ISSN (Print): 2788-8320 ISSN (Online): 2788-8339

JOURNAL OF SOCIAL RESEARCH DEVELOPMENT

www.jsrd.org.pk editor@jsd.org.pk

EFFECT OF ECONOMIC DIGITALIZATION ON ENVIRONMENTAL QUALITY: EVIDENCE FROM SELECTED ASIAN COUNTRIES

Wasi Ahmad[1], Muhammad Umar Farooq[2], Muhammad Sohail Amjad Makhdum[3], Anam Shehzadi[4], Sadia Ali[5]

[1]M. Phil Student, Department of Economics, Government College University, Faisalabad.
[2]Assistant Professor, Department of Economics, Government College University, Faisalabad.
[3]Associate Professor, Department of Economics, Government College University, Faisalabad.
[4]Assistant Professor, Department of Economics, Government College University, Faisalabad.
[5]Assistant Professor, Department of Economics, Government College University, Faisalabad.

KEYWORDS

Digital Economy, Environmental Quality, Ecological footprints, Environmental Kuznets Curve theory, Theory of planned behavior

ARTICLE HISTORY

Date of Submission: 04-08-2026
Date of Acceptance: 01-09-2026
Date of Publication: 09-09-2026

ABSTRACT

Environmental changes, along with global warming and climate change, are raising concerns about environmental degradation in Asian countries. Although researchers have widely explored the relationship between the digital economy and the environment, they have not yet properly examined how the digital economy, supported by facts and verbal exchange technology, affects environmental impacts. This study aims to fill this gap by examining the relationship between the digital economic system and environmental impacts in Asian countries. Most previous studies have used carbon emissions to assess environmental satisfaction; however, this study uses environmental footprints as a measure of environmental quality, based mainly on panel data from 14 Asian countries between 2005 and 2024. The pooled OLS regression and fixed-effects model show that the digital economy significantly reduces ecological footprints and improves environmental conditions; trade openness and urban population also significantly reduce ecological footprints, but energy use, industrialization, and natural resource rent increase ecological footprints and environmental pollution. The results of the Driscoll-Kraay estimation show the individual and mixed effects of the economic digitalization. Results show reduced environmental degradation when considering variables such as urban population and trade openness.

Correspondence	**Anam Shehzadi**
Email:	anamshehzadi@gcuf.edu.pk
DOI	https://doi.org/10.59075/jsrd.v7i7.513
Volume/Issue	**7(7), 2026, 127-140**

Introduction

Recently, environmental changes, such as global warming and climate change, have made people in many developing Asian countries concerned about environmental damage. Major changes in the ecosystem, as well as the risks of global warming, such as resource depletion, soil erosion, and water pollution, have made it necessary for stakeholders to consider how information system technologies can be more environmentally friendly (Marikyan & Papagiannidis, 2022).

The impact of carbon emissions and environmental problems is not just a country's problem. It affects the entire Asian region. The inevitable consequences of climate change and environmental damage need to be addressed together. The Sustainable Development Goals (SDGs) aim for sustainable human and economic development, and they emphasize the conservation of biodiversity to control environmental damage and manage ecosystems (Nathanial & Adeleye, 2021).

Environmental damage and climate change are not just local problems. They are global challenges affecting many countries. Environmental quality issues have become a top priority for researchers as they are one of the biggest challenges for both developing and developed countries. All countries, whether developed or not, are facing the problem of rising sea levels that are greatly affecting people's lives and the structure of nations. According to the Intergovernmental Panel on Climate Change, greenhouse gas emissions, including carbon dioxide (CO_2) and other gases, are considered a serious environmental problem with long-term impacts on both human and natural systems. The increase in greenhouse gases in the atmosphere is a major cause of climate change and global warming (Yahong et al., 2022).

In today's world, where digitalization is becoming more common, many environmental economists have talked about how ICT, or digital transformation, plays a role in economic growth and environmental quality. As part of economic growth, digital transformation helps the economy in three main ways. First, new technologies in ICT reduce overall costs and simplify communication, which reduces transaction costs. This is seen in areas such as online business, online banking, e-commerce, and many apps on smartphones. Second, digital transformation helps the financial sector by improving services and making it easier for investors to manage money, which in turn boosts the financial system. Third, it changes the structure of industries by introducing more modern production methods. In contrast, the impact of ICT on the environment has been widely studied. Some researchers argue that the development of ICT may also have adverse effects on the environment; however, current studies suggest that more research is needed to understand the relationship between ICT and environmental quality. The rise of ICTs began in the early 1990s, and it has transformed the way people live, work, and communicate. Digital transformation has made societies more connected, helping to break down barriers between countries and encouraging trade, economic diversification, and foreign investment. It also has the potential to improve price stability, reduce unemployment, and lower transaction costs. (Ahmed et al., 2021).

The digital transformation and digitalization era have promoted the global economy and society, which has pushed the boundaries of knowledge development to the frontiers of integration. Financial digitalization creates financial benefits and creates new ones through efforts for financial improvement, and the digital transformation of the economic system and society has a momentous impact on environmental excellence. In addition to virtualization techniques, environmental regulations have also been used, which help reduce pollution emissions. Therefore, it is a good necessity to clarify the relationship between financial digitalization and environmental health and improve the environment for financial digitalization (Wen et al., 2021).

With the strong upward thrust of economic digitalization, keep in mind that the relationship between economic digitalization and the environment is increasingly important for financial stability. The prevailing view is usually to study the combination of economic digitalization and the environment. (Zihanxin Li et al., 2021). Advances in Internet technology have encouraged the expansion of aid reform and the vigorous implementation of new environmental care technologies, improving the prevention and control of environmental pollutants and the reduction of environmental pollution (Zihanxin Li & Nuoyan Li & Huwei Wen., 2021).

An attractive and fascinating aspect of researching Asian economies is that they are densely populated and affected by excessive resource consumption, environmental degradation, and global warming. The region is facing severe climate change in the form of changing rainfall patterns, severe flood events and sea level rise and severe water shortages in response to fitness problems due to glacier melting and heat waves, water scarcity floods. But these economies have the potential to introduce sustainable ICTs that allow for digital transformation within the context of virtual economic systems, agricultural production, and other services (Saif and Abid 2023).

To realize its intention to support limited development, it is crucial to assess whether the parentage of both the digital eras (the use of specific symbols within this operation such as digitization) helps reduce CO_2 emissions or instead the environmental impact on the planet. The conceptual approach to the use of digital media fully enhances its performance after helping in the use of all medicinal herbs; for this, carbon pollution generated by the area of instinctual contentment can be prevented by digital financial gizmos, for example, the growing and immersive interactive era wants to sell a sustainable economic policy to improve development (Bansal et al. 2022; Muntasir Murshid 2024).

This same desire for such a concept seems to be seen in 14 selected Asian 14 countries to see the impact of the digital economy on the environment, as the results were obtained from 2005 to 2024.

Research gap:

Previous research has mainly focused on carbon emissions to optimize the environment, but this study fills the gap by using natural footprints as a proxy for environmental degradation (Asif Khan and Wu Zimi 2022). A recent study observed the impact of digitalization on conservation quality; a few simple ones are not the most effective for China and SAARC countries. One for you in detail, but they are affecting the entire space (Saif and Gill 2023). Therefore, the entire area was selected from different countries based on reliable and real records of recent years, and a look at the previous and new ones. The negative effects of globalization on environmental quality have been eliminated through short-term financial growth and industrial development (Rahman et al., 2021).

Literature Review

Wen et al. (2021) have looked at the investigation of the impact of the digital financial system on environmental quality. The environment is gradually becoming important for sustainable development. This paper collects the records of 217 towns in China. In this paper, using panel data from 2003 to 2018, this study first examines the coupling coordination of the economic digitization device and the surrounding system and uses the robustness version extensively. The consequences demonstration that the development of virtual reduced decreases Pm 2.5. The added value of industry creates higher CO_2 emissions and environmental footprints in the environment as industrialization becomes more energy-intensive and modifies energy intake patterns in the early period of economic boom, leading to higher environmental pollution. (Mentel et al., 2022).

Saif and Abid (2023) investigated digital transformation, institutional excellence, and environmental sustainability in this paper. This paper collects records of SAARC economies from 1990 to 2018. This paper uses a second-generation CD check for moving sectional dependency, panel unit root (CIPS, CADF), and Westerlund extrapolation. Further examine the PMG-ARDL method for long run and digitalization of short-run estimates reduces the environmental footprint. This paper presents the use of ecological footprints as a proxy for environmental excellence.

Majid and Sharif (2024) investigate the function of digitalization on the environmental impact in this paper by collecting records from 164 international locations covering the period 1990 to 2023. The paper measures digitalization through 4 indicators. Mobile subscribers and inexperienced boom measure CO_2 emissions compared with GDP, using pooled OLS, fixed effects, random effects, and GMM models for regression estimation. Comparing the results according to the results for robustness Digitalization facilitates reducing CO_2 emissions and increases inexperienced growth. Digitalization reduces CO_2 emissions indirectly for better environmental satisfaction.

Yang et al. (2025) investigated the relationship between digital substitution and comprehensive green growth in this paper. Digital exchange effectively promotes comprehensive green growth. This paper uses a sample of 31 provinces in China and collects seven-year panel data from 2014 to 2021. This paper used entropy-weighted average (EWM) TOPSIS and panel regression models to analyze the transmission mechanism and heterogeneity. The results show that digital transformation effectively promotes inclusive non-experimental development, and virtual commerce also promotes green and inclusive development in the commercial form. Heterogeneous examination allows the effect of virtual substitution to be explored, said Jap, in the main and western regions of China. In the future, digital substitutions will be widely used in commercial areas to make development more beautiful.

Zhang Z, (2023) explored the environmental impact of financial digitalization. The virtual economic system reduces environmental impact. One such publication had to use panel cointegration because after up to 40 regions with Chinese. The data format was collected once a year, compared to 2019. Its fixed effects and its edition were used to test a synthetic market framework that was studied for green contentment. The results prove that the simulated financial model now clearly prevents environmental degradation. Officials should introduce different methods across different socio-economic regions.

Digital Economy Index is measured with ICT-primarily based indicators: 1. Internet person subscriptions (per 100 people), 2. Cellular mobile subscribers (per 100 people), 3. Fixed mobile smartphone subscribers (per a hundred human beings), 4. Fixed subscribers (per 100 human beings) (Ulucak et al., 2020; Saif & Abid, 2023; Shehzadi, A., 2023). Principal component analysis used to broaden the Digital Economy Index is as follows.

The ideal person in an ICT-based digital economic system designs a completely new prototype of a business enterprise while maintaining environmental exceptionalism; for example, the use of phone software in transportation reduces visitor crowding and carbon emissions (Gloet & Samson 2022).

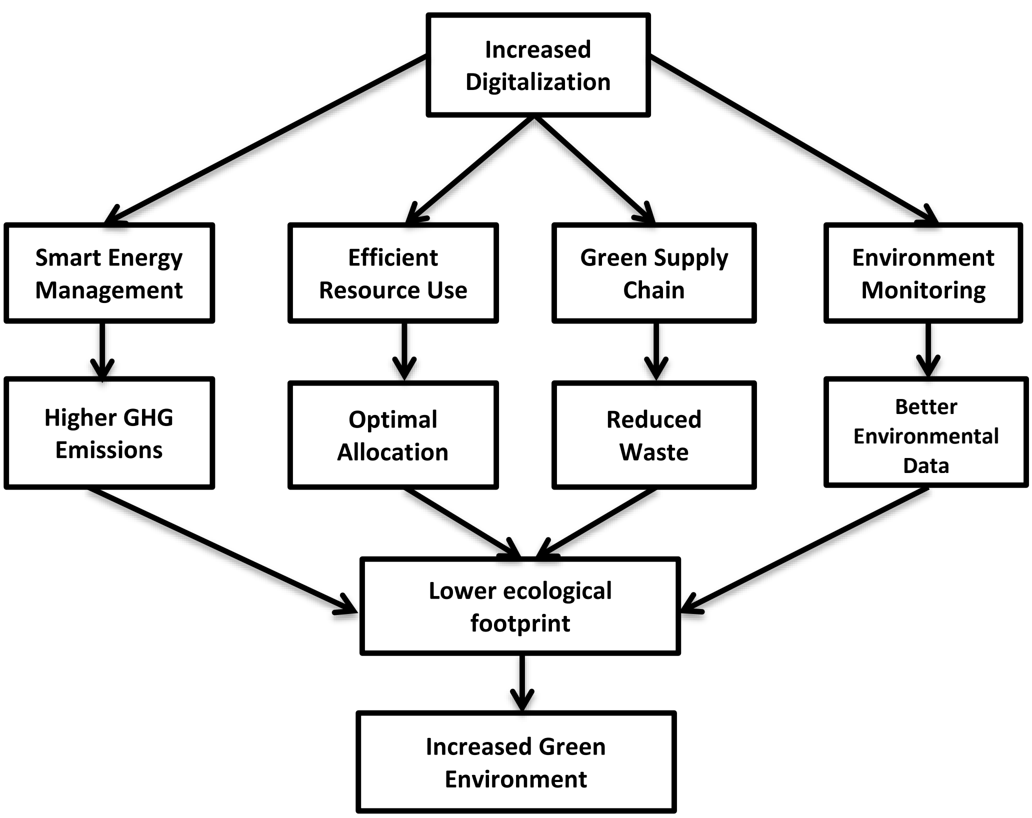
In developing economies, the use of cellular utility by farmers is increasing manifold and upgrading to higher quality of crop (Kamal M & Bablu T A, 2023); telework, online shopping, video conferencing, and women's empowerment are also easier for women. These services prove beneficial by reducing traffic, fuel consumption, and the cost of doing work. (Hilty & Aebischer, 2014: Zelalim A, 2025).

Trade openness is undoubtedly huge for environmental development because of the adoption of technological goods and offerings supported by economic integration and the sale of cleaner technological methods. (Omar & Miao, 2025). Greater openness of exchange is probably the result of greater competition, which is mainly due to low power efficiency and the exit of very few productive firms from the market. Several studies suggest that the effects of trade liberalization on the environment can be divided into three outcomes: scale, structure, and method (production perspective). The potential effects of technology lead to beneficial environmental outcomes. While the scale effect (size of the economy) can produce spectacular pollution, the structure effect depends on the comparative advantage of the United States. The effects of alternative openness on the environment, first class, and the effects of the Internet depend on each of the opposing forces (Shehzadi and Wetzel, 2024; Pharm & Nguyen, 2024).

The use of energy produces environmental pollution. In emerging nations, facing the problem of environmental pollution due to the causal relationship between them, because it has been observed that with the development of the economy, environmental issues always increase. (Xiong & Xu 2021). Energy consumption (coal, oil, natural gas) significantly increases environmental pollution, driving carbon emissions (CO_2), ecological degradation, and hazardous air quality. While supporting economic growth, these fossil fuels directly cause severe air and water pollution, habitat loss, and climate change (Destek & Sinha, 2020).

The study highlighted the relationship between city population and the environmental demands created by rapid urbanization, including loss of habitat, air quality, greenhouse gas emissions, and environmental justice issues. However, it also emphasizes the potential for sustainable urban planning and innovative solutions to mitigate these problems and challenges. Achieving environmental sustainability in city areas requires balanced improvement laws, resource-efficient technologies, and environmental protection efforts. Furthermore, this theory highlights the role of urbanization in greenhouse gas emissions and climate change. To mitigate the impacts, it is important to adopt sustainable urban planning plans, power green technology, and environmentally friendly principles such as renewable energy sources, clean water and sanitation systems, e-transport, and inexperienced places. (Nowell James, 2024). Urbanization promotes environmental sustainability over time by using environmentally friendly technologies, adopting the Kuznets curve, and green regulations (James N., 2024).

Globalization has major impacts on the production and investment of goods and services due to socio-economic and political factors; however, our problems are almost entirely environmental. Global networks and financial conditions have negative impacts on the environment, including deforestation, erosion, global warming, and climate change (Hengyun et al., 2021). The decisions of economies to embrace globalization have worsened their environmental conditions due to the fact that their EFP numbers have rapidly increased alongside globalization activities. (Saber and Gorus, 2019). Globalization increased the ecological footprints within the SAARC international locations during the period from 1971 to 2014 (Saber and Gorus, 2019). The adoption of digital economies within the herbal aid-based industries in South Asian economies is related to increasing the productivity of natural aid as well as sustaining the carbon footprints of such industries. (Murshid et al., 2024; Khan et al., 2025).



Source: Majeed, M. T., & Sharif, F. (2024).

Data Description

The study focuses on the fourteen Asian economies according to our sample Area limitations. There are mostly developing economies in this list of countries (China, Mongolia, Indonesia, Philippines, Thailand, Viet Nam, Bangladesh, India, Nepal, Pakistan, Bahrain, Sri Lanka, Oman, Qatar). The specific country's selection is due to some reasons: first, the adoption of digitalization and the availability of reliable economic data of economies and, most importantly, the economic digitalization variable in our model (indicators). In these countries, there is strong adoption of the digital economy, participation in economic digitalization, and availability of data. Limiting the sample to these economies improves the comparability of results and generates observable outcomes.

Table1:

Variable Name	Measurement	Variable Description	Source
Ecological Foot prints	Global hecter per capita	Overall index of ecological footprints	Global footprint network
Digital Economy	Index (0-100)	Index of four indicators (0 -100)	World Bank
Trade Openness	(%) of GDP	Trade percentage of GDP	World bank
Energy use	Per capita people	Use energy equaivant to kg per million peoples	World Bank
Urban population	Urban population per capita	People who live in urban areas	World Bank
Industrialization	US Dollars $	Industries including construction added value	World bank
Globalization	Index (0-100)	Overall all index form KOF	KOF Swiss Economic Institute
Natural resource rent	% of GDP	Rents from natural resources	World Bank

Results and Discussion

Table2: CDF Test Table for Cross-Sectional Dependency:

Variables	CD-test	p-value	Average joint-T	Mean P	Abs mean(P)
Ecological footprints	12.599	0.000	20.00	0.30	0.44
Digitalization	36.925	0.000	20.00	0.87	0.87

Globalization	21.778	0.000	20.00	0.51	0.65
Trade openness	6.94	0.000	20.00	0.16	0.36
Energy use	12.836	0.000	20.00	0.30	0.55
Urban population	36.394	0.000	20.00	0.85	0.85
industrialization	35.368	0.000	20.00	0.83	0.83
Natural resource rent	24.964	0.000	20.00	0.59	0.60

Cross-sectional dependency (CD) test, commonly known as the Pesaran CD test

Ho: cross-sectional independence exists.

H1: cross-section dependency exists.

If the p-value is less than (0.05), we reject H0 and conclude the cross-sectional dependency exists. Other than the p- value less than (0.05), cross-sectional dependency does not exist between variables in our table. In our table, the p-values of all the variables ecological footprints, digital economy, globalization, trade openness, energy use, urban population, industrialization, and natural resource rant statically significant at the first level shows cross sectional dependent in all the variables in our model.

Natural resource rent is less than 5 % shows the strong cross-sectional dependency (Pesaran, M. H. 2007).

Table3: Im- Pesaran Shin Unit-Root

Variables	At level				At First difference			
	Statistics	P-value	Statistics and Trend	P-value	Statistics	P-value	Statistics and Trend	P-value
Ecological footprints	-1.955	0.0393	-2.231	0.005	-4.361	0.000	-4.494	0.000
Digital Economy	-1.270	0.9693	-1.260	0.911	-2.712	0.000	-3.256	0.000
Globalization	-2.412	0.0021	-2.811	0.0001	-4.561	0.000	-4.783	0.000
Trade openness	-1.755	0.148	-2.122	0.005	-3.838	0.000	-3.857	0.000
Energy use	-0.855	0.999	-1.991	0.094	-4.152	0.000	-4.305	0.000
Urban population	-1.571	0.967	-0.560	1.000	-1.713	0.713	-2.133	0.026
industrialization	-0.482	1.000	-1.654	0.398	-3.739	0.000	-4.249	0.000
Natural resource rent	-0.885	0.994	-0.964	0.997	-3.654	0.000	-4.002	0.000

In Pesaran shin unit root test check for stationery in this results ecological foot prints statistics (-1.9559) and p-value (0.0393) less than 0.05 show the stationary at the level without time trend and statistics (-2.231) the p-value (0.005) shows the stationary at first level within time trend. At the first difference, the statistics (-4.361) and p-value (0.000) show the stationary at the first difference without a time trend, and the statistics within the time trend (-4.494) and p-value (0.0000) shows the stationary within time trend.

The digital economy statistics at the level without time trend statistics (-1.2704) and p-value (0.96930) shows the non-stationary and statistics (-1.2601) at the level with time trend p-value (0.9113) show non-stationarity of the variables. At the first difference, the statistics (-2.7125) and p-value (0.0000) shows the stationary, and the statistics (-3.2564) and p-value (0.0000) show stationarity at the first difference within a time trend.

The globalization statistics (-2.4122) and p-value (0.0021) show stationarity at the level without time trend, and the statistics value (-2.8110) and p-value (0.0001) at the level within time trend show stationarity in globalization. At the first difference statistics (-4.5618) and p-value (0.0000) show stationarity without a time trend, and the statistics (-4.7838) and p-value (0.0000) show stationarity at the first difference within a time trend.

The trade openness statistics (-1.7554) and p-value (0.1488) show non-stationarity at the level without time trend. Statistics within the time trend (-2.1224) and p-value (0.0057) show stationarity at level within the time trend. The statistics (-3.8384) and p-value (0.0000) predicts the stationary at the first difference without a time trend, and the statistics (-3.8577) and p-value (0.0000) shows the stationary at the first difference within the time trend.

The energy use statistics (-0.855) and p-value (0.999) shows the non-stationary at level without a time trend. The time trend statistics (-1.9914) and p-value (0.0944) also show non-stationarity of energy use at level. The statistics (-4.1528) and p-value (0.0000) shows the stationary at first difference without the time trend, and the statistics (-4.1528) with a p-value (0.0000) also shows the stationary of energy use in the first difference with the time trend.

Urban population statistics (-1.5718) and p-value (0.9672) greater than (0.05) show that non-stationary at level without a time trend. The statistics (-0.5603) and p-value (1.0000) also shows the non-stationary of urban population at level without a time trend. The statistics (-1.7131) and p-value (0.7131) also show non-stationarity in the first difference without a time trend. The statistics (-2.1336) and p-value (0.0269) shows the stationary at the first difference with the time trend.

Industrialization statistics (-0.4822) and p-value (1.000) at the level without time trend: the p-value is greater than significant level show non-stationary and at the level with the time trend, statistics (-1.6540) and p-value (0.3987) also shows the non-stationary. At the first difference statistics (-3-7397) with a p-value (0.0000) show perfect stationarity without a time trend. Within time trend statistics (-4.2498) and p-value (0.0000) stationary at the first differences.

Natural resource rent statistics (-0.8855) with a p-value (0.9949) are non-significant and shows the non-stationary at level without time trend; within the time trend statistics (-0.9644) with a p-value (-0.9972) also non-stationary. At the first difference, the statistics (-3.6542) and p-value (0.0000) without time trend within the statistics (- 4.002) and p-value (0.000) with time trend, show that natural resource rent. (Pesaran, M. H. 2015)

Table4: Westerlund (2007) Cointegration Test:

Statistics	Value	Z-value	P-value	Robust P-value
Gt	-3.177	-2.082	0.019	0.037
Ga	-3.416	5.247	1.000	0.810
Pt	-10.429	-1.434	0.076	0.135
Pa	-6.834	2.012	0.978	0.168

Westerlund ECM Cointegration test used for check long run relationship between variables in this results show the Gt test p-value less than 0.05 and (0.037) robust p-value significant at 5 % level the group–t allows the heterogeneity of variables and other three test not significant at the 5 % level there is not a strong evidence but a Cointegration exist due to 1st group-t test in our results nit shows strong Cointegration because panel years are not a very large and heterogeneity in the data the results show the some countries group long run relationship exist.

Table5: Outcomes from Regression Analysis of Different Models:

Variables	Pooled OLS	Fixed Effect	Random Effect	Dricoll-Krayy
Economic Digitalization	-.031***	-.016***	-.0174**	-.0317**
	(.010)	(.005)	(.005)	(.0112)
Trade Openness	-.011***	-.0168***	-.0168***	-0.011***
	(.002)	(.003)	(.003)	(.002)
Energy Use	5.663***	3.694***	4.918***	5.663***
	(.234)	(.593)	(.461)	(.255)
Urban	-.0042***	-.0038	-.0047**	-.0042***
Population	(.001)	(.002)	(.0018)	(.001)
Industrialization	7.74e13***	3.79e13**	4.36e13**	7.74e13 ***
	(1.69e13)	(2.22e13)	(1.82e13)	(1.22e13)
Globalization	.086***	.1140***	.1240***	0.861***
	(.015)	(.0197)	(0.187)	(.012)
Natural resourc	.0826***	.0196***	.0214***	.0866***
Rent	(.007)	(.001)	(.005)	(0.008)
Constant	-2.821***	-2.931***	-3.833***	-2.821***
	(.727)	(1.001)	(.99162)	(.4019)
Hausman Test				
Chi-square	11.979	**P-Value**	.035**	

The coefficients of the digital economy negatively statically significant with ecological footprints in pooled OLS (-.031), fixed effect (-.0.162) and random (-.074) effect & Discroll-kraay (-.031) models shows that decrease in the ecological footprints are negative significant relationship between digital economy and ecological footprints for the better environmental quality and helps to decrease the environmental issues. (Rehman, S., & Gill, A. R. 2023). The coefficient of trade openness (-0.118) in pooled OLS, (-0.168) in fixed effects, and (-0.687) in random effects, Discroll-Kraay (-0.011) also show a negative relationship between trade openness and ecological foot prints, the trade openness reduces ecological footprints in Asian countries due to the heavy adoption of digital goods and services. To help reduce ecological and environmental problems in Asian developing nations, our analysis data must depend on Asian developing countries. (Miao et al., 2025). The coefficient of energy use (5.663) in pooled OLS, (3.694) in fixed effects, and (4.918) in random effect, (5.663) show a positive, significant relationship between energy use and ecological footprints. The use of energy consumption increases the ecological footprints and worse of environmental conditions. (Radulescu et al., 2021, Hassan et al., 2025). The coefficients of urban population (-.0042) pooled OLS, (-.0038) fixed effect, (-.0047) random effect, (-.0042) Driscoll-Kraay results show that urban population helps to reduce ecological footprints and environmental negative effects (Nuta et al., 2024). The coefficients of industrialization (7.74e13) pooled OLS, (3.79e13) fixed effect (4.36e13) random effect, (7.74e13) in Discroll-Kraay model shows that there are positive significant relationship between industrialization and ecological footprints there shows the industrialization increase the ecological footprints other environmental harms due to release different gases and dust particles in the air (KHAN et al., 2023). The coefficients of globalization (0.8607) in pooled OLS, (.114062) in fixed effects, (.124) random effect and (0.860) in the Discroll-Kraay regression model shows the globalization harm for the environmental quality and increases the ecological footprint (Radulescu et al., 2021). The last dependent variable of our regression models the coefficient of natural resource rent (.0826) in pooled OLS, (0.19662) in fixed effect model (0.0214) in random effect model, (.0866) in Discroll-Kraay model shows the positive significant relationship between ecological footprints there are help to increase the ecological foot prints in the south Asian economies. (Muntasir 2024).

All the variables are stationary at the primary distinction we used fixed effect, random effect version approach and the usage of Hausman check for take a look at the reliability and suitable in which variable are maximum correct between fixed effect and random effect model in our panel facts evaluation. (Pandya et al., 2023).

The results of Hausman check chi rectangular coefficient (11.979) and p-value (0.5). The p-value of is much less than (0.05) shows that our version with a constant effect is most suitable, and the distinctions among the coefficients are systematic. (Wooldridge, 2010) The constant-effect version is most dependable and suitable for the analysis; it presents consistent and reliable estimates by controlling unobserved heterogeneity across cross-sectional units (Sani et al., 2023).

Conclusion and Policy Recommendations

In this have a look at we analytically comparing existing research in environmental economics, this take a look at first recognized the index of the digital economic system. The growth of the digital economy is closely linked to the environment. On the whole, the improvement of the digital financial system is helpful in selling environmentally first-rate. Considering the direct and indirect importance of digitalization for environmental excellence across Asian nations, essential rules may be applied. First, to price the technology leading to the digitalization of Asian economies, governments must make net offerings more accessible for the respective populace. Reduce the cost of the usage of internet services; investing in infrastructure is essential, especially widening the bandwidth of internet service providers. Governments need to promote the use of renewable power resources like solar, wind, and hydropower to lessen the dependency on fossil fuels and decrease environmental degradation. Policymakers ought to implement strict environmental policies to govern excessive exploitation of herbal assets and ensure sustainable resource management. Mostly, developing nations in Asia have to inspire digital transformation & technological innovation, which could enhance energy performance and help environmentally friendly production approaches. Investment in green technologies and clean electricity infrastructure should be accelerated to promote sustainable economic growth. Governments need to beef up cross-border cooperation and related guidelines to cope with increasingly demanding situations and support sustainable development goals.

References

Bansal, S., Singh, S., & Nangia, P. (2022). Assessing the role of natural resource utilization in attaining select sustainable development goals in the era of digitalization. *Resources Policy*, *79*, 103040.

Chu, Y., Du, Y., & Yang, Y. (2025). The impact of digital trade on inclusive green growth—evidence from China's experience. *Frontiers in Environmental Science*, *13*, 1559586.

Destek, M. A., & Sinha, A. (2020). Renewable, non-renewable energy consumption, economic growth, trade openness and ecological footprint: Evidence from organisation for economic Co-operation and development countries. *Journal of cleaner production*, *242*, 118537.

Digital Transformation, Institutional Quality, and Environmental Sustainability: Evidence from SAARC Countries. *irasd Journal of Economics*, *5*(2), 392-407

Gloet, M., & Samson, D. (2022). Knowledge and innovation management to support supply chain innovation and sustainability practices. *Information Systems Management*, *39*(1), 3-18.

Hassan, E., Shehzadi, A., Qaiser, I., Arshad, N., & Ali, S. (2025). The Role of Technological Innovation and ICT in Ecological Footprint: Evidence from Asian Countries. *Bulletin of Multidisciplinary Studies*, *2*(3), 318–326. https://doi.org/10.5281/zenodo.17448041

Hilty, L. M., & Aebischer, B. (2014). ICT for sustainability: An emerging research field. *ICT innovations for Sustainability*, 3-36.

Hung, H. T. (2026). Westerlund: Westerlund ECM Panel Cointegration Test. *Available at SSRN 6042154*.

James, N. (2024). Urbanization and its impact on environmental sustainability. *J. Appl. Geogr. Stud*, *3*, 54-66.

Kamal, M., & Bablu, T. A. (2023). Mobile applications empowering smallholder farmers: A review of the impact on agricultural development. *International Journal of Social Analytics*, *8*, 36-50.

Khan, A., & Ximei, W. (2022). Digital economy and environmental sustainability: do information communication and technology (ICT) and economic complexity matter?. *International journal of environmental research and public health*, *19*(19), 12301.

Khan, S., Yahong, W., & Zeeshan, A. (2022). Impact of poverty and income inequality on the ecological footprint in Asian developing economies: Assessment of Sustainable Development Goals. *Energy Reports*, *8*, 670-679.

Li, Z., Li, N., & Wen, H. (2021). Digital economy and environmental quality: Evidence from 217 cities in China. *Sustainability*, *13*(14), 8058.

Li, Z., Li, N., & Wen, H. (2021). Digital economy and environmental quality: Evidence from 217 cities in China. *Sustainability*, *13*(14), 8058.

Lolemo, S., & Pandya, H. (2023). The Impact of Digitization on the Profitability of Selected Indian Banks: Pooled OLS Model Approach. *International Journal of Management, Public Policy and Research*, *2*(3), 1-9.

Majeed, M. T., & Sharif, F. (2024). The role of digitalization in driving green growth: A global panel data perspective. *Pakistan Journal of Commerce and Social Sciences (PJCSS)*, *18*(2), 435-467

Mentel U., Wolanin E., Eshov M., Salahodjaev R. (2022). Industrialization and CO2 emissions in sub-saharan Africa: the mitigating role of renewable electricity. *Energies* 15 (3), 946. 10.3390/en15030946

Murshed, M. (2024). Is digitalization essential for abating carbon emission growth in South Asia?. *Heliyon*, *10*(20).

Murshed, M. (2024). Is digitalization essential for abating carbon emission growth in South Asia?. *Heliyon*, *10*(20).

Murshed, M. (2024). Is digitalization essential for abating carbon emission growth in South Asia?. *Heliyon*, *10*(20).

Nathaniel, S. P., & Adeleye, N. (2021). Environmental preservation amidst carbon emissions, energy consumption, and urbanization in selected African countries: implication for sustainability. *Journal of Cleaner Production*, *285*, 125409.

Nuta, F., Shahbaz, M., Khan, I., Cutcu, I., Khan, H., & Eren, M. V. (2024). Dynamic impact of demographic features, FDI, and technological innovations on ecological footprint: evidence from European emerging economies. *Environmental science and pollution research*, *31*(12), 18683-18700.

Papagiannidis, S., & Marikyan, D. (2022). Environmental sustainability: A technology acceptance perspective. *International Journal of Information Management*, *63*, 102445.

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of applied econometrics*, *22*(2), 265-312.

Pesaran, M. H. (2015). *Time series and panel data econometrics*. Oxford University Press

Pham, D. T. T., & Nguyen, H. T. (2024). Effects of trade openness on environmental quality: evidence from developing countries. *Journal of applied economics*, *27*(1), 2339610.

Rahman, M. M., Khan, Z., Khan, S., & Abbas, S. (2023). Disaggregated energy consumption, industrialization, total population, and ecological footprint nexus: evidence from the world's top 10 most populous countries. *Environmental science and pollution research*, *30*(56), 119069-119083.

Rehman, A., Radulescu, M., Ma, H., Dagar, V., Hussain, I., & Khan, M. K. (2021). The impact of globalization, energy use, and trade on ecological footprint in Pakistan: does environmental sustainability exist? *Energies*, *14*(17), 5234.

Sabir S.Gorus M. S. (2019). The impact of globalization on ecological footprint: empirical evidence from the South Asian countries. *Environ. Sci. Pollut. Res.*26 (32), 33387–33398. 10.1007/s11356-019-06458-3

Sani, M., Suleiman, S., & Isyaku, M. (2023). Robust Hausman Pretest for Panel Data Model in the Presence of Heteroscedasticity and Influential Observations. *Journal of Basics and Applied Sciences Research*, *1*(1), 27-35.

Shah, A. A., Hussain, M. S., Nawaz, M. A., & Iqbal, M. (2021). Nexus of renewable energy consumption, economic growth, population growth, FDI, and environmental degradation in south asian countries: New evidence from Driscoll-Kraay standard error approach. *iRASD Journal of Economics*, *3*(2), 200-211.

Shahzad, U., & Miao, C. (2025). Mitigating CO2 Emissions: China-East Asia Trade, Digitalization, and Geography's Impact on Sustainable Environmental Development. *Food and Energy Security*, *14*(2), e70085.

Shehzadi, A. (2023). Energy efficiency and productivity in emerging and developing Asian countries: A firm level analysis. *Journal of Asian Economics*, *88*, 101653.

Shehzadi, A., & Wetzel, H. (2024). Self-generation and outage losses: A firm-level analysis for emerging and developing Asian countries. *Energy Reports*, *11*, 2832-2840.

Ulucak, R., Danish, & Khan, S. U. D. (2020). Does information and communication technology affect CO2 mitigation under the pathway of sustainable development during the mode of globalization?. *Sustainable Development*, *28*(4), 857-867.

ur Rehman, S., & Gill, A. R. (2023). Digital Transformation, Institutional Quality, and Environmental Sustainability: Evidence from SAARC Countries. *irasd Journal of Economics*, *5*(2), 392-407.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data*. MIT press.

Xiong, J., & Xu, D. (2021). Relationship between energy consumption, economic growth and environmental pollution in China. *Environmental Research*, *194*, 110718.

Zelalem, A. (2025). *Factor Affecting E-Marketing Adoption On Ambo Town Transport Office* '(Doctoral dissertation, Ambo University).\

Zeshan Abbas Khan, Anam Shehzadi, Muhammad Faraz Riaz, & Sadia Ali. (2025). INSTITUTIONAL QUALITY AND INNOVATION AT FIRM LEVEL: AN EMPIRICAL EVIDENCE FROM ASIAN COUNTRIES. *Policy Research Journal*, *3*(8), 775–781. Retrieved from https://policyrj.com/1/article/view/948