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Research Article

Impact of Economic Growth and Energy Consumption on Environmental Degradation: An Evidence from Selected Asian countries

Qudsia Arshad [1,*], Zeeshan Muhammad Yasir [2], Iram Batool [3]
[1] COMSATS University Management Sciences Department, Park Road, Chak Shahzad, Islamabad, Pakistan
[2] Manager Research Coordination and Operation, Independence Power Producers Advisory Council (IPPAC), Pakistan
[3] Director (Treasurer Office), PMAS Arid Agriculture University, Rawalpindi, Pakistan

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*Corresponding Email: qudsia_arshad@comsats.edu.pk

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Abstract

Environmental degradation has become an emerging issue that has been debated by researchers and policymakers around the globe. This environmental pollution may have adversarial influences on the living standard and life quality of humans. In keeping this issue in view, this research identified the major determinants of environmental degradation in 13 selected Asian economies by using data from 2009 and 2020 by using the GMM technique. Findings reveal that the increase in gross domestic product and industrialization increases environmental degradation. Results also show an environmental Kuznets curve. Moreover, gross domestic product square, energy consumption, and gross fixed capital formation are the major causes of environmental degradation in these selected Asian countries. The study suggested for better role of institutions in controlling emissions, ecological reductions, and improving green growth. There was also a need for better energy policies to control emissions and increase growth and development in the concerned economies. Finally, the focus should be made on the growth of the industrial sector.

Keywords: Environmental degradation, Industrialization, Economic growth, Asian nations

Introduction

The growth of global supply chains has intensely changed the ways to achieve raw materials, how to produce the goods, traded and consumed, and hence the geographic distributions of income gains and ecological pressures. However, the Asia-Pacific region dwells in a decisive position in the worldwide supply chain, as it has supplied many of the commodities and workers in the globe. APAC's share or involvement increased up to 36.1% in 2018 (Asian Development Banks, 2009). CO2 emissions have a major share of climatic variations and are accountable for the steady intensification in worldwide temperature. The worldwide CO2 emissions have enhanced from two billion tonnes of CO2 in 1900 to over 36 billion tonnes in 2015. The CO2 emissions growth tended to increase more by 2.7% and 0.6% in 2018 and 2019 respectively (Ritchie and Roser, 2017). Energy usage and environmental pollution are also associated. Energy usage by rural and urban communities leads to enhanced environmental pollution. The usage of energy for high growth has been observed to increase very rapidly. Thus, many efforts as energy disaster and emission release regulators are usually focused on the industrial part, unnoticing the household sector, which is inexpensive energy usage (Xiao-wei et al., 2016).

Institutions may also play a part in rapidly increasing environmental pollution. As indicated by Apergis and Ozturk (2015), good quality institutions are expected to maintain sustained financial and economic

development, its disastrous involvement in the EKC setting can be barely unnoticed for lessening terrible circumstances of the environment. It has been noticed that strong institutions result in a strong country and cause economic development in the nation. Different growth rates at the regional level fundamentally owing to institutional dissimilarities (Song, 2019; Khan & Hou 2021). Similarly, Pan et al. (2021) pointed out that the Heckscher–Ohlin theory and mass production theory favor the view that a nation rich in natural resources promotes growth in a better way as compared to those having fewer resources. On the other hand, this has not been observed as effective in total ways. The nations gifted with ordinary resources are less efficiently industrialized than rich nations that have less copious natural resources. Research already done on the issue has focused on the influence of labor force participation rate, inflation, human capital, etc on CO_2 emission in a few of the nations. However, our research has focused on the role of economic growth with other control variables in ecological footprint consumption in some Asian economies. So, we will see the influence of gross domestic product, gross domestic product square, industrialization, energy consumption, gross fixed capital formation, and institutional quality on environmental degradation by using its proxy of ecological footprint consumption with the GMM technique in some selected Asian countries in this research. This study contributes in this way as we have used ecological footprint which is a better environmental degradation proxy along with a broad index of institutional quality.

Background

Ecological footprints consumption is the main source of environmental damage in economies (Wackernagel and Rees, 1998). Ecological footprints measures are the result of major economic actions which have been happened for the survival of societies.

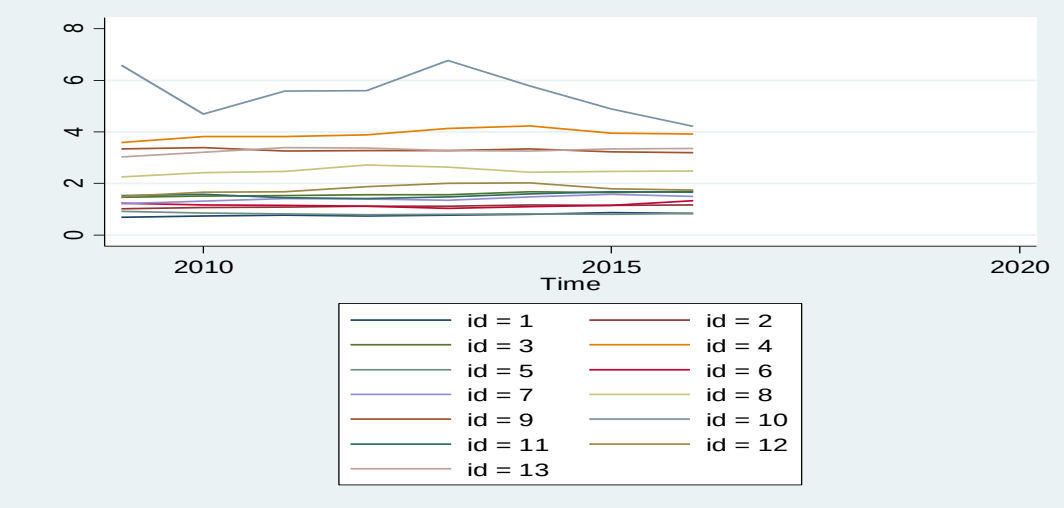

Figure 1. Ecological foot prints consumption.

In Figure 1, the ecological footprint of global hectares per person in Asian nations has been observed as changing. Though, much-increasing tendency of Brunei Darussalam country has been noted in the data. The economic efforts have been made on the cost of environmental damage.

In Figure 2, the data trend points out the increasing tendency of economic growth per capita in Asian nations because of high energy usage, much industrialization, and specialization of products. Due to high energy use. It has been revealed that economic growth has tended to increase in Brunei Darussalam nation at a high rate. However, its growing tendency is less in Bangladesh.

The data also reveals the advancing tendency of gross fix capital formation in majority of the Asian nations. Over the years, gross fix capital formation has tended to be augmented in concerned economies. Figure 3 indicates the increasing tendency of gross fix capital formation in Brunei Darussalam and decreasing tendency in Pakistan among Asian nations.

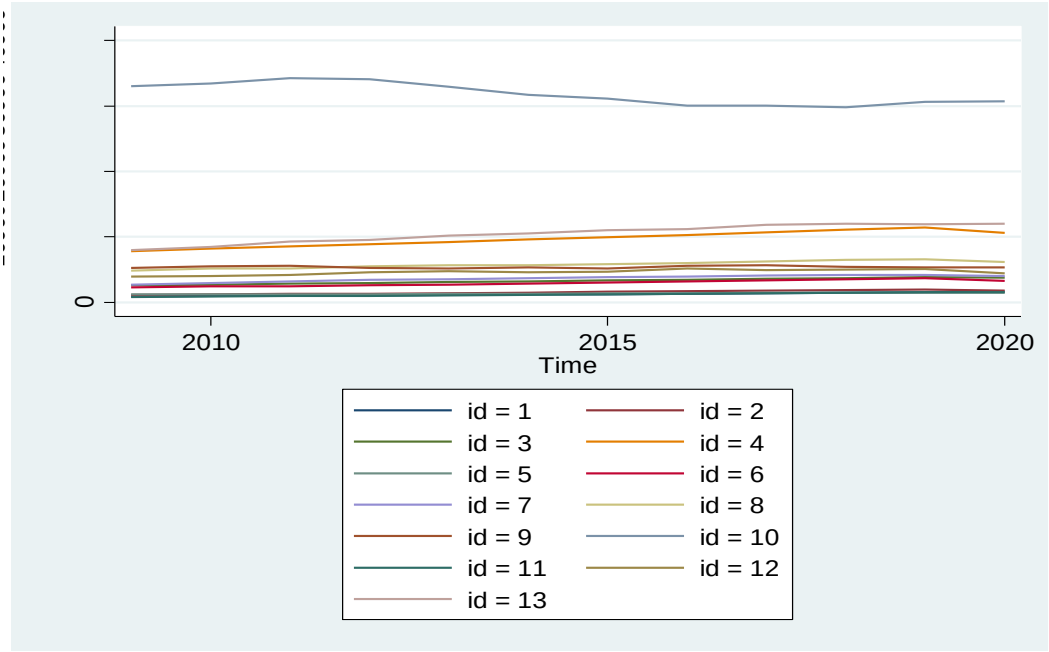

Figure 2. Economic growth.

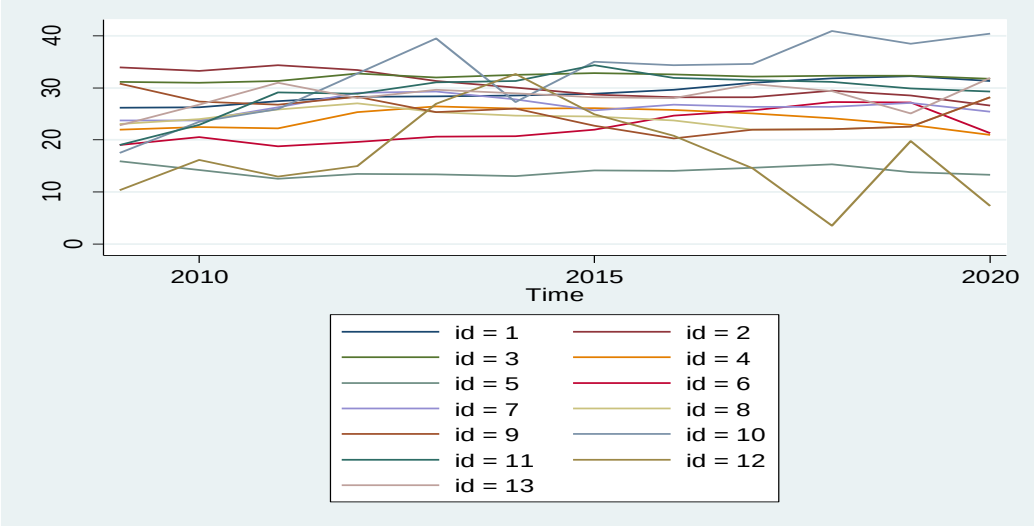

Figure 3. Gross fixed capital formation.

Literature Review

Here we explain a lot of reviewed studies highlighting the factors such as industrialization, energy usage, GDP, and gross fixed capital formation along with other variables affecting ecological foot prints consumption and CO_2 emissions in many developing and developed nations of the world. Lopez (1994) focused on how liberalized trade caused natural resources devastation as manufacturers adopted their standard response effects making. It was also found the growth was fundamentally uncomplimentary for partialities homothetic. However, pollution was observed to increase with income in non-homothetic cases. Similarly, Antweiler et al. (2001) analyzed how free trade affected the environment. Findings showed that trade-inducing method and scale effects led to decreased pollution. Generally, trade liberalization was observed favoring the environment.

Focusing on the significance of energy consumption, Ang (2007) found an association between emissions and energy usage by using data from 1960 to 2000. The study findings highlighted that environmental degradation was increased because of the high utilization of energy. However, Albornoz et al. (2009) emphasized on the role of foreign direct investment in ecological footprints consumption in Argentinian firms. Findings indicated

that foreign-owned firms had implemented environmental running schemes in a better way than local firms. Similarly, Hitam and Borhan (2012) used data from 1965 to 2010 to find out how foreign direct investment affected the ecological damage in Malaysia. The ARDL result found that income square and exports led to a reduction the CO_2 emissions.

Economic growth seemed to be the major reason for growth. Pointed out the significance of growth in ecological degradation, Saboori and Suleiman (2013) showed that more usage of energy for growth purposes resulted in high environmental damage in Malaysia. The study result also confirmed the EKC hypothesis. By using data from 1990 to 2021, Allali et al. (2015) analyzed the role of energy usage in increasing emissions in Algeria. The study result pointed out that high energy consumption was caused by high CO_2 emissions in the economy. Södersten et al. (2018) examined the effect of gross fixed capital formation in carbon footprint in less developed and rich nations of the world. The findings indicated that investment systems played a large part in emerging nations as compared to rich nations. The study also found a relative decoupling of the capital formation of gross fixed capital formation from economic growth.

Uzar (2021) investigated how institutional quality with other factors affected the ecological footprint by using data from 1992–2015 in E-7 nations. It was found that institutional quality led to reduce ecological footprint for nations. However, growth and energy usage led to enhanced ecological pressure on E-7 nations. The study suggested improved energy sources and institutional quality.Suki et al. (2021) highlighted the impact of regional trade integration for enhancing sustainable energy in South Asia by using data from 1992 to 2018. The study result revealed that local inter-trade could contribute to environmentally friendly energy, thus endorsing sustainable environmental steadfastness. However, Ghosh et al. (2022) showed how non-renewable energy led to an increase the ecological degradation in Asian nations. The finding confirmed that non-renewable energy contributed in enhancing ecological degradation in Asian nations. However, net oil exporting nations are severely affected by non-renewable energy resources because of much dependence on natural resources.

Qayyum et al. (2024) also focused on the role of growth, and energy usage in ecological foot prints consumption by using data from 1990 to 2021. It was found that institutional quality and information communication and technology led to improvement in the environment. However, trade, energy usage, and economic development resulted in environmental degradation. The result confirmed the environmental Kuznets curve hypothesis in MERCOSUR nations. Likewise, Dam et al. (2024) found that green growth exerted a vital decreasing and differentiating influence on CO_2 in the long run. The result also showed that institutional quality affected the environment adversely in OECD economies.

Theory and econometric specification

Here, we explain the theoretical fundamentals associating economic growth, growth square, energy consumption, industrialization, gross fixed capital formation and institutional quality with ecological footprint consumption. Firstly, a linkage between economic growth and ecological degradation is explained. Next, the linkage of energy consumption and foreign trade with environmental quality is assessed. Lastly, the estimable econometric specification is framed. The linkage of growth and environment is signified by the Environmental Kuznets Curve hypothesis which shows development associated with increased income per capita results in poor ecological conditions wished for continuous growth for high employment chances ignoring ecological results. However, as the economy expands continuously and high level of income are maintained, individuals are much more careful regarding natural surroundings and are demanding a clear atmosphere.

This performance of the nation and community resulted in an inverted U-shaped curve called the Environmental Kuznets Curve. Together with it, energy usage and CO_2 are linked by economic activities levels in the economy. Some studies show that energy consumption is the result of high-level income actions and, thus, too much emissions (e.g., Bowden & Payne, 2009; Belloumi, 2009). Theoretically, a lot of variables have been often considered to elucidate ecological degradation; these are economic actions, energy use, urbanization and population growth (Sharma, 2011; Shahbaz et al., 2013; Sadorsky, 2014).

The ecological footprint indicator was first suggested in 1991 by Rees and Wackernagel (1992). Thus, the objective of refining ecological quality turns into the topmost precedence in the plans of all economies. For this, key factors of ecological degradation are found. Empirically, the energy economic linkages used to find out the major causes driving ecological degradation and strategies to be suggested to make better ecological excellence were categorized into two major groups. The first group highlights that all studies show the environmental Kuznets curve hypothesis (Kuznets, 1955; Grossman & Krueger, 1995; Charfeddine & Khediri, 2016). Such a proposition shows linkage between ecological degradation and economic growth is inverted U-shaped. This means its dependence on the growth of economies. Support for the EKC supposition is very varied (Stern, 2001). Moreover, the research regarding energy use and economic growth nexus has been observed by Soytas and Sari (2009), and Kahia et al. (2016a,b). It shows that energy use is the major driver of ecological degradation.

Grossman and Krueger (1991) discuss that rapidly increasing economic growth leads to higher ecological greenhouse gasses in the initial phase, other than in future phases decreases environmental effluence; elevated release of contaminant are determined by high energy consumption causing from economic growth (Wang et al., 2016). Institutional quality is very significant, though to a certain extent ignored parts that may affect ecological quality (Cole, 2007; Ibrahim & Law, 2015: Panayotou (1997). On the other hand, institutional failure results in dilapidation of the ecology. Properly working eminence institutions develop the environment with low income in the country (Panayotou et al., 1997).

Methodology

This research work has emphasized on the role of institutional quality, industrialization, gross domestic product, gross domestic product square, energy usage, and gross fixed capital formation in enhancing environmental degradation in Asian nations by using unbalanced panel data from 2009 to 2020. It has been assessed the environmental degradation in some Asian nations such as Pakistan, Bangladesh, India, Sri Lanka, Indonesia, Philippines, Malaysia, Thailand, Iran, Iraq, Turkey, Myanmar, and Brunei Darussalam taking into consideration key factors. The selection of the panel of countries was based on data accessibility. The dependent variable was ecological footprint consumption as a proxy of environmental degradation. The annual data for industrialization, energy consumption, gross domestic product, and gross domestic product square and gross fixed capital formation were taken through World Development Indicators. The ecological footprint data was used from the Global Footprint Network. The information for institutional quality (i.e., voice and accountability, political stability and absence of violence, Government effectiveness, and control of corruption was used by Worldwide Governance indicators. Finally, the study has constructed an institutional quality index by PCA technique. Following Antweiler et al. (2001), who combined the Hecksher-Ohlin, model to fester the influence of trade into scale, composition, and technique influences.

Model specification

The existing research has highlighted how economic growth, energy usage, institutional quality, industrialization and gross fixed capital formation on ecological footprints consumption in some selected Asian economies. For the association of dependent and independent variables, we have used GMM technique which solves the endogeneity issue by familiarizing instrumental variables (Omri and Chaibi, 2014) and also removes cross-country differences and country-specific heterogeneities.

The empirical model is shown as:

$$LEFit = \beta_0 + \beta_1 IQit + \beta_2 LECONit + \beta_3 LDPPCit + \beta_4 LGDPPC2it + \beta_5 INSit + \beta_6 LGROSFit + uit \quad (1)$$

Where the subscript "i" indicates economies (i = 1...11 for nominated Asian economies), though, "t" exposes the time requirement. Where LEFit is the natural logarithm of per capita ecological footprint. While IQit indicates the institutional quality index. LGDPPCit indicates gross domestic product per capita. INS reveals the industrialization with its proxy of manufacturing value added. Furthermore, LECONit points out energy consumption. Finally, LGDPPC2it and LGROSFit measure the natural log of gross domestic product per capita

square and gross fixed capital formation, congruently.

Results and Discussion

Here, we have analyzed how the explanatory factors may influence the environmental degradation in some chosen Asian nations. Table 1 reveals summary statistics of major variables. On average, the log GDP is 3.59 percent. In case of institutional quality, the sample covers countries with indexes ranging from -2.8369 percent to 1.8540 percent. The average IQ index across nations is 1.89e-08 percent from 2009 to 2020. The same, variations have been noticed in industrialization from -25.7 to 35.9887 along with variables. Finally, average energy consumption across nations is 2.9942 percent.

Table 1. Summary statistics.

Variables	Observations	Mean	Standard deviation	Minimum	Maximum
LEF	104	0.2663	0.2581	-0.157276	0.8304129
IQ	130	1.89e-08	1.0000	-2.8369	1.8540
LENUSE	78	2.9942	0.4416	2.2857	3.9929
LGDPPC	156	3.5903	0.4108	2.9168	4.5345
LGDPPC2	156	13.0584	3.04217	8.5078	20.5625
INS	155	4.4196	7.3811	-25.7	35.9887
LGROSF	156	1.3931	0.1406	0.5438	1.6116

Table 2. GMM Results, Log ecological foot prints consumption (dependent variable).

Variables	Coefficients, Standard Errors and T-values
LEF1	0.5090*
	0.1336
	(3.81)
LEF2	0.5916
	0.1231
	(0.48)
IQ	-0.0006
	0.0155
	(-0.03)
LECON	0.2132
	0.2117
	(1.01)
LGDPPC	1.5347***
	0.7932
	(1.93)
LGDPPC2	-0.2276***
	0.1254
	(-1.81)
INS	0.0025

	0.0016
	(1.61)
LGROSF	0.2804**
	0.1021
	(2.75)
AR1	0.097
AR2	0.731
Sargan test	0.665

t-values are in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

In Table 2, findings show the positive and significant coefficients of one-year lag in LEF. However findings for two years lag in EF seem insignificant.

Gross domestic Product (LGDPPC) affects environmental degradation in Asian economies. One percent increased gross domestic product will increase EF by 1.53 %. The possible reasons may be that the high usage of energy for high production has harmful effects on the environment decreases its quality and increases its pollution emission. A high working population leads to high mass consumption income. So more people contribute to environmental degradation. The study result is consistent with Saboori and Suleiman (2013).

Gross Domestic product square (LGDPPC2) also affects environmental degradation in Asian economies. One percent increase in gross domestic product square will increase EF by 0.2276 %. The possible reasons may be that the high energy utilization by the majority of the population for high production affects badly the environment and decreases its quality and increases its pollution emission. A high working population results in high mass consumption income. So, more people contribute to environmental degradation. The finding is supported by Saboori and Suleiman (2013) and Hitam and Borhan (2012).

Moreover, the U–U-shaped behavior recommends that consistently rising growth will be linked with an increasing ecological footprint. It indicates more care particularly because the country requires enhancing economic growth to make better the standard of life for the general public energy.

The improved renewable energy sector is a predominantly significant chance for these economies because of their geographical location. It has been noticed that more usage of energy may be harmful to the environment. Findings show the positive influence of energy consumption on ecological footprints consumption. But the result is insignificant.

Our major and key variable is institutional quality. Institutional quality affects negatively ecological footprints consumption, recommending that strong institutions improve ecological performance, whereas weak institutions may tend to deteriorate the environment. The institutional quality has advantageous environmental influences in poor nations. Though, the coefficient of the political institutions variable is insignificant.

The coefficient of gross fixed capital formation (LGROSF) is positive and statistically significant. One percent increased gross fixed capital formation increases the environmental degradation by 0.2804 percent. The reason may be that increased capital formation may increase production, growth, and living standards by using new information communication technologies to lessen the time of transportation and increase the usage of e-works results in better ecological quality utilization. Finally, many industries may increase industrialization and economic growth. However, the coefficients of industrialization are positive but insignificant.

Conclusions and Recommendations

The existing study highlights the role of institutional quality, energy consumption, gross domestic product, gross domestic product square, industrialization, and gross fixed capital formation in affecting ecological footprints consumption checked in some chosen Asian nations. We have used the GMM technique to find out a significant association among the factors. The results reveal that energy consumption, gross domestic

product, industrialization, and gross fixed capital formation are key determinants of environmental degradation in this analysis. The result concludes that economic growth, growth square, and gross fixed capital formation as the major factors affecting ecological foot print consumption. It seems that there can be more production in the concerned economies which will result in more growth and development at the cost of the environment. Strategies should be made to increase economic growth and to make safe the environment.

Based on the findings, it is suggested that institutions must play an important role in ecological footprints and reducing environmental degradation. Better planning should be made for better energy usage and green growth. There should be the more stable environment in the economies for more investments and capital formations which resultantly enhance economic growth.

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