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Revisiting the Globalization-Ecological Footprint Nexus in Asian Countries: Evidence from the CS-ARDL Approach

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Abstract

Globalization affects many aspects of our lives. Its environmental impact has been a significant concern in the last few decades. This study examines the relationship between globalization and ecological footprint in Asia. The study considers a panel data for 16 Asian countries from 2004 to 2022. The study utilizes the Cross-Sectional Auto Regressive Distributed Lag technique to estimate the short and long-run coefficients. The results indicate that overall and economic globalization positively impacts environmental quality, but social globalization damages the ecological quality of sampled countries. Political globalization positively impacts environmental quality in the short run. The results suggest that policymakers should focus on formulating policies that mitigate the adverse implications of globalization and its sub-indices on the environment. The study provides valuable insight for stakeholders aiming to balance economic growth with environmental sustainability.

Keywords: Ecological Footprints, Overall Globalization, Economic Globalization, Social Globalization, Political Globalization, CS-ARDL
JEL Classifications: Q5, F6, F15

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1. Introduction

Environmental sustainability has remained a priority area for economies worldwide in recent decades in the context of the 2030 agenda for sustainable development. The third industrial revolution in the 1970s led to high economic growth. However, rapid industrialization and economic growth, supported by the globalization of economies, generated an externality of environmental change. Ecological researchers are keen to explore the factors that mitigate/foster environmental degradation (ED). Several international accords aimed at minimizing the impacts of climate swaps failed to restrain CO_2 emissions (Gardezi et al., 2023). The Paris Agreement, endorsed in December 2015, addressed the costs of climate change. According to this convention, CO_2 is responsible for 75% of greenhouse gas (GHG) emissions and is the major contributor to ED. This agreement aimed to mitigate the harmful effects of these GHGs while attaining economic growth (Liu et al., 2021). The value of environmental sustainability reached new heights as COP28 emphasized transitioning from non-renewable to renewable energy sources. Policy actions focused on combating climate change and building resilience in vulnerable regions (Akhtar et al., 2024).

Existing literature suggests implications for the ED, which refers to the process of natural resource depletion. It is not only a threatening issue for the physical well-being of people, but it also produces a lot of economic losses. Many researchers opined that globalization could improve environmental quality (EQ) through access to environment-friendly technologies. Updated knowledge and information through social globalization could generate more awareness of environmental issues, reducing human pressure on nature (Farooq et al., 2022; Stern, 2004; Santiago et al., 2020). However, environmental economists are highly concerned that the increasing degree of globalization damages the environment (Mehmood & Tariq, 2020; Gardezi et al., 2023). Global economies' over-reliance on fossil fuel energy causes sustainability problems and high GHG emissions (Ansari et al., 2021). Fossil fuels have intensified global warming, prompting the environmental researchers for the sustainable development agenda. This agenda requires shifting the resources to renewable sources (Al-Mulali et al., 2016). According to the Global Footprint Network (2022), 135 out of 188 countries are experiencing a biological capacity deficit, underscoring the urgency of addressing these environmental challenges. Thus, it is imperative to reevaluate how globalization affects the environment. The extent of globalization must be scrutinized under the radar of environmental sustainability.

The study aims to reveal how overall globalization and its various dimensions, namely economic, social, and political globalization, influenced the environment of selected Asian countries from 2004 to 2022. Existing literature overlooked the social and political dimensions of globalization. This study is novel in examining how overall globalization and its three sub-dimensions impacts EQ for the sampled countries. The study considers a comprehensive measure of EQ, that is, ecological footprint (EFP), which offers a more holistic perspective than focusing solely on CO2 emissions. This approach provides a robust yardstick for assessing environmental degradation, capturing multidimensional effects on the environment.

The remaining sections are organized as follows: Section 2 discusses the literature review. Section 3 describes the methodology and data. Section 4 reports the results and discussions. The last section concludes the study and proposes policy guidelines.

2. Literature Review

Global warming has emerged as a leading cause of climate change worldwide (Ahmad et al., 2022; Milfont et al., 2021). Researchers have expressed concern about globalization's environmental impacts. It is a double-edged sword, positively and negatively impacting the world economies. Past literature has presented mixed results concerning globalization-EFP nexus.

Several studies have highlighted that globalization tends to reduce EFP. Feng et al. (2024) found that PG positively influenced the environment in resource-rich economies, while Jahanger et al. (2022) discovered that globalization reduced the EFP in the Latin American and Asian regions. Additionally, Latif et al. (2023) confirmed a positive relationship between economic globalization and EQ for 48 Asian countries. Ansari et al. (2021) also revealed that globalization reduces the EFP in the long run for the sample of 22 countries. Furthermore, Yang and Usman (2021) uncovered global CO_2 emissions in the ten highest healthcare spending countries.

Conversely, some studies have pinpointed the negative impacts of globalization on EQ. For instance, Gardezi et al. (2023) showed a positive link between overall globalization and carbon emissions in underdeveloped economies, while Mehmood (2022) revealed that globalization damages the region's EQ. Figge et al. (2017) documented an increased pressure on EQ with an increasing degree of globalization for 171 countries. Additionally, Le and Le (2023) revealed that EG and SG preserve the EQ, whereas PG damages the EQ. Further, globalization's impact varied across income groups, harming low-income countries. That

means globalization enhances the EQ of middle-income countries but damages the EQ of low-income countries.

To sum up, the evidence on globalization's environmental impacts is mixed. The relationship between globalization and EFP is multifaceted and varies across different regions and income groups. Further research and analysis are necessary to revisit globalization's environmental implications thoroughly.

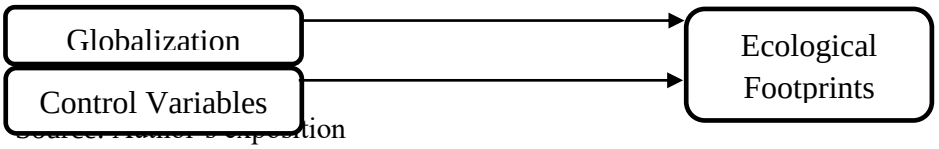
3. Methodology

This section comprises two sub-sections. The first sub-section explains the theoretical framework relating globalization and the environment. The second sub-section provides details of data and econometric procedure.

3.1 Theoretical Framework for Globalization-Environment Nexus

Globalization refers to enhanced interdependence among world economies regarding trade, financial flows, and technology transfer (Odugbesan et al., 2021). Earlier literature defined globalization very narrowly. Later, the scope of globalization broadened, and it became a multifaceted phenomenon. The pluralist approach defines the process of globalization as the co-evolution of economies across multiple domains, including social, cultural, economic, political, ecological, and beyond the borders (Rennen & Martens, 2003). In the context of a pluralistic approach towards globalization, one of the pioneering studies by Dreher (2006) pinpointed that globalization is a multifaceted phenomenon affecting economies in various dimensions, namely economic, social, and political globalization. The degree of globalization affects the state of natural resources. Figure 1 discusses the conceptual frameworks for the globalization-environment nexus, which unequivocally emphasizing how various forms of globalisation drive a country's development (Gurgul & Lach, 2014; Chang & Lee, 2010).

Figure 1 Conceptual Frameworks for Globalization- Ecological Footprints Nexus



Source: Author's exposition

The process of globalization fuels economic growth. Thus, the relationship between globalization and EFP stems from economic expansions and increased globalization. When economic globalization promotes economic growth, the growth tends to deteriorate EQ as

income increases, but later, it improves EQ. The scale, technique, and composition effects are realized with economic growth. Economic globalization (EG) contributes to the scale effect by increasing production and consumption, putting pressure on the EFP (Antweiler et al., 2001). However, as economies advance, they can adopt eco-friendly technologies and bring structural changes that minimize environmental damage (Braslauskas, 2020; Anwar et al., 2020).

The expansion of ideas, information, and exposure, known as SG, profoundly impacts individuals' behavior and consciousness about EQ (Rennen & Martens, 2003). Education and exposure play a crucial role in fostering environmentally conscious behavior and promoting cleaner products (Motoshita et al., 2015). However, if education fails to instil a sense of social responsibility, it may harm the environment (Rennen & Martens, 2003).

PG involves international agreements to address environmental damage through collaboration between nations (Acheampong, 2022). Effective political cooperation can enhance the efficiency of governing institutes, reduce human demands on nature, and promote innovation and good governance by adopting eco-friendly practices (Lemos & Agrawal, 2006). On the other hand, more attention is given to investment targets and neglecting environmental sustainability (Grant & Keohane, 2005).

Model Specification

The following econometric model estimates the globalization-environment nexus.

$$EFP_{it} = \alpha_1 + \alpha_2 OG_{it} + \Sigma_{j=1}^{k} \alpha_j W_{jit} + \varepsilon_{it} + u_i \quad (1)$$

where EFP_{it} = Ecological footprint in the ith country at time t

OG_{it} = Overall globalization index of ith country at the time t

W_{it} = Vector of j control variables for the ith country at time t

To avoid misspecification, the study considers several control variables, such as gross domestic product (GDP), energy consumption (EC), foreign direct investment (FDI), and financial inclusion (FI).[2]

In Model (2), the study replaces OG with its first dimension, that is EG to explore EG-EFP nexus as under.

$$EFP_{it} = \beta_1 + \beta_2 EG_{it} + \Sigma_{j=1}^{k} \beta_j X_{jit} + \varepsilon_{it} + u_i \quad (2)$$

where EG_{it} =Economic Globalization index for the ith country at time t.

X_{it} = Vector of j control variables for the ith country at time t

[2]Because of the insignificant contribution of GDP and FDI we dropped these two variables.

The next model evaluates the impact of second sub-dimension of globalization, that is SG, on EFP.

$$EFP_{it} = \gamma_1 + \gamma_2 SG_{it} + \Sigma_{j=1}^{k} \gamma_j Y_{jit} + \varepsilon_{it} + u_i \quad (3)$$

where SG_{it} = Social globalization index for the i[th] country at time t.

Y_{it} = Vector of j control variables for the i[th] country at time t

Finally, the baseline model (1) is re-estimated for the third dimension of globalization, that is PG's as under;

$$EFP_{it} = \theta_1 + \theta_2 PG_{it} + \Sigma_{j=1}^{k} \theta_j Z_{jit} + \varepsilon_{it} + u_i \quad (4)$$

where PG_{it} = Political globalization index for the i[th] country at time t.

Z_{it} = Vector of control variables for the i[th] country at time t

Energy Consumption

EC can be defined as the amount of energy required to perform various tasks. Energy is an essential input along with all other inputs in the production process. Excessive use of energy escalates EFP (Le & Le 2023).[3]

Financial Inclusion

FI refers to accessible and affordable financial resources for individuals and economies to meet their routine needs. FI comprises three dimensions: the availability of financial resources and services, access to all these facilities, and usage of all these financial resources (World Bank, 2014). FI can impact EQ in both positive and negative ways. FI initiative can fuel sustainable economic growth and ensure environmental sustainability (Jordaan et al., 2017). High levels of FI indicate economic prosperity (Emara & El-Said, 2021). FI facilitates economic expansion, it could be expected to have some environmental cost (Lesani et al., 2020). According to one perspective, ensuring convenient and affordable access to financial resources alleviates credit constraints, leading to high economic activity, which needs more energy consumption and, hence, high CO_2 emissions. It also encourages individuals to use more energy-intensive appliances, which again consume traditional fuels and emits high GHG (Le et al., 2020).

Measurement of Financial Inclusion

The study constructs a three-dimensional FI index using principal component analysis (PCA), considering access, availability, and usage dimensions of FI. This study measures the access dimension through the number of commercial bank accounts. The availability of resources means easy availability for all the users. The study took the number of bank outlets

[2] U.S Energy Information Administration (2023)

per 100000 elders and the number of ATMs per 100000 elders to measure the availability of financial resources following Ullah et al. (2022). Usage of financial services refers to the additional facilities an account holder can use for financial services, i.e., debit and credit card services, loan and mortgage services, insurance services, etc. The study quantifies the usage dimension through outstanding deposits and loans with commercial banks following Ahmed et al. (2022).

3.2 Data and Econometric Procedure

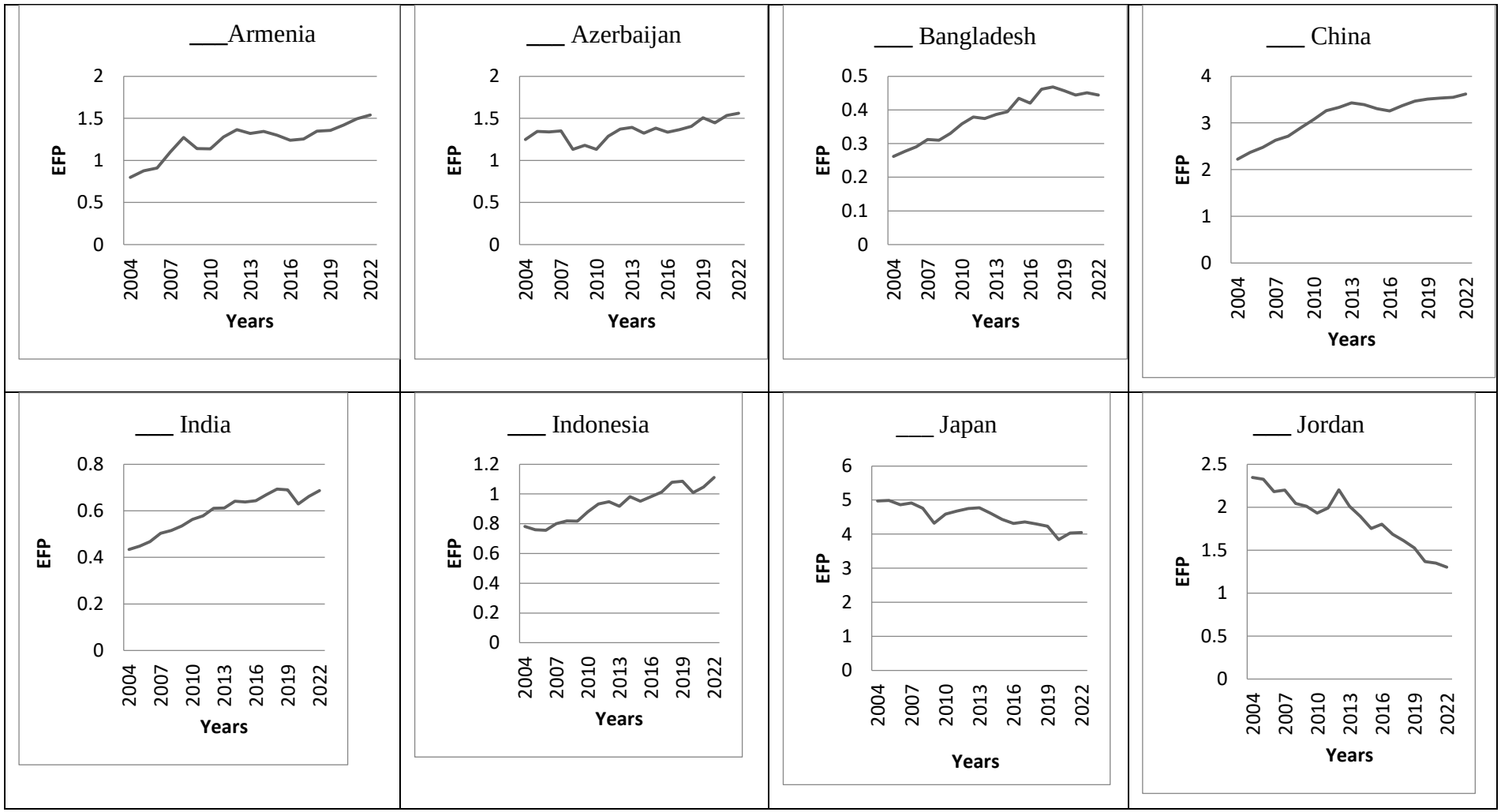
This study unfolds globalization's impact on EFP for Asian countries. The authors consider annual data ranging from 2004 to 2022. Initially, the study considered data on all Asian countries. Later, the sample, but our sample, was confined to 16 Asian countries based on the consistent data availability on usage, availability, and access dimensions of FI. Tables A1 and A2 in Appendix A provide a list of countries and a description/measurement of the variables used in the analysis.

The study employs the CS-ARDL technique to estimate short, and long-run coefficients. This technique was developed by Chudik and Pesaran (2015). The former technique has many advantages over conventional ARDL estimation techniques. Besides handling the problem of CSD and heterogeneity, this technique provides valid results even in the presence of serial correlation and common correlation bias, and it also tackles the problem of non-stationarity of the data.

4. Results and Discussion

The trend analysis evaluates the state of EFP in the context of sampled Asian countries. Figure 2 graphs EFP from 2004 to 2022 for 16 Asian countries. The country-wise graphs of EFP indicate an increasing trend over the sampled period 2004-2022 in most countries. A few exceptions exist for Japan, Jordan, and the United Arab Emirates, where environmental damage

Figure 2 Trend Analysis of Ecological Footprints for the Sampled Countries



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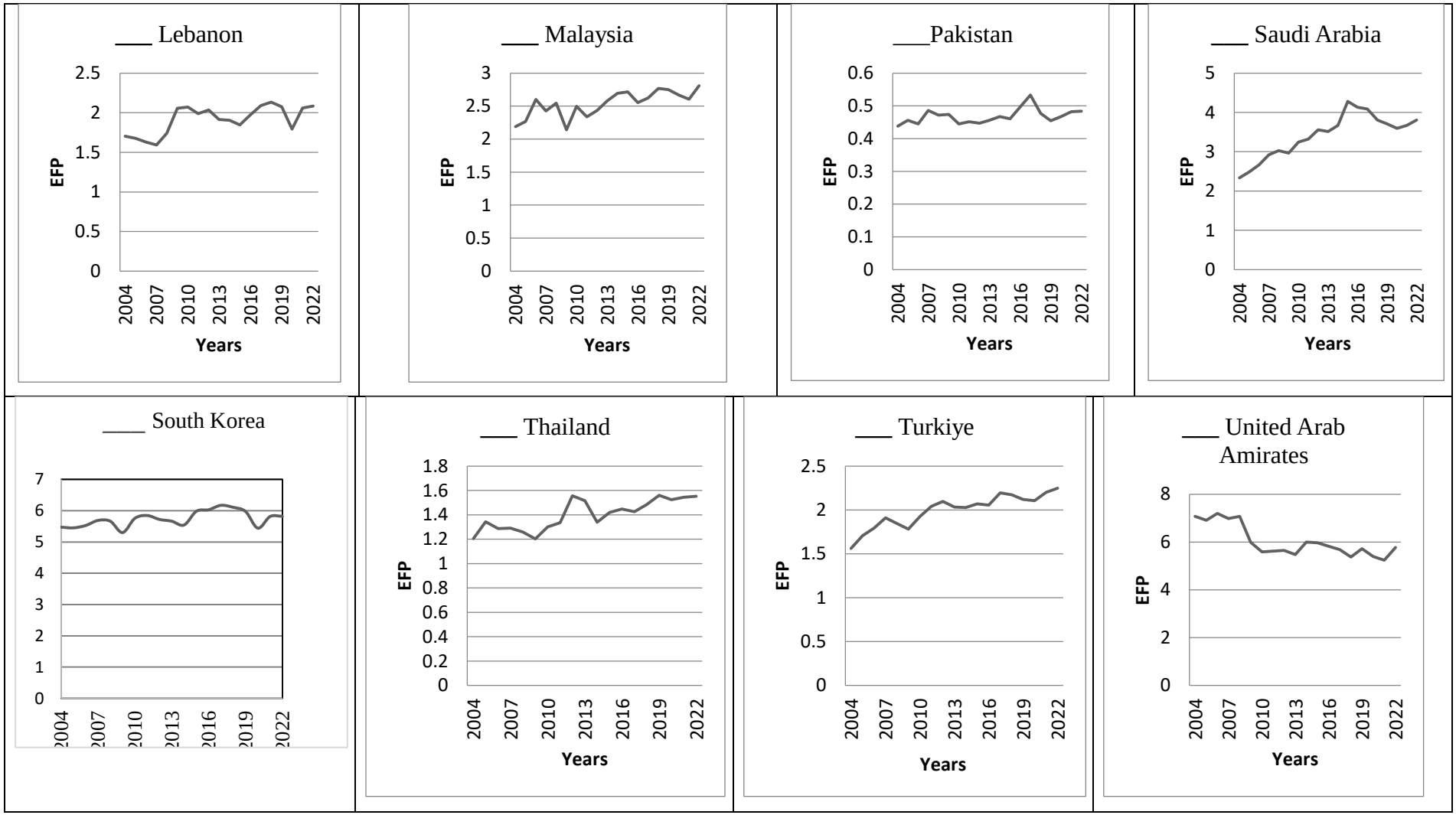

Source: Author's construction

is declining. Japan is a developed country with a huge stock of human capital, which helps attain energy efficiency, waste management, greenhouse technologies, and strict environmental laws to manage its EFP. It has launched many public awareness campaigns to promote responsible consumption behaviors and collaborates internationally to address the issue of climate change. On the other hand, Jordan, a developing country, committed to net zero emissions by 2050 through their "Green Plan 2030". It focuses on water, energy, food security, resilience, and sustainable development. The United Arab Emirates distinguishes itself through significant investments in education and public awareness about sustainable environmental practices.

Second, the growing population in the sampled countries also puts pressure on natural resources, further contributing to high EFP (Javeed et al., 2023).

In the case of South Korea, data shows fluctuations in the trend of EFP. First and foremost, the economy of South Korea heavily relies on the exports of semiconductors and electronics, and changes in global demand for these products directly affect the country's economic activity and resource utilization. The country's export experience cyclical patterns due to technological advancement and market dynamics, so in a boom period, resource consumption rises and adversely affects the environment, and conversely, downturns lead to reduced EFP (Winchester & Reilly, 2019).

This study uses PCA to build a composite index of FI (FII). Table 1 shows three-dimensional composite FII results for the samples of 16 Asian economies. Following Sadia et al. (2019), an index must elaborate accumulatively on 50-60% of the available information in the data. Accordingly, this FII considers only the first component to have an eigenvalue greater than one, explaining almost 53% of the available information in the data.

Table 1 Results of Principal Component Analysis

Components	**Three-Dimensional FII**	
	Eigenvalues	Proportion
Component 1	1.5863	0.5288
Component 2	0.7534	0.2511
Component 3	0.6603	0.2201

Source: Authors' estimation

Table 2 demonstrates the statistical properties of variables. First, the mean values of EFP and EC also lie near the minimum values of their respective data sets, indicating the low performance of the selected sample in their respective fields. Second, the average FI is very low, suggesting a poor state of FI in Asian countries. Third, OGI, SGI, and PGI are near the

maximum values of their respective data sets, which indicates an active engagement of sampled countries in global interactions, trade, and diplomacy.

Table 2 Descriptive Statistics

Variables	Observations	Mean	St. Dev	Min.	Max.
EFP	342	2.4540	1.7132	0.2618	7.2002
FI	342	0.182	0.1424	0	1
OGI	342	0.6791	0.1895	0	1
EGI	342	0.5100	0.2325	0	1
SGI	342	0.6133	0.2215	0	1
PGI	342	0.7469	0.2228	0	1
EC	342	33036.7	37177.48	1261.467	169047.5

Source: Authors' Estimates

Fourth, the mean value of EG lies near the centre of minimum and maximum values, indicating a moderate economic pattern of countries. Finally, variability across the data is negligible for all variables, showing minimal dispersion among the observations.

Table 3 reports the results of the diagnostic tests. The first test is the CSD test proposed by Pesaran (2021). The null hypothesis for the test states that the cross sections are independent. Results show that the values of the test statistics are high, and the probability is less than 1%. Hence, the rejection of the null hypothesis confirms the presence of CSD. The second is the slope heterogeneity test (Pesaran & Yamagata, 2008). The null hypothesis is that slope coefficients are homogenous.

Table 3 Diagnostic Tests

Cross-Sectional Dependence Test		
Variable	Test Statistics	P-values
EFG	16.481***	0.000
OGI	51.715***	0.000
EGI	4.411***	0.000
SGI	61.334***	0.000
PGI	45,121***	0.000
FI	20.202***	0.000
EC	14.24***	0.000
Slope Heterogeneity Test		
Delta	5.650***	0.000
Delta Adj	7.962***	0.000
Note: *** indicates the significance at 1%.		

Source: Authors' Estimates

Delta tilde and delta-adjusted tilde statistics have probabilities of less than 1%, indicating the rejection of null hypothesis at a 1% significance level and concludes that slope coefficients are heterogeneous. The first-generation unit root test is irrelevant when CSD and slope heterogeneity exist (Ahmad et al., 2022). Thus, the authors apply a second-generation unit root, namely CIPS. The results
of CIPS are documented in Table 4.

Table 4 Results for Unit Root Test

Variables	CIPS		Order of Integration
	At Level	First Difference	
EFP	-2.110	-4.352***	I(1)
OGI	-2.6777	-4.392***	I(1)
EGI	-2.511	-4.367***	I(1)
PGI	-2.830**	-4.590	I(0)
SGI	-2.557	-4.131***	I(1)
FI	-1.247	-3.711***	I(1)
EC	-2.505	-3.931***	I(1)
Note: *** refers to significance at 1%, whereas * * means significant at 5%.			

Source: Authors' Calculation

The null hypothesis states that variables are non-stationary. All the variables except PGI are non-stationary at levels and become stationary after the first difference. The mixed degree of integration and CSD make CS-ARDL an appropriate estimation technique.

Before estimating short-run and long-run coefficients through the CS-ARDL model, the study tested the existence of co-integration by employing the second-generation panel co-integration test, namely, the Westerlund co-integration test. Table 5 presents the findings of this test. The results reveal a long-run co-integrating relationship between all the variables for all models.

Table 5 Results for the Co-Integration Test

Models	Variance Ratio
Model 1	-1.957** (0.02)
Model 2	-1.224** (0.091)
Model 3	-1.813** (0.035)
Model 4	-1.605** (0.054)
Note: * * refers to significance at 5%, and * shows significance at 10%. Values in the parenthesis are probability values.	

Source: Author's Estimates

Table 6 reports the findings of the four models specified through Model 1 to Model 4 for the globalization-environment nexus. The Model (1) evaluates the impact of OG on the EFP. The coefficient of OG is negative and statistically significant at 1%, suggesting that an increase in overall globalization is associated with a decrease in EFP. A percentage rise in OG tends to decrease EFP by approximately 0.299% and 0.378% in the short and long run. OG affects the EFP through various channels. First, it facilitates the transfer of technology, knowledge, and best practices across the border. Second, it promotes efficiency in production processes, reduces waste, and improves resource management. Third, countries engaged in global trade and investments often adopt international standards and regulations to address environmental concerns. This helps control the environmental damage. Fourth, globalization provides consumers access to diverse products and services that are environment-friendly.

Next, the regression model considered several control variables to avoid misspecification. The first control variable is FI, which favorably affects EFP. Ecological damage has declined for Asian countries by 0.117% and 0.239% in the short and long run, respectively, with an increase in FI by 1%. This impact is, however, insignificant, indicating that the direct effect of FI on EFP is not substantial. The second control variable is EC. High EC increases EFP in the Asian countries.

Table 6 Results for Globalization-Environment Nexus: CS-ARDL Models

Variables	Model 1 Equation (3.1)	Model 2 Equation (3.2)	Model 3 Equation (3.3)	Model 4 Equation (3.4)
Short Run Estimates				
LOG	-0.299*** (0.01)	-	-	-
LEG	-	-0.126* (0.10)	-	-
LSG	-	-	0.305** (0.03)	-
LPG	-	-	-	-0.700* (0.06)
LFI	-0.117 (0.19)	-0.112 (0.33)	-0.074 (0.21)	0.013 (0.80)
LEC	0.521*** (0.00)	0.436*** (0.00)	0.643*** (0.00)	0.445*** (0.00)

ECT(-1)	-0.95*** (0.00)	-0.91*** (0.00)	-0.96*** (0.00)	-0.96*** (0.00)
Long Run Estimates				
LOG	-0.378*** (0.01)	-	-	-
LEG	-	-0.579 (0.10)	-	-
LSG	-	-	0.510 (0.11)	-
LPG	-	-	-	-0.099 (0.83)
LFI	-0.239 (0.24)	-0.237 (0.26)	0.087 (0.25)	-0.019** (0.01)
LEC	0.626*** (0.00)	0.617*** (0.00)	0.743*** (0.00)	0.560*** (0.00)

Notes: Significance at 10, 5, and 1 percent are denoted by *, **, and ***, respectively. The dependent variable is Ecological Footprints (EFP). The independent variables are indices for overall globalization (OG), economic globalization (EG), social globalization (SG), and political globalization (PG). The control variables are energy consumption (EC) and financial inclusion (FI). All the variables appear in log form. Values in the parenthesis are probability values.

A percentage increase in EC enhances EFP by 0.521% and 0.626% in the short and long run, respectively. These coefficients are also statistically significant at a 1% level of significance. The negative impact is attributed to many factors. First, non-renewable energy consumption, the extraction of fossil fuels, and the building of energy infrastructure can disrupt the ecosystem. Non-renewable energy sources deplete natural resources. The rising population in sampled countries leads to high energy demand for households, industrial, and transportation sectors. Urban areas consume more energy due to concentrated economic activities, infrastructure, and transportation networks. Energy-intensive sectors like oil and gas contribute significantly to overall consumption. Second, the energy production and consumption processes are inefficient in Asian countries, contributing to a high rate of GHG emissions and environmental decay. Third, more reliance on non-renewable energy resources raises the perils of global warming and extreme weather events in sampled countries. The findings align with Jahanger et al. (2022) and Le and Le (2023).

Model 2 to Model 4 in Table 6 report the results of three sub-dimensions of globalization on EFP. In Model 2, the study replaces OG with the index of the first sub-

dimension of globalization, economic globalization (EG). The short-run coefficient of LEG is negative and statistically significant at 10%. A percentage increase in EG tends to reduce EFP by almost 0.126%. In the long run, the coefficient of LEG is large (-0.58). Thus, EG tends to have an insignificantly lower impact on EFP than in the short run. As EG involves increased trade, FDI, and cross-border activities, it amplifies positive environmental outcomes when it aligns with better financial services. The coefficient of LFI is statistically insignificant, whereas LEC shows a significantly damaging impact on the EQ for the sampled Asian countries with coefficients 0.436 and 0.617, respectively. The findings are in line with Gardezi et al. (2023), Xu et al. (2018), and Le and Le (2023).

Model 3 scrutinizes the impact of SG on the EFP in the sampled Asian countries. The short-run effect of SG on EFP is 0.305%. This impact is also statistically significant at 5%. In the long run, the coefficient of LSG is again positive but statistically insignificant. A positive sign shows that EFP also increases with each percentage increase in SG. Environmental changes often unfold gradually. SG affects the environment through intricate channels. SG encompasses various dimensions, including interpersonal communication, cultural exchange, tourism, migration, and information inflow. As SG accelerates, urban areas expand, increasing energy consumption, waste generation, and pollution. The growing population also puts pressure on natural resources and ecosystems. Exposure to global trends and consumer culture drives product demand, producing resource extraction, manufacturing, and waste. Cultural diffusion can also influence unsustainable lifestyles. Tourism, a key factor of social globalization, impacts fragile ecosystems, especially coastal areas and wildlife habitats. Air travel also contributes significantly to GHG emissions. SG promotes technology adoption but also leads to challenges with electronic waste disposal. SG exacerbates these challenges by increasing electronic consumption, facilitating the export of e-waste to countries with lax regulations, and impacting the EQ of those regions. The impact of FI remained statistically insignificant. The short-run coefficients indicate an adverse impact, while the effect is positive in the long run. LEC shows a positive and statistically significant coefficient at a 1% significance level. These findings are in line with Dreher (2006).

Finally, Model (4) evaluates how PG affects the EFP for the sampled Asian countries. The estimated coefficients of PG demonstrate a negative and statistically significant impact on EFP. A percentage increase in PG tends to decrease EFP by almost 0.70% in the short run. PG encourages countries to adopt standard policies and regulations. Regarding environmental protection, shared standards can lead to better management of

natural resources, pollution control, and sustainable practices. More importantly, countries engaging in global forums and treaties collaborate on environmental issues. These collaborations promote collective efforts to reduce GHG emissions and combat climate change. Such cooperation can enhance EQ by fostering joint actions and inspiring the possibilities of global collaboration. PG facilitates the exchange of knowledge across borders. Advanced countries often transfer eco-friendly technologies to emerging nations. These technologies can improve waste management, renewable energy adoption, and pollution control, positively impacting the environment. PG attracts FDI and development aid. These financial inflows can be directed towards environment-friendly projects, such as forestation, clean energy infrastructure, and conservation efforts. PG involves diplomatic negotiations and dialogues. Environmental diplomacy addresses transboundary issues like air and water pollution, deforestation, and biodiversity conservation. The long-run relationship between PG and EFP is negative and statistically insignificant for the Asian samples. The possible reason would be the delayed effects of policies, regulations, and institutional changes. In this Model, FI has a negative but statistically insignificant coefficient. That means the impact of FI is favorable for the EQ in the sampled countries. The probability value associated with FI is low in both short-run and long-run analyses. The coefficient of EC is positive and statistically significant at a 1% significance level. This indicates that EC increases EFP.

5. Conclusion and Policy Recommendations

This study explores the connection between overall globalization, its sub-indices, and EFP for selected Asian countries using CS-ARDL. The findings reveal that overall globalization significantly decreases EFP in the short and long run, indicating the adoption of more efficient technologies transmitted through global interaction. In addition, economic globalization also negatively and significantly impacts EFP, reflecting that increased economic interdependence helps to raise EQ. In contrast, social globalization raises ecological damage, leading to highly irresponsible consumption and lifestyle changes. The coefficient of PG is negative but significant only in the short run, indicating that political integration and cooperation can initially reduce EFP through international environmental agreements and policies. The impact of FI is that it increases environment-related awareness in emerging Asian economies. However, the adverse effects of EC in Asian countries reflect the large share of non-renewable energy sources that put pressure on EFP. Policymakers and governments should promote trade policies that support the exchange of eco-friendly technologies and sustainable practices, including environmental clauses in trade agreements

to combat ED. Collaboration between governments and NGOs is essential for promoting the adoption of eco-friendly products. Additionally, cultural exchange programs focused on environmental protection are crucial for raising awareness, sharing best practices, and fostering a global network of environmentally conscious individuals. These initiatives, alongside promoting sustainable lifestyles and eco-tourism, can help mitigate the negative impacts of SG and PG in Asian countries.

Limitations of the Study

This study focuses on the selected Asian countries from 2004 to 2022 and has some limitations. First, the regional focus on Asia means that the results may not be generalized to other regions with different economic, social, political and environmental contexts. The analysis may be extended by considering a large group of countries possessing varying degrees of globalization to evaluate their impact on EFP. Second, data availability posed another limitation. The study relied on secondary data sources, which may have limitations regarding availability, accuracy, and consistency. In particular, data on other indicators of FI is not readily available.

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Appendix A

Table A1: List of Sampled Countries

S #	Country Codes	Country Name
1	ARM	Armenia
2	AZER	Azerbaijan
3	BGD	Bangladesh
4	CHN	China
5	IND	India
6	IDN	Indonesia
7	JPN	Japan
8	JOR	Jordan
9	LEB	Lebanon
10	MYS	Malaysia
11	PAK	Pakistan
12	SAU	Saudi Arabia
13	KOR	South Korea
14	THA	Thailand
15	TUR	Turkey
16	ARE	United Arab Emirates

Table A2: Variables Description and Data Sources

Variables	Description/Measurement of Variables	Data Sources
Ecological Footprint (EFP)	A method to measure human demand on natural capital. Measured as gha/person	Global Footprint Network Database (2022).
Overall Globalization (OG)	A composite index comprising economic, social and political globalization. It takes a value between 0 (Autarky) and 1 (globalization).	KOF Globalization Index 2022
Economic Globalization (EG)	EG includes trade and financial flows. This index takes values from 0 to 1. 0 denotes no globalization, and 1 indicates the highest degree of globalization.	KOF Globalization Index 2022
Social Globalization (SG)	SG is a composite index of interpersonal, information, and cultural globalization.	KOF Globalization Index 2022
Political Globalization (PG)	The PG index consists of the aggregate impact of the number of embassies and NGOs and membership in international treaties and organizations.	KOF Globalization Index 2022
Financial Inclusion (FI)	FI is a composite index that encapsulates access, availability, and usage of financial services.	Financial Access Survey by IMF (2022), WDI (2024)
Energy Consumption (EC)	EC is taken as primary per capita energy consumption. It is measured in kilowatt-hours.	U.S Energy Information Administration (2023)