Industrial Expansion, Trade Openness and Environmental Degradation in Asia: A Panel Data Analysis

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ARTICLE DETAILS	ABSTRACT
History: *Accepted 17 February 2023* *Available Online March 2023*	*The study is conducted to examine the influence of Industrial expansion and Trade openness on Environmental degradation by using panel data of 16 Asian economies from 1992 to 2020. The results are estimated through panel unit root test and then Panel ARDL technique. The results of unit root test propose to apply Panel ARDL and their results are estimated for short run and long run. It is analysed that Industrial value addition are population density are increasing CO_2 Emission in Asian economies while trade openness, government expenditure and GDP are reducing CO_2 Emission.*
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1. Introduction

The economic development might be reliant on the rapidly growing procedure of industrialisation within any economy. The industrial production is responsible for the generation of the services, goods as well as employment opportunities which makes a contribution to economic growth; however, it is also one of the main sources of waste and pollution. The industrialisation has been known to accelerate the economic development of a country. According to Neumayer (2003), generally, the industrial sector has been considered as more concentrated towards pollution in comparison to the service sector. The industrial outcome might provide assistance in the explanation of the pollution level as the wastewater within the developing countries is likely to be dumped without any treatment into the rivers (WHO/UNEP, 1997).

Today, each and every country of the world is dependent upon the export of products and services for providing assistance in the economic expansion; however, the major emphasis is on the industrial sector as the levels of trade openness and international trade has been increasing. The ASEAN countries are situated within Southern East Asia and include Indonesia, Brunei, Singapore, Cambodia,

Malaysia, Laos, Vietnam, Myanmar, Thailand, and the Philippines. These countries emphasise the industrial investment in the various sectors, for instance, food, petroleum, vehicles, and textiles. The ASEAN countries have developed the 'ASEAN Economic Community in the year 2016 for increasing the cooperation between the members of ASEAN for driving the economic stability within the South East Asian region.

According to the World Bank (2015), industrial value-added encompasses manufacturing, gas, mining, construction, water, and electricity. Value-added has been defined as a sector's net output which appears after the addition of all of the outputs and the subtraction of the intermediate inputs. The calculation of value added is carried out without subtracting the depreciation of the fabricated assets or the degradation and depletion of the natural resources.

The association between trade liberalisation and the economic growth within the developing countries has been under the debate between economists of development in the past few years. The query is that does the economic growth of the developing countries increases due to trade liberalisation and if the answer is yes then what is the reason behind it. There have been various empirical studies which associate the economic growth to the openness of the rules of trade (Little, Scitovsky, & Scott, 1970; Balassa & Associates, 1971; Bhagwati, 1978 ; Heitger, 1987; Krueger, 1978; Dollar, 1992; Quah & Rauch, 1990; Romer, 1989; Michaely, Papageorgiou, & (eds.), 1991; Thomas, Nash, & Associates, 1991).

However, certain studies have identified little empirical pieces of evidence for providing support to the relationship between economic growth and trade liberalisation (Sachs, 1987; UNCTAD, 1989; Agosin, 1991; Shafaeddin, 1994; Greenaway & Sapsford, 1994; Jenkins, 1996; Taylor, 1991). The development of the endogenous growth theory has also offered the theoretical framework for endeavouring the empirical work related to the relationship between economic growth and trade policies.

Economists have designed various sophisticated models that are made for the purpose of stimulating the alterations in the economic conditions that are anticipated from an agreement of trade. It has been observed that the increase in the level of the economic activity can have an impact on the environment and each of the products have the probability to create some sort of pollution. There have been slight changes in the pollution due to trade liberalisation; however, free trade does not have a detrimental effect on the environment.

The previous studies regarding trade liberalisation, industrial expansion and environmental degradation within the Asian countries. It has been found that numerous studies have been accomplished to recognise the advantages of trade suggesting that it is an instrument in accelerating the economic growth of the countries in trade and developing countries in actual. In order to analyse the impacts by making use of the dataset of the industrial level between the whole manufacturing sector. The pre and post-liberalisation period was also compared in order to investigate whether the local Indian production and exports enhance dirty technology relatively to clean technology or not.

The objective that has been set for this research is to investigate the impact of industrial expansion and trade liberalisation on the environmental degradation in Asia. The study is organized as section one is providing preliminary information regarding the research topic and purpose. section two provides the theoretical and conceptual framework. section three reveals the literature related to the topic. section four offers the methodology of the research. section five provides the results of the research and section six provides the policy and the recommendations.

2. Literature Review

In this section, the previous related studies and research have been reviewed as these serve as valuable literature with respect to the research topic. The literature review highlights the results of previously done studies and their relevance to the current research. In the paragraphs following this introduction, the relevant aspects of those past studies have been reviewed.

Numerous studies have been carried out to recognise the advantages of trade suggesting that it is an instrument in accelerating the economic growth of the countries in trade and developing countries in particular. Albeit the significance of international trade with regards to economic growth, environmentalists have claimed that the open trade policies, although, add value to the welfare of economies, producers, and consumers, it also degrades the ecosystem and environment as a result of activities that are carried out owing to the very openness of this international trade.

The research was conducted by Chou et al., (1991) for the examination of the effect of openness to trade on environmental degradation. The environmental quality in this study was designed as differentiated and non-tradable degradation. It was depicted by the findings of this research that in a situation where the customers consider consumption and environmental characteristics as the substitutes and in case a comparatively high value is placed by the customers on the quality of the environment in comparison to the quality of the product, then there is a chance that the openness of the trade might minimise the welfare of the trading countries. There is a likelihood of net welfare loss which

In their study, Grossman & Krueger (1992) analysed the impact of the North Atlantic American Free Trade Agreement (NAFTA) and after the analysis claimed that given that trade restrictions are removed then it is going to impact the environment in general. To support this statement the study argued that the increase in the level of economic activity and the changes in techniques and composition of production affects the environment. The study applied cross-sectional data of 42 countries by studying their urban areas demonstrating that the open trade has impacted those areas. In this research economic growth and air, the quality relationship was studied and the results showed that the concentration of two pollutants i.e. smoke and sulphur dioxide increases as the per capital GDP increases at national income's low levels. However, it decreases with GDP growth as the income level is higher.

The study conducted by Jouathan (2001) depicts that generally, trade is beneficial economically due to the fact that the countries which are involved in international trade could get the advantage from following their competitive advantage with the help of trade. However, there are also increased chances that they will be harmful at the national, regional as well as global level. The environment in the resource-based industries including material mining, extraction of oil which can also make a contribution to environmental degradation, might also be affected by the Foreign Direct Investment (FDI).

The study conducted by Usman in 2003 identified that the situation within the developing countries is completely different in comparison to that of the developed countries. In the case of dealing with the effects of international trade on the environment of the developing countries, it has been identified that they are more reliant on the exploitation of the natural resources and the agricultural sector. This is because of the fact that for keeping the balance of the payment in their favour or in surplus. Due to this, the developing countries enhance the trade volume which leads to the overexploitation of the natural resources which in turn damages the environment. In the actual terms,

all these things result in a deteriorating living standard.

The influence of trade on the environment has also been examined by Jha & Gamper-Rabindran (2004) when in the year 1991, the barriers of trade were removed from the FDI because of trade liberalisation. In order to analyse the impacts by making use of the dataset of the industrial level between the whole manufacturing sector. The pre and post-liberalisation period was also compared in order to investigate whether the local Indian production and exports enhance dirty technology relatively to clean technology or not. They also examined that the pollution in the intensive sector has increased because of the FDI inflow. Their findings indicated that after the liberalisation of trade in India, the exports and FDI were enhanced in the more polluted sectors in comparison to the less polluted sector.

Kakaliy and Chakraborty (2005) also examined the impact of liberalisation of trade on India's environment by analysing pollution heaven hypothesis (PHH) and factor endowment hypothesis (FEH). The method utilised for the testing of PHH and FEH was Input-Output methods. As per their examination, the evidence from India does not support PHH (pollution heaven hypothesis) whether checked with the rest of the countries for trade or only with the European Union EU but it supports factor endowment hypothesis (FEH) while exporting more goods that are labour concentrated which are eco-friendly.

It has been claimed by Khalil & Inam (2006) that the Economists have debated that the increment in the local production because of the international trade in order to get the foreign currency results in the enhancement in the market share of each of the currency along with conveying the efficiency within the utilisation of limited resources. However, on the other hand, it is criticised by the environmental economist that the real or actual costs of trade liberalisation are the degradation of the environmental resources and the reduction of natural resources. According to their findings, there has been a principle relationship between the environment and international trade. Therefore, it is important to develop a policy inclined towards environmental protection.

Eventually, these things will have an influence on the economic growth which, Fried (2011) has also discussed in his analysis concerning the influence of carbon on economic growth. His research findings indicated that the output might directly be affected by environmental pollution and will also reduce the productivity of the labour and capital made by men. This damage and distressfulness happen principally because of environmental pollution and can also make a contribution to the distractive effect on human benefit as well as the economy. The aim of carrying out this study was to investigate the effect of CO_2 on the economic growth of the ASEAN by making use of the data from 1965 to 2010. Three simultaneous studies were formulated in this research for the empirical analysis which indicates that there is an environmental Kuznets relationship in the ASEAN (Ali, Zaman, & Ali, 2015).

According to Kawai & Wignaraja (2014), the evolving trade policy architecture of Asia is probably to be progressively anchored on the Free Trade Agreements (FTAs) for the predictable future. For this prediction, there are three reasons. The first reason is that the multifaceted negotiation function at the WTO appears as there is a slight end in sight for the long-standing WTO. The second reason is that the momentum for the more unilateral liberalisation in Asia appears to have grown weary with the tariffs of import attaining the historically low level in the initial 2000s. The third reason is that nearly all of the Asian economies have been following FTAs in order to sustain the momentum for liberalisation and to make an effort to minimise the more difficult behind the barriers of border regulation.

According to the study of Ali et al. (2015), the findings of the study carried out by Rudel in 1999 are different and indicate that international trade is a significant factor within the increased rate of tropical deforestation. Particularly, the trade with the developed countries has forced South East Asia and Latin America to enhance the deforestation. Due to trade liberalisation, there has also been the extinction of the valuable plant and animal species. Because of all of the transboundary issues of international trade, the problem regarding the environmental effects of international trade has become very much complex and is also considered significant on the international level.

According to Azam (2016), in the procedure of sustainable economic development, environmental pollution is a significant issue as it has alarming concerns for economic growth as well as the well-being of humans. Pollutions have been considered as the cause of a number of negative impacts on resource enervation, health and the natural disasters related to changes in climate. It has been explained that with the development of the economy, the environment will also be affected that will have an adverse impact on the society, natural order, infrastructure, and the economy. The unfavourable relationship between environmental degradation and economic growth need adequate environmental policy strategies and reactions, at regional, local, national as well as international level. It has been claimed that smart policies for the control of CO_2 emission can provide a stimulus for economic growth.

According to Jacob (2018), the latest research of ESCAP indicates that between the 1990s and 2010s, the market income Gini coefficient which is the most widely utilised measure of the inequality in income has increased in four out of five most populated countries in the region having an effect on the approximately 70 percent of the population of Asia Pacific. The research also depicted that environmental factor such as erosion of the natural capital, air pollution and the steady impact of the natural hazards were among the essential factors which contributed to the increase in income equality in the countries since the 1990s. Inequality can be addressed by the targeted policies for disrupting the association between income equality and environmental degradation.

According to Higuchi & Shimada (2019), the industrial policy has been a debated issue between the policymakers and the researchers. The supporters of the industrial policy claim that the large push-type policies for the promotion of industrial development are essential to economic development. However, it has been claimed by the opponents that these types of interventionist policies will alter the market and will have a harmful influence on economic growth. During this period, the significance of the policy for the promotion of industrialisation and for reforming the investment climate has been accepted. In recent years, renewed consideration of the industrial policy has been known as the reoccurrence of the industrial policy due to the general acknowledgment of the significance of the formation of jobs within the developing countries.

3. Data and Methodology

According to the set aims and objective for the research, a secondary method of data collection has been selected in which the data has been collected through World Bank Indicators. We have collected panel data of sixteen countries from the World Bank Indicators of thirty years (1992-2020). The countries that we have selected are Azerbaijan, Bahrain, Bangladesh, Cambodia, China, India, Indonesia, Japan, Malaysia, Nepal, Pakistan, Saudi Arabia, Sri Lanka, Thailand, United Arab Emirates and Oman. The data acquired by the World Bank Indicators is then represented in the form bar charts which have been developed by the help of Ms Excel. We have used Graphical analysis, descriptive statistics and correlation analysis. Granger causality test, Unit root test (ADF) and Auto regressive and Distributed lag model (ARDL) will be applied in Results. Carbon dioxide emissions are the ones arising

from the manufacturing of cement and the burning of fossil fuel and its unit of measurement is kilotons. The General government final consumption expenditure, GDP, Industrial value added are taken in US Dollars. The population density is the midyear population that is divided by the area of land in square kilometres.

Considering the objectives of the study that is to see the effect of Trade Liberalization and Industrial Expansion on Environmental Degradation in Asian Economies, the following model is presented.

$$CO2KT = \beta_0 + \beta_1 \, INDV + \beta_2 \, TRAOP + \beta_3 \, POPD + \beta_4 \, NGEX + \beta_5 \, NGDP + ui$$

Where, CO2KT is Environmental Degradation, INDV is Industrial value added, TRAOP is Trade openness, POPD is Population Density, NGEX is Government Expenditures, NGDP is Nominal Gross Domestic Product, u_i is error term and β's are coefficient's slopes.

4. Results and Discussion

In this study, Levin, Lin and Chu test is applied as unit root test and their results are presented in table 1. These results display that Co2 Emission, Population Density and Trade Openness are stationary at level while GDP, Industrial Value added and Government Expenditure are stationary at 1st difference. So Panel ARDL will be the best choice for estimation of econometric results.

Table 1: Levin, Lin and Chu test: Unit Root Test

Variables	Test for unit root in	Include in test equation	t-statistics	probability	Remarks
Co$_2$ Emission	Level	Intercept	-2.91	0	I(0)
Gross Domestic Product	Level	Intercept	1.66	0.95	I(1)
		Trend and intercept	-0.29	0.38	
	1st difference	Intercept	-13.76	0	
Industry value added	Level	Intercept	2.2	0.98	I(1)
		Trend and intercept	-0.38	0.34	
	1st difference	Intercept	-11.79	0	
Government Expenditure	Level	Intercept	2.23	0.98	I(1)
		Trend and intercept	-0.92	0.17	
	1st difference	Intercept	-13.42	0	
Population Density	Level	Intercept	-4.55	0	I(0)
Trade Openness	Level	Intercept	-2.55	0	I(0)

The results of Panel ARDL is reported in table 2. The affiliation among industrial value added and ecological degradation is positive, and the probability of relationship is significant. Main reason of increase in the carbon dioxide expansion is due to the companies find out alternative but less environment friendly ways to reduce products or material cost in an attempt to increase industrial value addition.

The relationship between Trade Openness and carbon dioxide emission is negative, and the probability of relationship is significant. The main reason of decrease in the carbon Dioxide omission is

due to the flexibility and openness in trade would ultimately reduce the environment degradation in a country.

Third variable is population density. The relationship between population density and environmental degradation is positive, and the probability of relationship is significant. The main reason of increase in the carbon Dioxide emission is due to the increase in population of the world. the south Asian countries are more effected due to this, because increasing in birth rate people produce more carbon dioxide. And in developing countries birth rates increases every year. The relationship between Government expenditures and carbon Dioxide omission is negative, and the probability of relationship is significant. The main reason of decrease in the carbon Dioxide omission is due to the government efforts that make some policies to reduce pollution. For example, they spend money on vacuum cleaning of roads and cleaning of rivers and water areas. It would ultimately reduce the environment degradation in a country.

Now we discuss about gross domestic product coefficient number -0.073764. The relationship between gross domestic product and ecological degradation is negative, and the probability of relationship is significant. The main reason of decrease in the carbon dioxide omission is due to the rise in countries development upward. It would ultimately reduce the environment degradation in a country.

Table 2: ARDL Long run and Short run results

Variables	Coefficient	Standard Errors	t-Statistic	Probability
Long Run Equation				
Industry value added	0.412442	0.074413	5.542594	0.0000
Trade openness	-0.184806	0.049301	-3.748557	0.0002
Population density	0.457106	0.104858	4.359295	0.0000
Government expenditures	-0.151202	0.069543	-2.174242	0.0311
Gross domestic product	-0.073764	0.125054	-0.589859	0.5561
Short Run Equation				
COINTEQ01	-0.376062	0.120232	-3.127810	0.0021
D(LCO2KT(-1))	-0.188033	0.108022	-1.740690	0.0835
D(LINDVAL)	-0.112169	0.218672	-0.512956	0.6086
D(LINDVAL(-1))	0.025439	0.173401	0.146705	0.8835
D(LINDVAL(-2))	0.063307	0.170318	0.371701	0.7106
D(LTRADOPEN)	0.112404	0.115871	0.970080	0.3334
D(LTRADOPEN(-1))	0.175118	0.110703	1.581867	0.1155
D(LTRADOPEN(-2))	0.237905	0.097063	2.451038	0.0153
D(LPOPDENSITY)	-100.0468	51.53049	-1.941507	0.0538
D(LPOPDENSITY(-1))	180.3478	98.60072	1.829071	0.0691
D(LPOPDENSITY(-2))	-101.8348	55.61908	-1.830933	0.0689
D(LNGEXP)	-0.219103	0.171420	-1.278163	0.2029
D(LNGEXP(-1))	-0.204871	0.189385	-1.081767	0.2809
D(LNGEXP(-2))	0.182589	0.179905	1.014917	0.3116
D(LNGDP)	0.142110	0.273899	0.518841	0.6045
D(LNGDP(-1))	-0.181900	0.288174	-0.631216	0.5287
D(LNGDP(-2))	-0.249375	0.263383	-0.946817	0.3451
Constant	2.639701	0.759778	3.474306	0.0006

5. Policy Recommendations and Conclusion

The industrial production is responsible for the generation of the services, goods as well as employment opportunities which makes a contribution to economic growth; however, it is also one of the main sources of waste and pollution. With the increase in international trade, the connection between the environment and trade has been under the discussion. The study used secondary panel data taken from World Development indicators of sixteen Asian countries from 1992 - 2020. LLC – Unit root test and Panel ARDL test are applied.

It can be concluded that the escalation in the activities of the economic growth has resulted in having a great impact on the environment due to the intensification in the emission of greenhouse gases and the addition of various pollutants into the environment. Main reasons of environmental degradation discussed in this work are industrialization, population density, Gross domestic product, technology, lack of government spending, CO2 Emission and trade openness. Considering all these factors of environmental pollution, different countries have different level of causes and impact on environment degradation in Asia. If one country performs better in industrialization but low at other factors such as population density. Similarly, all countries at some point lack controls and measures to avoid impact on environmental degradation.

The results suggest that the carbon Dioxide omission would reduce on average in the long run if trade openness increases (Dean, 1992). Government should encourage flexibility, openness and transparency in the trade market in order to reduce the pollution. If population density increases, the pollution would also increase on average in the long run. People from rural areas move to developed areas for necessities which in turn increase population density (Copeland and Taylor, 1997). Government should provide facilities such as hospitals, schools and public parks and job opportunities in the rural areas in order to equalise population density. If Government expenditures increases, the carbon Dioxide omission would reduce on average in the long run (Choi, 2010). Government should invest money on vacuum cleaning of roads and cleaning of rivers and water bodies. It would ultimately reduce the environment degradation in a country. As calculated above in the results, if gross domestic product increases, the carbon Dioxide omission will decrease (Cederborg and Snöbohm, 2016). Government should ensure that living standard of the community also enhanced with the increase of gross domestic product by providing infrastructure, training, education and employment opportunities.

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