ FD, FIA, FID, FIE, FIL, FMI FMA, FMD, FME | GDP & GLOB = - effect FD = + effect |
| Li, Ozturk, Majeed, Hafeez & Ulla (2022) | BRICS | Panel ARDL & NARDL | CO ₂ FD = financial deepening index, financial institution deepening & financial market deepening | ARDL: FD improves while FID & FMD deteriorate EQ in the long run NARDL: positive (negative) shock to FD, FID, FMD deteriorate (improve) EQ in the long run |
| Ibrahim & Ajide (2021) | BRICS | AMG and Common Correlated Effect MG (CCEMG) | CO ₂ FD: Broad money | FD and regulatory quality increase CO ₂ |
| Hunjra, Tayachi, Chani, Verhoeven and Mehmood (2020) | SouthAsian (India, Bangladesh, Nepal, Sri Lanka and Pakistan) | Generalized least squares (GLS) technique | CO ₂ FD: private sector domestic credit | IQ moderate – effect of FD on EQ |
| Ahmad, Ahmed, Yang, Hussain & Sinha (2022) | Argentina, Colombia, Chile, China, Brazil, India, Malaysia, Poland, Mexico, Philippines, Pakistan, Peru, South Korea, South Africa, Saudi Arabia, Turkey, and Thailand | Cross-sectional ARDL | Ecological footprint | FD degrades EQ while human capital and IQI improve it; Human capital and IQ moderate the effect of FD on EQ |
| Tamazian and Rao (2009) | 24 transition economies | GMM estimation | CO ₂ FD: financial liberalization | IQ and FD improve EQ but there is no moderating effect |
| Tamazian, Chousa, and Vadlamannati, (2009) | BRIC | | CO ₂ FD: financial liberalization, deposit money bank assets to GD | FD, particularly financial liberalisation improves EQ |
| Yao, <i>et al.</i> (2021) | BRICS & N-11 | System GMM | Ecological footprint FD: bank domestic credit | FD and its interaction with control of corruption improve EQ |

Notes to Table 1: Financial Development Index (FD) Financial Institution Access (FIA), Financial Institution Depth (FID), Financial Institution Efficiency, (FIE), Financial Institution Index (FII), Financial Market Access (FMA), Financial, Market Depth (FMD), Financial Market Efficiency (FME), and Financial Market Index (FMI), Belt and Road Initiative (BRI), Brazil, Russian, India, China, South Africa (BRICS), Bangladesh, Egypt, Indonesia, Iran, Mexico, Nigeria, Pakistan, the Philippines, Turkey, South Korea, and Vietnam (N-11), generalized method of moment (GMM), carbon-di-oxide (CO₂).

Past studies tended to rely on individual or conventional metrics of FD such as financial depth, stock of private credit, and market capitalisation as a share of GDP. By doing so, they did not consider all dimensions of the financial system and sectors. This study used the financial development index of the World Bank and IMF to overcome this deficiency. Second, CO₂ emissions and other pollutants have frequently been used as measures of environmental degradation in the literature; however, these indicators fail to capture the complex nature of environmental degradation. This study used the ecological footprint to overcome this deficiency. Further, Zhang, Ozturk and Ullha (2022) found that a strong institution is required to reduce CO₂ in BRICS. Thus, we hypothesise that FD may have an indirect impact on the environmental footprint via IQ. However, extant studies have not investigated this indirect effect critically. For example, Yao, *et al.* (2021) evaluated the moderating effect of control of corruption, leaving out the remaining five components of IQ. To address the aforementioned deficiencies, this study assessed the effect of the FD index on EF and determined the moderating effect of the IQ index in BRICS.

3. MATERIAL AND METHODS

This section discusses the design of research, sample and data, techniques for estimation, and model specification. To achieve the objectives, a quantitative approach was implemented for the BRICS economies.

3.1 Sample and data

This study investigated the impact of financial development on environmental quality in BRICS nations and the extent to which institutional quality affects the relationship between them. The analysis used annual data with a 24 year sample size (1996-2020). The chosen sample period was based on the formation of the BRIC economies and the availability of data. In addition, the study used annual frequency because it has been favoured by empirical studies on the relationship between FD, EQ, and IQ (Khal et al, 2020).

The first and dependent variable of the study is EQ, which uses EF as its proxy, being an accurate and detailed measure of human activities in the environment (Uddin, Alam & Gow, 2019). EF is obtained from the Global Footprint Network. It is a more all-inclusive and truer gauge for environmental sustainability. EF captures stress on direct land (built-up area, forest, cropland, pasture, and hydropower area) and indirect land occupation by fossil defined as extra biologically productive area required to sequester atmospheric fossil CO₂ and calcination CO₂ from cement burning through afforestation (Silalertuksa & Gheewala, 2019). Due to its superiority over the CO₂ and similar measures, it has received significant traction in recent literature (Yao, *et al.*, 2021; Ahmad, *et al.*, 2022; Alper *et al.*, 2023).

This study measured FD using the financial development index (FDI) because it offers a comprehensive means for comparing different facets of financial systems across economies than other proxies (Shoab, Rafique, Nadeem, & Huang, 2020). The study

measured IQ using the average of all the IQ components, namely political stability, control of corruption, rule of law, regulatory quality, government effectiveness as well as voice and accountability (Ali *et al.*, 2022). Control variables include population which is available from Macrotrend.net, GDP per capita and financial development index from the World Bank, index of the six components of the institutional quality from Global Economy and energy consumption from the BP Statistical Review of World Energy database (EC).

3.2 Estimation technique and model specification

The panel data regression technique was used to estimate the effect of FD and IQ and their interaction on EQ. The study used the panel autoregressive distributed lag (ARDL) model. ARDL models are frequently used in a single-equation framework to analyse dynamic relationships. The ARDL model, in its equilibrium correction representation, can be used to separate the long-run and short-run effects, as well as to test for cointegration or, more broadly, the existence of a long-run relationship between the variables of interest (Kripfganz and Schneider, 2018). The justification for using the P-ARDL model is that static panel estimations, such as fixed and random effects estimations, cannot differentiate between the short-run and long-run effects of financial development on the environment. The ARDL equation followed in this study is consistent with Shin *et al.*, (2011). It is given thus:

$$\begin{aligned} \Delta EF_{it} = & \alpha + \beta'_1 EF_{it-1} + \beta'_2 FDI_{it-1} + \beta'_3 IQI_{it-1} + \beta'_4 GDPPK_{it-1} + \beta'_5 POP_{it-1} \\ & + \beta'_6 EC_{it-1} + \beta'_7 \Delta FDI * IQI_{it-i} + \sum_{i=1}^m \lambda_i \Delta EF_{it-i} + \sum_{i=1}^n \pi_i \Delta FDI_{it-i} \\ & + \sum_{i=1}^r \psi_i \Delta IQI_{it-i} + \sum_{i=1}^p \beta_i \Delta GDP_{it-i} + \sum_{i=1}^q \gamma_i \Delta POP_{it-i} + \sum_{i=1}^s \Gamma_i \Delta EC_{it-i} \\ & + \sum_{i=1}^r \kappa_i \Delta FDI * IQI_{it-i} + \varepsilon_{it} \end{aligned} \quad (1)$$

Where $i = 1, 2, \dots, N$ and $t = 1996, 1997, \dots, 2020$. The t is the number of time units while i is the number of countries or a cross-section. $\beta'_i (i=1,2,\dots,7)$ represents the long-run coefficients and $\lambda_i, \pi_i, \psi_i, \beta_i, \gamma_i, \kappa_i$ are the short-run coefficients. EF is a dependent variable representing ecological footprint. Independent variables are: FDI (Financial Development Index), IQI (Institutional Quality Index), GDP (gross domestic product), POP (population), EC (energy consumption), FDI*IQI interaction of the two, and ε is the error term. The panel error correction model estimated after the establishment of the cointegration is given as:

$$\begin{aligned} \Delta EF_{it} = & \alpha_0 + \sum_{i=1}^m \lambda_i \Delta EF_{it-i} + \sum_{i=1}^n \pi_i \Delta FDI_{it-i} + \sum_{i=1}^r \psi_i \Delta IQI_{it-i} + \sum_{i=1}^p \beta_i \Delta GDP_{it-i} \\ & + \sum_{i=1}^q \gamma_i \Delta POP_{it-i} + \sum_{i=1}^s \Gamma_i \Delta EC_{it-i} + \sum_{i=1}^r \kappa_i \Delta FDI * IQI_{it-i} + \theta ecm_{it-1} \\ & + \varepsilon_{it} \end{aligned} \quad (2)$$

Where ecm_{it-1} represents the error correction and θ the speed of adjustment between long run equilibrium and short run dynamics. To confirm the presence of a long-run relationship between ecological footprint and its explanatory variables, the coefficient θ must assume a negative and significant value.

4. FINDINGS AND DISCUSSION

4.1 Panel unit root results

We relied on Levin, Lin and Chu (2002) and Im, Pesaran and Shin (2003) unit root tests to determine the property of dependent and independent variables. The stationarity of the variables is established if the associated p -values are less than 5%. The panel unit root test results in Table 2 show that FDI, IQI, FDI*IQI, GDPPK, and EC, are stationary at level, which makes them integrated at order zero (0) while EF and POP are integrated of

order (1). Essentially, all explanatory variables are of mixed order of integration of order 0 and 1.

Table 2: Panel unit root tests

| variables | Levin, Lin & Chu | | Im, Pesaran and Shin | |
|-----------|------------------|------------|----------------------|------------|
| | Levels | first diff | Levels | first diff |
| FDI | 0,029 | 0,000 | - | - |
| FDIIQI | 0,000 | - | - | - |
| IQI | 0,000 | - | - | - |
| logEC | 0,0394 | 0,000 | - | - |
| logEF | 0,555 | 0 | 0,492 | 0,0008 |
| logGDPPK | 0,005 | - | 0,377 | 0,602 |
| Logpop | 1,000 | 0,000 | 1 | - |

4.2 Cointegration tests

Subsequently, the Pedroni (2004) panel cointegration test was employed to generate the within (four tests) and between (three tests) the groups' results for the BRICS bloc.

Table 3: Pedroni residual cointegration tests

| Test Stats. | Without interaction | | With interaction | |
|-------------|---------------------|-------|------------------|-------|
| | Panel | Group | Panel | Group |
| v | 4.324 | . | 4.515 | . |
| rho | 0.836 | 1.804 | 0.901 | 1.940 |
| t | 1.618 | 2.772 | 1.902 | 3.256 |
| adf | 0.504 | 2.241 | 0.749 | 1.427 |

All test statistics are distributed $N(0,1)$, under a null of no cointegration, and diverge to negative infinity (save for panel v).

The result in Table 3 suggests that there is a cointegrating relationship between ecological footprint and the explanatory variables. The results are presented both with and without interactions between FDI and IQI and at least five of the seven tests reject the hypothesis of no cointegration because they are significant at least at a 10% level of significance.

4.3 ARDL results

Given that the model accommodates 1(0) and 1(1) variables, we estimated both the long and the short-run panel ARDL models using the logarithm of population, energy consumption, ecology footprint and GDP per capita. Table 4 presents the long-run results of the impact of dependent on independent variables without the interaction (3,3,3,3,3) and with interaction of IQI and FDI (2,3,3,3,3) on the environmental footprint. The results of the first model reveal that IQI, EC, POP, GDP exert an increasing effect on EF while FDI exerts a decreasing effect on EF in the long run. All the variables are statistically significant at the 5% significant level, *albeit* EC. It suggests that a percentage increase in GDP will result in a 64.3011% and 8.21% increase in EF while a percentage increase in FDI will result in a 32% decline in EF. This finding is consistent with Aluko and Obalade (2020) and Li *et al.* (2022) who reported that financial development reduces

CO₂ in BRICS, and Alper *et al.* (2023) who found that energy use and economic growth, and Khan *et al.* (2022) who found that certain components of IQI lead to deterioration in ecological footprint.

The results of the second model show that the interaction between FDI and IQI portend a desirable (reducing) effect on EF in the long run. In this context, FDI*IQI spurs 103% reduction in EF in the long run. This is in line with Hunjra *et al.* (2020) who demonstrated the moderating effect of institutional quality on the effect of credit to private sector on CO₂ in South Asia but this differs from Tamazian and Rao (2009) who showed that IQ does not moderate the relationship between finance and environment in 24 transition economies. The magnitude of FDI's impact on EF has also increased from 32% to 77%. This evidence shows that various measures undertaken by BRICS to improve their financial sector, for example, the establishment of the BRICS New Development Bank, and the BRICS Contingent Reserve Initiative, among others, would have a beneficial effect on the environmental footprint in the long run. In addition, the outcome of other variables such as population has changed favourably.

Table 4: Long-run results of the panel ARDL

| | Without interaction | | With interaction | |
|--------------------------------|---------------------|--------|------------------|--------|
| Dependent variable: | D(LOGEF) | | | |
| Selected model | PMG(3,3,3,3,3,3) | | PMG(2,3,3,3,3,3) | |
| Variable | Coefficient | Prob. | Coefficient | Prob. |
| Long-run (Pooled) Coefficients | | | | |
| FDI | -0.321879 | 0.0000 | -0.769463 | 0.0000 |
| IQI | 0.022721 | 0.0004 | 0.617629 | 0.0000 |
| LOGPOP | 0.082066 | 0.0001 | -0.544879 | 0.0000 |
| LOGEC | 0.047395 | 0.0834 | - | - |
| LOGGDPK | 0.643011 | 0.0000 | 0.829664 | 0.0000 |
| FDIIQI | - | - | -1.034465 | 0.0000 |
| C | -2.227778 | 0.0000 | -0.928072 | 0.0000 |

Table 5: Short-run results of the panel ARDL

| | Without interaction | | With interaction | |
|-------------------------------------|---------------------|---------------|------------------|---------------|
| Dependent Variable: | D(LOGEF) | | | |
| Selected model | PMG(3,3,3,3,3,3) | | PMG(2,3,3,3,3,3) | |
| Variable | Coefficient | Prob. | Coefficient | Prob. |
| Short-run (Mean-Group) Coefficients | | | | |
| COINTEQ | -0.838499 | 0.0192 | -0.458720 | 0.0033 |
| D(LOGEF(-1)) | 0.234229 | 0.4514 | 0.077260 | 0.7331 |
| D(LOGEF(-2)) | -0.056573 | 0.8485 | - | - |
| D(FDI) | -0.622790 | 0.3651 | 0.396972 | 0.7146 |
| D(FDI(-1)) | 0.004494 | 0.9771 | 0.644567 | 0.1271 |
| D(FDI(-2)) | 0.087776 | 0.3506 | 0.204094 | 0.4958 |
| D(IQI) | 0.052442 | 0.3355 | 0.552994 | 0.1629 |
| D(IQI(-1)) | 0.045333 | 0.2693 | 0.262410 | 0.7047 |
| D(IQI(-2)) | 0.076647 | 0.3951 | -0.478214 | 0.0622 |
| D(LOGPOP) | -72.21328 | 0.8180 | 0.260351 | 0.0046 |
| D(LOGPOP(-1)) | 256.5280 | 0.5937 | 58.03818 | 0.6242 |

| | | | | |
|----------------------|-----------------|---------------|-----------------|---------------|
| D(LOGPOP(-2)) | -154.8136 | 0.3796 | -32.98208 | 0.7608 |
| D(LOGEC) | -0.048611 | 0.8271 | - | - |
| D(LOGEC(-1)) | 0.403095 | 0.1935 | - | - |
| D(LOGEC(-2)) | 0.102972 | 0.8459 | - | - |
| D(LOGGDPPK) | 0.993759 | 0.0379 | 1.938589 | 0.0135 |
| D(LOGGDPPK(-1)) | 0.384291 | 0.7960 | -1.564903 | 0.2968 |
| D(LOGGDPPK(-2)) | -0.117734 | 0.8162 | 1.060727 | 0.2464 |
| D(FDIIQI) | - | - | -1.510553 | 0.0924 |
| D(FDIIQI(-1)) | - | - | -0.500465 | 0.7338 |
| D(FDIIQI(-2)) | - | - | 0.905204 | 0.0282 |

From the short run results of the model without and with FDI*IQI presented in Table 5, while the explanatory variables except for GDP are not statistically significant from the first model, the relevant variables are statistically significant in the second model. Specifically, GDP and POP increase EF in the short run in the BRICS nations. This is in congruence with extant studies (Alper, *et. al.*, 2023). Although FDI does not have a significant effect in the short run, the institutional quality (-0.478214) and its interaction with FDI (-1.510553) have an expected significant reducing impact on EF.

5. CONCLUDING REMARKS

This study examined the impact of institutional quality and financial development and their interaction on environmental quality in five emerging markets (BRICS) using panel ARDL for the 1996-2020 period. We found that growth of the BRICS nations is associated with environmental degradation in the short and long run. Even if the BRICS economies are growing, a rise in income alone cannot address the environmental deterioration in the absence of stringent environmental regulations. While financial development does not have a significant impact on the ecological footprint in the short run, its impact in the long run is significant and desirable. Conversely, while institutional quality does not have a desirable effect on the ecology footprint in the long run, its impact in the short run is significant and desirable.

Importantly, we showed that financial development moderates the unfavourable effect of institutional quality on ecological footprint in the long run while institutional quality moderates the effect of financial development on the ecological footprint in the short run in BRICS. This implies that the roles of both the financial development and institutional quality or good governance in engendering environmental quality are interdependent rather than being mutually exclusive. Thus, the policy implication of the findings is that good institutional quality is a necessary condition, for the desirable effect of financial development on environmental quality to be realised in the BRICS nations in the long run. At the same time, a developed financial sector is a necessary condition for the desirable effect of institutional quality on environmental quality to be realised in the short run. Therefore, the goals of achieving good governance or institutional quality and a higher level of financial development must be pursued simultaneously in BRICS.

The findings of the study suggest that the current BRICS economic partnership strategy 2025, which expresses the bloc's commitment to sustainable development is a step in the right direction and must be pursued vehemently. The strategy aims to stimulate strong economic growth and confront macroeconomic shocks and financial volatility. This is enshrined in the priority areas such as the facilitation of the New Development Bank as a

competitive and effective multilateral development institution responding to the interests of all shareholders while expanding the use of national currencies, attracting financial resources of national and international development banks, including the New Development Bank, to implement the top-priority projects in BRICS (University of Toronto, 2020). It is worth noting that the implementation by BRICS of the UN 2030 Agenda for Sustainable Development encouraged and improved collaboration on advancing sustainable development in economic, social and environmental dimensions. However, BRICS seems to pay little attention to its institutional quality in its recent economic partnership strategy 2025. Kanyane and Sambo (2021) observed inadequate governance, ownership policy, oversight, and accountability disparities in the BRICS nations.

It is therefore important that appropriate institutional policies spanning all facets of governance indices (voice and accountability, political stability, government effectiveness, regulatory stability, regulatory quality, rule of law, and corruption control) that would promote favourable institutions should be pursued by the emerging BRICS countries. In addition, emerging countries through their various innovative financial strategies can create incentive in their domestic economies to foster environmental sustainability. This can be achieved by financing energy efficient production and industrialisation. This study concludes that financial development can contribute significantly to lowering ecological footprint when a strong institutional structure is in place, and vice versa. In terms of enhancing environmental protection, this highlights the complementary roles of the strong institutional infrastructure in the BRICS economies. Overall, this research concludes that FD can effectively mitigate environmental degradation when combined with a strong institutional framework, and *vice versa*. This is likely to be the case when quality institution interacts with economic growth and population, and hence, future studies must explore these interaction and moderation relationships. In addition, changing market condition² must be considered in the investigation of the subject matter.

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REFERENCES

- [1] Acheampong, A. O. (2019). Modelling for insight: does financial development improve environmental quality, *Energy Econ.*, 83, 156-179
- [2] Ahmad, M., Ahmed, Z., Yang, X., Hussain, N., and Sinha, A. (2022). Financial development and environmental degradation: do human capital and institutional quality make a difference?. *Gondwana Research*, 105, 299-310. Retrieved 12 April, 2023, from <https://www.sciencedirect.com/science/article/pii/S1342937X21002677>.
- [3] Akram, F., Abrar-ul-Haq, M., and Raza, S. (2018). A Role of Corporate Governance and Firm's Environmental Performance: A Moderating Role of Institutional Regulations. *International Journal of Management Studies*, 25(2), 19-37.

² Obalade *et al.* (2023) demonstrates that emerging markets such as South Africa undergo changing market conditions.

- Retrieved 12 April, 2023, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3703616.
- [4] Ali, S., Zhongxin, W., Ali, Z., Fei, G., and Chowdhury, M. A. S. (2022). Does institutional quality moderate the relationship between corporate governance and stock liquidity? Evidence from the emerging market of Pakistan. *Frontiers in Psychology, 13*. Retrieved 12 April, 2023, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9534311/>.
- [5] Aluko, O. A., & Obalade A. A. (2020) Financial development and environmental quality in sub-Saharan Africa: Is there a Technological Effect? *Science of the Total Environment, 747*, 141515.
- [6] Becerra, O., Cavallo, E., and Scartascini, C. (2012). The politics of financial development: The role of interest groups and government capabilities. *Journal of Banking and Finance, 36*(3), 626-643. Retrieved 12 April, 2023, from <https://www.sciencedirect.com/science/article/pii/S0378426611003074>.
- [7] Choong, C. K., and Chan, S. G. (2011). Financial development and economic growth: A review. *African Journal of Business Management, 5*(6), 2017-2027. Retrieved 12 April, 2023, from https://www.researchgate.net/publication/228431470_Financial_development_and_economic_growth_A_review.
- [8] Cynthia, R., Armijo, L., & Katada, S. (2017). Conclusion: Whither the BRICS?', *The BRICS and Collective Financial Statecraft* (New York, 2017; online edn, Oxford Academic, 19 Oct. 2017), <https://doi.org/10.1093/oso/9780190697518.003.0005>, accessed 23 Mar. 2024.
- [9] Eryilmaz, F., Bakır, H., and Mercan, M. (2015). Financial development and economic growth: panel data analysis. *Handbook of Research on Strategic Developments and Regulatory Practice in Global Finance* (pp. 233-245). Hakkari University, Turkey: IGI Global.
- [10] Fahad, S., Hasanuzzaman, M., Alam, M., Ullah, H., Saeed, M., Khan, I. A., and Adnan, M. (2020). *Environment, climate, plant and vegetation growth (1st ed.)*. Springer International Publishing Switzerland.
- [11] Golubović, T.D. (2022). Environmental Consequences of Soil Erosion. In Zivkovic, S (Ed), *Prevention and Management of Soil Erosion and Torrential Floods* (pp. 112-131). University of Niš, Serbia: IGI Global.
- [12] Gupta, S., and Palsule-Desai, O. D. (2011). Sustainable supply chain management: Review and research opportunities. *IIMB Management review, 23*(4), 234-245. Retrieved 12 April, 2023, from <https://www.sciencedirect.com/science/article/pii/S0970389611001017>.
- [13] Guru, B. K., and Yadav, I. S. (2019). Financial development and economic growth: panel evidence from BRICS. *Journal of Economics, Finance and Administrative Science, 24*(47), 113-126. Retrieved 12 April, 2023, from <https://www.emerald.com/insight/content/doi/10.1108/JEFAS-12-2017-0125/full/html>.
- [14] Hunjra, A. I., Tayachi, T., Chani, M. I., Verhoeven, P., and Mehmood, A. (2020). The moderating effect of institutional quality on the financial development and environmental quality nexus. *Sustainability, 12*(9), 3805. Retrieved 12 April, 2023, from <https://www.mdpi.com/2071-1050/12/9/3805>.
- [15] Hussain, M., Butt, A. R., Uzma, F., Ahmed, R., Irshad, S., Rehman, A., and Yousaf, B. (2020). A comprehensive review of climate change impacts, adaptation, and

- mitigation on environmental and natural calamities in Pakistan. *Environmental monitoring and assessment*, 192, 1-20. Retrieved 12 April, 2023, from <https://link.springer.com/article/10.1007/s10661-019-7956-4>.
- [16] International Monetary Fund. (2021). What's Next For Emerging Markets?. Retrieved 12 April, 2023, from <https://www.imf.org/external/pubs/ft/fandd/2021/06/index.htm>.
- [17] Johnson, D.L., S.H. Ambrose, T.J. Bassett, M.L. Bowen, D.E. Crummey, J.S. Isaacson, D.N. Johnson, P. Lamb, M. Saul, and A.E. Winter-Nelson (1997). "Meanings of environmental terms." *Journal of Environmental Quality*. 26: 581–89. doi:10.2134/jeq1997.00472425002600030002x
- [18] Khan, H., Weili, L., and Khan, I. (2022). The role of financial development and institutional quality in environmental sustainability: panel data evidence from the BRI countries. *Environmental Science and Pollution Research*, 29(55), 83624-83635. Retrieved 12 April, 2023, from <https://link.springer.com/article/10.1007/s11356-022-21697-7>.
- [19] Kanyane, M. H., & Sambo, V. T. (2021). State of State-Owned Enterprises' Governance in BRICS Countries - Issues for Consideration. *African Journal of Governance and Development*, 10(1), 199-215.
- [20] Khan, M.A. (2022). Institutional perspective of financial sector development: A multidimensional assessment. In gu, L, Khan, M.A and Bhatti, M.I (Eds), *Economic Systems* (pp. 101041). LaTrobe University, Australia: Elsevier BV.
- [21] Kripfganz, S., & Schneider, D. C. (2018, September). ardl: Estimating autoregressive distributed lag and equilibrium correction models. In *Proceedings of the 2018 London Stata conference* (Vol. 9).
- [22] Levinson, A. & Taylor, M. S. (2008). Unmasking the pollution haven effect. *International Economic Review*, 49(1), 223-254.
- [23] Li, X., Ozturk, I., Majeed, M. T., Hafeez, M., and Ullah, S. (2022). Considering the asymmetric effect of financial deepening on environmental quality in BRICS economies: Policy options for the green economy. *Journal of Cleaner Production*, 331, 1-9, 129909.
- [24] Mohanty, S and Sethi, N. (2022). The energy consumption-environmental quality nexus in BRICS countries: the role of outward foreign direct investment. *Environmental Science and Pollution Research*, 29(13), 19714-19730. Retrieved 12 April, 2023, from <https://link.springer.com/article/10.1007/s11356-021-17180-4>.
- [25] Obalade, A. A. (2024). Finance, Growth and Institutional Framework in Emerging Countries. *Review of Integrative Business and Economics Research*, 13(2), 347-354.
- [26] Obalade A. A., Khumalo Z., Naidoo M., Thwala, N., Maistry, S. Muzindutsi, P. F. (2023). Macroeconomic determinants of Bond Performance under changing regimes: Evidence from South Africa. *Review of Integrative Business and Economics Research*, 12(1), 92-110.
- [27] Richard, W. (2016). Panel Data 4: Fixed Effects vs Random Effects Models. Department of Sociology, University of Notre Dame. Retrieved 12 April, 2023, from <https://www3.nd.edu/~rwilliam/stats3/Panel04-FixedVsRandom.pdf>.
- [28] Seddighi, H. (2011). *Introductory econometrics: a practical approach*. (2nd ed.). Retrieved 12 April, 2023, from <https://www.taylorfrancis.com/books/edit/10.4324/9780203157688/introductory-econometrics-hamid-seddighi>.

- [29] Sehrawat, M., Giri, A. K., and Mohapatra, G. (2015). The impact of financial development, economic growth and energy consumption on environmental degradation: Evidence from India. *Management of Environmental Quality: An International Journal*. Retrieved 12 April, 2023, from <https://www.emerald.com/insight/content/doi/10.1108/MEQ-05-2014-0063/full/html>.
- [30] Sharma, P.D. (2008). Environmental Degradation – Combating the menace of hunger and poverty. [Weblog]. Retrieved 13 April 2023, from <https://saferenvironment.wordpress.com/2008/08/14/environmental-degradation-combating-the-menace-of-hunger-and-poverty/>.
- [31] Shivanna, K. R. (2022). Climate change and its impact on biodiversity and human welfare. *Proceedings of the Indian National Science Academy*, 88(2), 160-171. Retrieved 12 April, 2023, from <https://link.springer.com/article/10.1007/s43538-022-00073-6>.
- [32] Shoaib, H. M., Rafique, M. Z., Nadeem, A. M., and Huang, S. (2020). Impact of financial development on CO 2 emissions: A comparative analysis of developing countries (D 8) and developed countries (G 8). *Environmental Science and Pollution Research*, 27, 12461-12475. Retrieved 12 April, 2023, from <https://link.springer.com/article/10.1007/s11356-019-06680-z>.
- [33] Sichoongwe, M. (2022). GDB | Brics and De-dollarization of the Global Financial System. [Weblog]. Retrieved 12 April 2023, from <https://www.isscad.pku.edu.cn/research/talkingglobaldevelopmentblog/527043.htm>.
- [34] Statista (2024). BRICS and G7 countries' share of the world's GDP in PPP 2000-2023. Retrieved 23 March 2024, from <https://www.statista.com/statistics/1412425/gdp-ppp-share-world-gdp-g7-brics/#:~:text=The%20BRICS%20countries%20overtook%20the,held%20by%20the%20G7%20countries>.
- [35] Stiftung, B., Azahaf, N., & Schraad-Tischler, D. (2012). Governance Capacities in the BRICS Sustainable Governance Indicators. Retrieved 23 March 2024, from https://www.sgi-network.org/docs/publications/Governance_Capacities_in_the_BRICS.pdf
- [36] Stosic, B., Milutinovic, R., Zakic, N., and Zivkovic, N. (2016). Selected indicators for evaluation of eco-innovation projects. *Innovation: The European Journal of Social Science Research*, 29(2), 177-191. Retrieved 12 April, 2023, from <https://www.tandfonline.com/doi/full/10.1080/13511610.2016.1157682>.
- [37] Tamazian, A., and Rao, B. B. (2009). Do economic, financial and institutional developments matter for environmental degradation? Evidence from transitional economies. *Energy economics*, 32, 137-145..
- [38] Tamazian, A., Chousa, J.P., and Vadlamannati, K.C. (2009). Does higher economic and financial development lead to environmental degradation: Evidence from BRIC countries. *Energy Policy* 37, 246–253.
- [39] Tian, Y., Wu, Y., Liu, H., Si, Y., Wu, Y., Wang, X., ... and Hu, Y. (2020). The impact of ambient ozone pollution on pneumonia: A nationwide time-series analysis. *Environment international*, 136, 105498. Retrieved 12 April, 2023, from <https://www.sciencedirect.com/science/article/pii/S0160412019333197>.
- [40] Uddin, G. A., Alam, K., and Gow, J. (2019). Ecological and economic growth interdependency in the Asian economies: an empirical analysis. *Environmental Science and Pollution Research*, 26, 13159-13172. Retrieved 12 April, 2023, from <https://link.springer.com/article/10.1007/s11356-019-04791-1>.

- [41] University of Toronto (2020). Strategy for BRICS Economic Partnership 2025. BRICS Summit 20 November 2020. [efaidnbmnnnibpcajpcglclefindmkaj/http://www.brics.utoronto.ca/docs/2020-strategy](http://www.brics.utoronto.ca/docs/2020-strategy)
- [42] Waheed, R., Chang, D., Sarwar, S., and Chen, W. (2018). Forest, agriculture, renewable energy, and CO2 emission. *Journal of Cleaner Production*, 172, 4231-4238. Retrieved 12 April, 2023, from <https://www.sciencedirect.com/science/article/pii/S0959652617325891>.
- [43] Wang, C., Cardon, P. W., Liu, J., and Madni, G. R. (2020). Social and economic factors responsible for environmental performance: A global analysis. *Plos one*, 15(8). Retrieved 12 April, 2023, from <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0237597>.
- [44] Wang, Z., & Huang, Y. (2023). Natural resources and trade-adjusted carbon emissions in the BRICS: The role of clean energy. *Resources Policy*, 86, 104093, <https://doi.org/10.1016/j.resourpol.2023.104093>.
- [45] Yao, X., Yasmeen, R., Hussain, J., and Shah, W. U. H. (2021). The repercussions of financial development and corruption on energy efficiency and ecological footprint: Evidence from BRICS and next 11 countries. *Energy*, 223, 120063. Retrieved 12 April, 2023, from <https://www.sciencedirect.com/science/article/pii/S0360544221003121>.
- [46] Zhao, W., Hafeez, M., Maqbool, A., Ullah, S., and Sohail, S. (2021). Analysis of income inequality and environmental pollution in BRICS using fresh asymmetric approach. *Environmental Science and Pollution Research*, 28, 51199-51209. Retrieved 12 April, 2023, from <https://link.springer.com/article/10.1007/s11356-021-14209-6>.