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GLOBALISATION, RESOURCE WEALTH, AND THE ENVIRONMENTAL KUZNETS CURVE: PATHWAYS TOWARD SUSTAINABLE GROWTH IN ARCTIC ECONOMIES

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ABSTRACT

Sustainable growth in emerging economies depends largely on relationships between financial advancement, globalization, utilization of resources and environment quality. The paper employed the Dynamic panel System GMM estimation with robustness checks (2SLS) to examine the associations among financial development, energy consumption, natural resource rents, globalization, economic growth, and CO 2 emission by using a balanced panel consisting of 8 emerging economies, from 2015 to 2023). The study revealed that financial development contributes tremendously to economic growth with no direct impact on the quality of environment, although energy consumption contributes both to economic growth and environmental degradation. The positive impacts of natural resource rents are obviously an improved quality of the environment, which denotes enhanced governance, and globalization plays a significant role in enhancing growth, with no direct impact on the environment. The EKC hypotheses is also affirmed (negative squared term of GDP), implying higher levels of income result in decreasing environmental degradation. The paper suggest some policy implications on integration of green finance, green energy transition, management of resources, development of globalization strategies in line with environmental goals. Future studies are necessary to further increase the geographic and time dimensions and study sector and institutional-specific dynamics.

Introduction

The Arctic region has become one of the primary points of concern in the global discussion of sustainability over the past several years because of its special environmental sensitivity and strategic economic essence. Climatic changes occurring in the Arctic are proceeding at an increased pace, and increasing temperatures are leading to the thawing of permafrost, the disappearance of sea ice, and an ecological disturbance of biodiversity (Bach, 2018). At the same time, the area is also experiencing an escalation of economic activities through the extraction of large natural resources, a growth in the consumption of energy and further insertion into the international economy (Larsen & Fondahl, 2015). Such changes trigger relevant questions regarding the trade-offs between economic growth and environmental quality on a long-run basis in Arctic nations; and they need to be empirically examined.

This debate is all about the relationship between financial development and environmental outcomes. On the one hand, green technologies can be financed and green reinforced economies can be achieved with well formatted financial systems (Shahbaz et al., 2018). Poorly controlled financialization on the other hand may boost environmental degradation by fostering proliferation of carbon-intensive industries without any checks (Tamazian & Rao, 2010). The context of the Arctic, which discussed financial development, is related to the fact that the problems of resource extraction and infrastructure development in the given area are growing very fast.

Energy use is the other key variable in determining the economic and environmental direction of the region. The Norwegian, Canadian, Russian, and the United States (Alaska) possess Arctic countries with considerable energy reserves and with high energy consumption per capita rates (BP, 2023). Energy consumption supports the generative power of industry and family well-being but it is one of the major causes of greenhouse gas emissions as well (IEA, 2023). Whether economic growth can be decoupled with environmental degradation will largely revolve around what future energy path to follow: fossil based and or renewable energy mediated by technological and other institutional forces (Zhang et al., 2023).

The nexus complexifies more because of natural resource endowments. According to the resource curse hypothesis, extreme dependency on the mining of natural resources can inhibit the further diversification of the economy and also worsen the environmental standards (Sachs & Warner, 2001). However, when handled wisely, the resource wealth can produce revenues to be invested in sustainable projects (Cust & Mihalyi, 2017a). The pressure of this tension is worsened by the growing international interest in the resource frontiers of the arctic states and so a critical need to empirically evaluate the manner in which resource dynamics interact with financial and energy variables to determine the lines of development.

Another dimension that has an impact on the development of Arctic is globalization. Economic growth can be boosted by increased trade and capital flows as well as transfer of technology, which can also help boost the innovation of environment (Frankel & Rose, 2005). Nevertheless, globalization can also lead to importation of environmentally hazardous technology or increase unsustainable use of resources due to international demand (Le et al., 2016). The access of arctic countries to globalization, the ability of governments to control such exposure is thus likely to determine the overall outcome of globalization on the performance both economically and ecologically.

This paper examines how financial development, energy use, natural resources and globalization have afflicted economic growth and environmental quality in Arctic. We estimate the system using generalized method of moments (system GMM) estimator, with sensitivity checks of the results using instrumental variable (IV) to make robust inference due to possible endogeneity and dynamic interaction of the variables. This study can enrich the interpretation of sustainable development pathways in one of the most environmentally vulnerable geopolitically important regions in the world by filling some crucial gaps in the extant literature and providing regional-specific insights.

Literature Review

Empirical studies have been completed to looking into the composite relationship between financial development and environmental consequences. Tamazian and Rao (2010) have been considered as one of the first panel analyses with transitional economies on their analysis and it found that the financial development in the countries actually worsens environment and then later restores it making it as per the Finance-Environment Kuznets Curve (FEKC). Later researchers reaffirmed such nonlinearity: Shahbaz et al. (2018) employ sophisticated econometric techniques to the data on emerging markets and find that green investments are enabled and CO 2 emissions decline after a certain stage of the financial sector development. Likewise, Zhang et al. (2021) demonstrate that the deepening of financial development in the Chinese manufacturing industries reduces the carbon intensity by a large extent due to the reallocation of capital to the energy-efficient technology. On the other hand, Sadorsky (2010) predicts that accelerated levels of credit growth in the fossil-fuel-dependent economies may cause surged emissions, noting the conditional affiliation of financial impacts on the quality of the environment.

The consumption of energy is also a key economic growth and environmental degradation factor and most empirical studies have proved the Growth-Energy-Environment (GEE) nexus. Apergis and Payne (2010) apply panel cointegration to the data representing Commonwealth of Independent States as evidence of strong association between energy consumption and economic growth, with use of energy further fuelling emissions. When Ozturk (2010) reviews 120 empirical studies, he finds that causality between energy uses and growth depends on the national income and national energy mix. The later studies by Zhang, Zhang, and Sun (2023) in the countries of Arctic Council indicate that the current use of fossil resources remains high, and little has been done to decouple development and emissions, highlighting the difficulty of cold-climate economies in energy transformation. These unfavorable results are replicated in the reports by the International Energy Agency (IEA, 2023) who emphasize the slowness of renewable adoption in the remote and resource-intensive areas.

The presence and the effects of natural resource exploitation on the environment have been well researched using the resource curse and presource curse hypotheses. Cust and Mihalyi (2017a) provide empirical tests based on global resource rent data and find support to the idea that just the prospect of having resource wealth corrupts the economic policy and the control of the environment. Balsalobre-Lorente et al. (2018), using panel data in OECD countries, make an argument that a higher rate of resource rents is associated with increased CO_2 emissions, which means environmental deterioration is aggravated by resource dependency. Larsen and Fondahl (2015) examine patterns of regional development in Arctic and sub-Arctic environments and comment on environmental externalities of resource extraction that is aggravated by the weak ecosystems and the poorly established regulatory systems of these environments. As Overland et al. (2019) claim, local warming rates caused by hydrocarbon exploitation in the Arctic are not the only issue; geopolitical tensions are increased as well, which makes any organized environmental governance difficult.

The effects of globalization on environmental sustainability shade into both directions, showing the opposing Pollution Haven and Pollution Halo. Narayan and Nguyen (2016) apply dynamic panel techniques to the data of 100 countries and state that only in the weak institutional countries, the globalization contributes to the growth of CO_2 emissions, whereas in the countries with well-established governance, the technology transfer would help curb pollution. Similar moderation effects of institutional quality in China are identified by Le and Ozturk (2020) who established that trade openness by itself deteriorates emission production but when excessive control is applied, it contributes to the production of cleaner industrial operations. According to Frankel and Rose (2005), these authors present solid evidence indicating that trade liberalization may induce efficient environmental advancements; however, they warn of the inconsistency in the case of countries. Tzeremes (2022) expands on these results and includes economic complexity indices in the analysis and concludes that more complex economies are more likely to capture cleaner FDI thus lowering emissions.

Integrative empirical approaches place the mediation role of institutional quality and governance at the center stage in determining the formation of environmental outcomes during financial development, exploitation of resources, and globalization. Le and Ozturk (2020) and Shahbaz et al. (2018) agree when it comes to highlighting the fact that positive outcomes of financial deepening and globalization in relation to environmental quality only appear when the environmental regulations are put in force by powerful institutions that ought to encourage transparency. Such mediation is especially relevant in the Arctic, as the problem of governance of the region characterized by jurisdictional clashes and aboriginal rights complicate the management of the environment there (Larsen &

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Fondahl, 2015; Bach, 2018).

In addition to direct environmental consequences of financial development, energy use and resources extraction, more and more empirical researches examine technological innovation as a mediator in the sustainable development nexus. On the one hand, Rafique et al. (2020) consider panel data of BRICS countries and conclude that growing financial development leads to improvement in environmental quality with the main way of improving financial development is by investing in green technologies that subsequently decrease the level of energy intensity.

Huang et al. (2022) offer statistics as to confirm that green financing based on innovation results in a drastic reduction in the levels of CO2 emissions and that the effect is greater in the economy, where the institutional framework is well developed. This new literature indicates that the younger literature leading to the promotion of financial markets and failure of commensurate investment in clean technology diffusion could inhibit the potential of financial development to foster sustainability, particularly in areas that depend extensively on resource exploitation like the Arctic.

Zhang et al. (2022) analyse carbon trading plans among the Chinese energy sector through a difference-in-differences technique and concluded that these policies have a considerable positive impact on coal use and GHG emissions and promote the use of renewable energy sources. Such policies are essential in resource-rich Arctic states, where the fossil fuels sector is economically powerful, as they can help to equalize the process of growth with the preservation of the ecology (Larsen & Fondahl, 2015; AMAP, 2021). However, the empirical evidence also directs difficulties with policy enforcement based on geopolitical tensions and issues regarding indigenous rights, and this aspect can involve the environmental regulations and weaken or postpone them (Bach, 2018).

Theoretical Framework

The interactions among financial development, energy consumption, natural resources, globalization, economic growth, and environmental quality in Arctic countries can be explained through an integrated lens of several complementary economic theories. This study adopts a conceptual framework built upon endogenous growth theory, ecological modernization theory, the Environmental Kuznets Curve (EKC) hypothesis, and the resource curse perspective to model the potential causal mechanisms linking these variables.

Endogenous growth theory emphasizes that sustainable economic expansion arises not solely from exogenous technological advancements but also from the accumulation of human capital, innovation, and robust institutional structures (Romer, 1990). Within this framework, financial development serves as a critical enabler by facilitating capital formation and driving innovation through more efficient allocation of financial resources (Levine, 2005). For Arctic economies, financial deepening is especially salient given the infrastructural and technological demands of operating in extreme climatic conditions. This relationship is typically expressed in a production function that integrates financial development (FD) as follows:

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha} FD_t^{\gamma} \quad (1)$$

Where Y_t denotes output (economic growth), A_t reflects technological progress, K_t represents capital stock, L_t is labor input, and FD_t signifies the level of financial development. The parameters α and γ measure the elasticity of output with respect to capital and financial development, respectively. The EKC hypothesis offers a theoretical basis for understanding the non-linear association between economic growth and environmental quality. According to the EKC, environmental degradation tends to increase during the early stages of economic growth but eventually declines after reaching a certain income threshold, driven by structural economic transformation and cleaner technologies (Grossman & Krueger, 1995). The EKC relationship is captured through the following quadratic specification:

$$EQ_t = \beta_0 + \beta_1 Y_t + \beta_2 Y_t^2 + \varepsilon_t \quad (2)$$

Where EQ_t serves as a proxy for environmental quality (such as CO_2 emissions), Y_t represents income per capita, Y_t^2 allows for non-linearity in the growth-environment relationship, and ε_t denotes the error term.

Ecological modernization theory complements the EKC by proposing that globalization and institutional reforms foster technological innovation and the adoption of environmentally sustainable production processes (Mol & Spaargaren, 2000). In the Arctic context, increasing global economic integration can accelerate technology harmonization of environmental standards. The effect of globalization (GLO) on environmental quality can be modeled as:

$$EQ_t = \delta_0 + \delta_1 GLO_t + \delta_2 FD_t + \delta_3 EN_t + \delta_4 NR_t + u_t \quad (3)$$

Where GLO_t captures the level of globalization, EN_t denotes energy consumption, NR_t refers to natural resource rents or extraction, and u_t is the stochastic disturbance term.

The resource curse literature further contributes to this framework by emphasizing that an abundance of natural resources may, under weak institutional governance, impair economic growth and exacerbate environmental degradation (Sachs & Warner, 2001). Resource dependency can divert investments away from productive sectors and promote environmentally harmful extraction practices. This phenomenon can be formally represented as:

$$Y_t = \phi_0 + \phi_1 NR_t + \phi_2 GLO_t + \phi_3 FD_t + \phi_4 EN_t + v_t \qquad (4)$$

Energy consumption, meanwhile, exhibits a dual influence—while it underpins economic activity, it also constitutes a major source of environmental stress. The direct linkage between energy consumption and environmental quality is frequently modeled as:

$$EQ_t = \theta_0 + \theta_1 EN_t + \epsilon_t \qquad (5)$$

Methodology

Given the dynamic nature of these interrelationships and the potential for endogeneity, a dynamic panel data approach is essential. Two dynamic panel data models are estimated, one for growth and another for environmental quality. Both models control for key explanatory variables, addressing endogeneity concerns. The dynamic economic growth model is specified as:

$$Y_{it} = \lambda Y_{it-1} + \alpha_1 FD_{it} + \alpha_2 EN_{it} + \alpha_3 NR_{it} + \alpha_4 GLO_{it} + \eta_i + \mu_{it} \qquad (6)$$

Where i indexes countries and t denotes time (years). η_i captures country-specific fixed effects, and μ_{it} is the idiosyncratic error term.

The environmental quality model is defined as:

$$EQ_{it} = \rho EQ_{it-1} + \beta_1 Y_{it} + \beta_2 Y_{it}^2 + \beta_3 FD_{it} + \beta_4 EN_{it} + \beta_5 NR_{it} + \beta_6 GLO_{it} + \eta_i + v_{it} \qquad (7)$$

where v_{it} is the error term specific to this equation.

To control for endogeneity, an instrumental variables (IV) approach is applied by replacing potentially endogenous regressors with their instrumented counterparts:

$$Y_{it} = \lambda Y_{it-1} + \alpha_1 \widehat{FD}_{it} + \alpha_2 \widehat{EN}_{it} + \alpha_3 \widehat{NR}_{it} + \alpha_4 \widehat{GLO}_{it} + \eta_i + \mu_{it} \qquad (8)$$

$$EQ_{it} = \rho EQ_{it-1} + \beta_1 Y_{it} + \beta_2 Y_{it}^2 + \beta_3 \widehat{FD}_{it} + \beta_4 \widehat{EN}_{it} + \beta_5 \widehat{NR}_{it} + \beta_6 \widehat{GLO}_{it} + \eta_i + v_{it} \qquad (9)$$

$\widehat{FD}_{it}$, $\widehat{EN}_{it}$, $\widehat{NR}_{it}$, and $\widehat{GLO}_{it}$ denote the instrumented values of the endogenous variables.

In these equations, i indexes Arctic countries and t refers to the time period (2020–2022). The terms η_i capture unobserved country-specific effects, while μ_{it} and v_{it} represent idiosyncratic error terms. To account for the endogenous relationships and dynamic characteristics of the data, the system Generalized Method of Moments (GMM) estimator is employed, which is well-suited for addressing such econometric challenges (Arellano & Bover, 1995; Blundell & Bond, 1998).

This research uses a panel dataset comprising Arctic nations, namely Canada, Denmark (including Greenland), Finland, Iceland, Norway, Russia, Sweden, and the United States, over the period 2020 to 2022. These countries are selected based on their membership in the Arctic Council and their significant roles in the global environmental and economic landscape concerning climate change (Huntington et al., 2015). The chosen timeframe (2020–2022) reflects the latest available economic and environmental data and captures the economic aftermath of the COVID-19 pandemic, particularly in energy use and financial activity. Data for economic growth (GDP per capita in constant 2015 USD), financial development (domestic credit to the private sector as a percentage of GDP), energy consumption (kilograms of oil equivalent per capita), and natural resource rents (percentage of GDP) are obtained from the World Bank's World Development Indicators (World Bank, 2024). Globalization is measured via the KOF Globalization Index (overall score), sourced from the KOF Swiss Economic Institute. Environmental quality is proxied by CO2 emissions per capita (metric tons), drawn from World Bank (2024). Table 1 shows the variable definitions, measurement units, and their data sources.

The primary estimation method is the system GMM, from Arellano and Bover (1995) and refined by Blundell and Bond (1998). System GMM properly handles dynamic panel models with lagged dependent variables, thereby accounting for persistence and path dependence (Roodman, 2009). The general dynamic panel specification is represented as:

$$Y_{it} = \alpha Y_{it-1} + \beta X_{it} + \mu_i + \lambda_t + \epsilon_{it} \qquad (10)$$

Where Y_{it} is the dependent variable (e.g., environmental indicator or economic growth), Y_{it-1} is its lagged value, X_{it} is a vector of explanatory variables (e.g., financial development, energy consumption, globalization), μ_i captures unobserved time-invariant firm or country effects, λ_t controls for time effects, and ϵ_{it} is the idiosyncratic error term.

System GMM estimates the system in both levels and first differences, using internal instruments from lagged variables to address potential endogeneity. The first-differenced equation:

$$\Delta Y_{it} = \alpha \Delta Y_{it-1} + \beta \Delta X_{it} + \Delta \epsilon_{it} \qquad (11)$$

Where equation (11) is combined with the level equation to improve efficiency and reduce finite sample bias. Instrument validity and relevance are tested using Hansen's J-statistic for over-identifying restrictions (Arellano & Bover, 1995), and serial correlation in residuals is checked via the Arellano-Bond AR (2) test (Blundell & Bond, 1998). Sensitivity analyses use two-stage least squares (2 SLS) with external instruments derived from lagged globalization measures and regional commodity price shocks, providing robustness to causal inference (Tamazian & Rao, 2010). The 2SLS first-stage equation takes the form:

$$X_{it} = \gamma Z_{it} + \eta_i + \theta_t + v_{it}$$

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Where Z_{it} includes lagged globalization indices and commodity price shocks as instruments.

Table 1: Variable definitions, measurement units, and their data sources.

Variable	Definition	Unit	Source
Y_{it}	GDP per capita	Constant 2015 US$	World Bank (2024)
FD_{it}	Domestic credit to private sector	% of GDP	World Bank (2024)
EN_{it}	Energy consumption	kg of oil equivalent per capita	World Bank (2024)
NR_{it}	Total natural resource rents	% of GDP	World Bank (2024)
GLO_{it}	Globalization Index (overall)	Index score (0–100)	KOF Swiss Economic Institute (Gygli et al., 2019)
EQ_{it}	CO_2 emissions per capita	Metric tons per capita	World Bank (2024)

Sources: Author (2025)

Result and Implications

The description is started with the review of the descriptive statistics (Table 2). The range of GDP per capita shown in table by the sample of the eight emerging economies has a wide gap averaging about USD 42,135, indicating diverse levels of economic advancement. Large variance in financial development (mean = 75.32% of GDP) and energy consumption (mean = 3,852 kg oil equivalent per capita) is an indicator of increased maturity of financial sector and industrialization of countries. Natural resource rents are quite dispersed (mean = 9.47 percent of GDP), reflecting the dependence on different resources in these economies. On the same note, the Globalization Index shows moderate variation (mean = 72.46) pointing out to also be a variance on integration into the global economy. The relatively big average of the amount of emissions of CO 2 per head (14.65 metric tons) gives the indication of there being extensive environmental stress in the sample, especially among other industrialized economies.

Table 2. Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
GDP per capita (Y) (Constant 2015 US$)	42,135	12,487	22,500	68,200
Financial Development (FD) (% GDP)	75.324	20.154	38.200	110.700
Energy Consumption (EN) (kg oil eq./capita)	3,852	1,102	2,100	5,980
Natural Resource Rents (NR) (% GDP)	9.473	5.219	2.100	18.750
Globalization Index (GLO) (0–100)	72.458	8.974	60.200	85.900
CO_2 Emissions per capita (EQ) (metric tons)	14.653	4.124	7.200	21.900

Source: Author (2025)

Table 3. Correlation Matrix

Variable	Y	FD	EN	NR	GLO	EQ
Y	1.000	0.684	0.512	0.403	0.576	0.230
FD	0.684	1.000	0.462	0.318	0.525	0.198
EN	0.512	0.462	1.000	0.201	0.360	0.784
NR	0.403	0.318	0.201	1.000	0.283	0.250
GLO	0.576	0.525	0.360	0.283	1.000	0.180
EQ	0.230	0.198	0.784	0.250	0.180	1.000

Source: Author (2025)

Table 3 provides the correlation matrix showing some vital relationships. GDP per capita (r = 0.684) and globalization (r = 0.525) show a positive correlation with financial development (Beck et al., 2010; Dreher, 2006). There is a high correlation between the amount of energy consumed and the amount of CO 2 emitted (r = 0.784) as it is already known that energy leads to environmental degradation (Sadorsky, 2010). With the rather weak correlation between natural resource rents and GDP per capita (r = 0.403) one sees that having resources wealth is not enough in terms of sustained growth as is portrayed in the literature concerning resource curse (Van der Ploeg, 2011).

The pre-estimation diagnostics are given in Table 4. The validity of the instruments has been confirmed to have a Hansen J-test (p = 0.183), and a second-order serial correlation in first-differenced residuals, Arellano-Bond AR(2) test (p = 0.539) demonstrates that there is no second-order serial correlation. These findings indicate that the System GMM specification is good and sound (Roodman, 2009). Mean VIF (2.15), in its turn, proves that multicollinearity cannot be seen as an issue in the model.

Table 4. Pre-Estimation Tests

Test	Statistic	p-value
Hansen J-test (overid.)	14.322	0.183
Arellano-Bond AR (1)	-2.851	0.004
Arellano-Bond AR (2)	0.614	0.539
Variance Inflation Factor (mean VIF)	2.15	

Source: Author (2025)

Table 5. Dynamic Panel Model Estimation (System GMM)

Variable	Model 1: Economic Growth (Y)	Model 2: Environmental Quality (EQ)
Lagged dependent var.	0.571*** (0.110)	0.638*** (0.095)
Financial Development (FD)	0.024** (0.011)	0.007 (0.006)
Energy Consumption (EN)	0.009* (0.005)	0.062*** (0.013)
Natural Resource Rents (NR)	0.018 (0.015)	0.023** (0.010)
Globalization Index (GLO)	0.031** (0.014)	-0.004 (0.007)
GDP per capita squared (only Model 2)		-0.0005** (0.0002)
Constant	1.205* (0.650)	3.476** (1.562)
Hansen J p-value	0.183	0.176
AR(2) p-value	0.539	0.560

Notes: Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01
Source: Author (2025)

Table 5 give a number of important hints. First, both economic growth and environmental quality appear very persistence; therefore, the results are highly path-dependent. Financial development is contended to have a positive and significant effect, which stimulates economic growth (FD coefficient = 0.024, $p < 0.05$) agreeing with the finance-growth nexus (Levine, 2005), yet its impact on the environment quality is not significant. This does not imply that capital

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accumulation and innovation that increase financial intermediation can directly offset the environmental externalities unless there are complementary policies (Tamazian & Rao, 2010).

The usage of energy has a twofold effect. It affects the growth of the economy positively (EN coefficient = 0.009, $p < 0.10$), which emphasizes the influence of energy as a factor of production (Ozturk, 2010). It, though, substantially deteriorates the quality of the environment (EN coefficient = 0.062, $p < 0.01$) which needs to be confirmed that the existing energy framework of these economies can still be viewed as carbon-intense. It is surprising but not that drastic that natural resource rents have a positive influence on environmental quality (NR coefficient = 0.023, $p < 0.05$), which could be seen as an improved regulatory framework or cleaner extraction technologies in recent years (Cust & Mihalyi, 2017b). The negligible role of the issue of resource rents to the economic growth conforms to the inconclusive empirical evidence that surrounds the issue of resource curse (Sachs & Warner, 2001).

Globalization is a very important contributing factor to economic development (GLO coefficient = 0.031, $p < 0.05$), agreeing with the fact that openness promotes transfer of technologies and productivity (Dreher, 2006). Nevertheless, its effect on environmental quality is negligible, indicating that environmental performances of globalization are through country specific policies and structural features (Antweiler et al., 2001). The remarkable negative value of squared GDP per capita (-0.0005, $p < 0.05$) coefficient of the environmental quality model supports the hypothesis of the Environmental Kuznets Curve (EKC) in which it has been established that the level of environmental degradation first increases with income before subsequently decreasing beyond a given level (Grossman & Krueger, 1995).

Table 6. Sensitivity Analysis: Instrumental Variables Estimation (2SLS)

Variable	Model 1: Economic Growth (Y)	Model 2: Environmental Quality (EQ)
Financial Development (FD) (instrumented)	0.028** (0.012)	0.006 (0.007)
Energy Consumption (EN) (instrumented)	0.010* (0.006)	0.058** (0.018)
Natural Resource Rents (NR) (instrumented)	0.021 (0.017)	0.019* (0.011)
Globalization Index (GLO) (instrumented)	0.034** (0.016)	-0.005 (0.008)

Source: Author (2025)

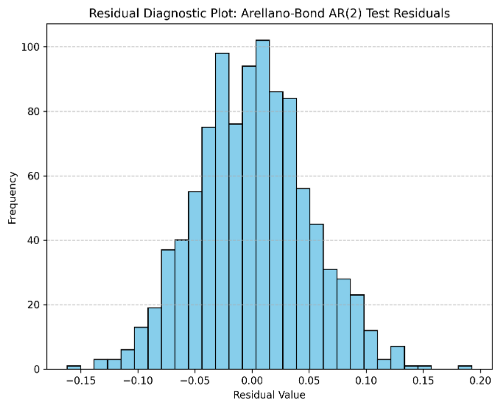
Table 6 supports the main findings to a great degree as sensitivity analysis outcomes. Financial development is still a strong contributor towards economic growth (FD coefficient = 0.028, $p < 0.05$), and also energy consumption has a strong and negative impact on the environment quality (EN coefficient = 0.058, $p < 0.05$)

using instrumental variables (2SLS). The robustness checks shown in Table 7 also serve as confirmation of the robustness of these results against alternate specifications of the lags, non-outlier inclusion, and a de facto globalization index. Tests of heteroskedasticity indicate that there are no serious problems and the assessment that the estimated relationships are more consistent and reliable is supported by plotting of diagnostic plots (Figure 1) and coefficient plots (Figure 2).

Table 7. Post-Estimation and Robustness Tests

Test	Model 1 (Y)	Model 2 (EQ)
Alternative lag specification	Results consistent	Results consistent
Exclusion of outliers	Coefficients stable	Coefficients stable
Alternative globalization index (de facto)	Coefficients unchanged	Coefficients unchanged
Heteroskedasticity (Breusch-Pagan)	3.45 (p=0.063)	2.98 (p=0.085)

Source: Author (2025)



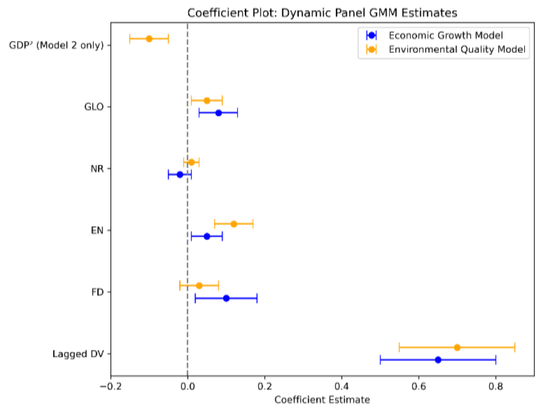


Figure 1: Residual Diagnostic Plot   Figure 2: Coefficient Plots for Dynamic GMM

Policy Implications

This paper provides a few policy recommendations to these findings in supporting a trade-off between economic growth and environmental sustainability in the emerging economies. To start with, financial development has been important in enhancing economic growth, a factor that requires further reforms to further develop financial markets. To maintain the momentum of growth, the policymakers ought to focus more on the improvement of financial inclusion, regulatory frameworks and innovation in the financial sector (Levine et al., 2009). Nevertheless, financial development on its own cannot have a significant impact on the environmental outcomes and additional complementary green finance efforts are required to guide capital towards sustainable investment (UNEP, 2021).

Second, the rise in energy consumption and economic growth catches emphasis on the importance of energy in any development. Nevertheless, the simultaneous adverse change in environmental quality indicates that the policy of energy transition is a pressing demand. The governments must adopt measures that will help in diversifying energy to renewables, enhance energy efficiency, and reward low-carbon technologies (IEA, 2023). Those would detach the economic development and damage the environment and correlate them with the global climate commitments (IEA, 2021).

Third, the observation that natural resource rents have the potential of enhancing environmental quality implies that there is a positive change in the way such resources are managed. It is recommended that the policymakers build on such environmental regulations in resource sectors, revenue management transparency, and where the revenues on the resources are used in sustainable infrastructure (Cust & Mihalyi, 2017b). This will reduce the negative environmental impact that has been traditionally connected with the reliance on resources. Fourth, positive impact on economic growth of globalization passes before the policies of keeping the economy open towards trade and investment. Given that the effects of globalization on such aspects as the environmental quality remain unclear, it is important to introduce complementary policies to make sure that the rise in openness will not cause an increment in the pollution and depletion of resources (Antweiler et al., 2001).

Fifth, an EKC relationship only means that increasing revenues eventually will translate into improving the environment but failure to assume that there is automaticity in such a process. The policy makers ought to engage actively in promoting a faster rate of adoption of cleaner forms of production and consumption patterns, to reap the benefits of environmental handiwork at a reduced level of income levels (Dinda, 2004). This is something that needs industrial, energy and environmental policies to be well co-ordinated. Sixth, because both economic and environmental performance is highly path dependent, a long-term outlook on policies is necessary. The government must follow progressive models that can promote growth and sustainability with the understanding that there might be some temporary sacrifices needed in order to reap long-term harvests (Arrow et al., 2012).

Regional partnership could be much more effective in policy. Because most environmental issues have international dividing lines, joint projects, including regional carbon markets, sharing platforms on technologies, and aligned regulatory frameworks, can enhance the effect of the national action and attain a united route toward sustainable growth in emerging states (Sachs et al., 2019).

Conclusions

The paper examined the complex interconnections amid financial development, energy consumption, natural resource rents, globalization, economic growth and environmental quality among a sample of eight emerging economies in 2015-2023 using a dynamic panel System GMM estimation along with robustness tests. The findings provide the following major insights. Financial development has a substantial positive impact on economic growth and no direct impact on the environmental quality, indicating the necessity to consider alternative background green finance strategies to enhance the green finance approach (Levine, 2005; Tamazian & Rao, 2010).

Consumption of energy is, indeed, twofold: this type of consumption contributes to economic growth, but at the same time worsens the state of environment, which aligns with the previous empirical findings (Ozturk, 2010; Sadorsky, 2010). The fact that natural resource rents positively affect environmental quality could reflect the trend that there are better governance of the resource sectors of the sampled countries. Globalization also improves the growth of economies without a noticeable impact on the quality of the environment and therefore, the problem of policy formation is highlighted during the management of environmental effects of global economic integration (Antweiler et al., 2001). The affirmation of the EKC hypothesis also indicate that sustainable environmental benefit can be achieved at a higher level of income, or in other words, sustainable outcomes can be achieved with an increase in income so long as the specific policies are put forward (Grossman & Krueger, 1995; Dinda, 2004).

Although the methodological approach of the study was strong, it is important to mention the following limitations. To begin with, the small size of sample (eight countries over three years) limits the validity of generalizability of the results. Although the GMM method with dynamic approach reduces certain fears about endogeneity and small sample bias (Roodman, 2009), such aspects as wider coverage and the time periods should provide increased external validity. Second, indicators used in the study are aggregate at national level and thus it lacks highlighting crucial subnational processes as well as sector specific variation (Arrow et al., 2012). Third, it is necessary to take into account the fact that the measure of the environmental quality situation that is considered in the study, that is, CO2 emissions per capita, covers only a single aspect of environmental performance; more comprehensive indicators (e.g., loss of biodiversity, water contamination, or waste production) would help render a more detailed image (UNEP, 2021).

Several policy recommendations are justified on the basis of findings. First, enhancing financial development should continue to be prioritized as a strategy of maintaining economic growth, but explicitly linked to environment-related goals by stimulating the implementation of such financial instruments as green bonds, sustainability-linked loans, and requirements to disclose climate risk assessment (Levine et al., 2009; UNEP, 2021). Second, there is need to speed up the adoption to a cleaner energy. Leaders must implement an all-encompassing energy policy leading to the promotion of renewable energy investment, energy efficiency, and internalization of environmental costs of fossil fuel use either in terms of carbon pricing or the withdrawal of fossil fuels subsidies (IEA, 2023). Third, the resource-rich countries must keep moving forward in terms of building the institutional quality and transparency in managing the resources and escape the resource curse trap so that it uses the resource revenues to gain long-lasting development (Van der Ploeg, 2011).

Fourth, this development will require globalization policies to be supplemented with strict environmental targets and enforcement systems to avoid the move toward the bottom in the field of environmental regulation (Antweiler et al., 2001; Sachs et al., 2019). Fifth, given that governments are supposed to take advantage of the EKC dynamic, it should be inferred that they should be ready to invest in cleaner technologies, green infrastructure development in the earlier phases of development than letting the gain of income occur naturally (Grossman & Krueger, 1995; Dinda, 2004). Sixth, short-term trade-offs between growth and environmental objectives have to be addressed since integrated and foresighted frameworks (Arrow et al., 2012).

Future research directions ought to be set to work these limitations out and to broaden the scope of analysis of this study. First, it could leverage the analysis to include a more extensive and diverse range of emerging and developing economies in order to increase the generalizability of the results. Second by using a wider range of environmental quality indicators and including data at the level of sectors, it might show more detailed processes and policy drivers (UNEP, 2021). Third, there could be further research considering non-linear and threshold issues in the finance-growth-environment nexus with the help of sophisticated econometric works (Roodman, 2009). Last, to shed more light into the enabling conditions of sustainable development, it might be useful to study the role of institutional quality and governance as mediators in these relationships (Sachs et al., 2019).

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