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DECOMPOSING THE TRADE-ENVIRONMENT NEXUS FOR SOUTH ASIAN COUNTRIES

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Abstract

The relationship between international trade and environment is extremely debatable issue since the enhancement in trade openness. Panel of South Asian countries has been used in this study over the period of 1980-2016 to examine the impact of international trade on environment by decomposition scale, technique, composition and comparative advantage effect. Panel ARDL methodology is used to investigate the long run and short run relationship between trade and environment. The results suggest the existence of long run relationship between international trade and carbon dioxide emission, whereas, the short run relation exist in scale effect, composition effect and comparative advantage effect. The results provide the modern approach to examine the impact of international trade in four sub-dimensions of trade openness. Thus, trade economist should focus on such policies which promote the use of environmental friendly technologies and efficient use of natural resources in production.

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Keywords: International trade, Environmental quality, Panel ARDL, Carbon dioxide emission, South Asian Countries.

1. INTRODUCTION

International trade plays a vital role in enhancing the economic activities. It increases the income level of a country but at the same time damages the natural environment [Azhar et.al. (2007)]. The sharp changes in environmental quality and the global warming forced the researchers to explore and determine the relationship between trade and environmental quality. Trade liberalization can increase the market share of the country and enhance the competition in the market by utilizing the resources properly. On the other hand, the supporter of environmental quality argues that the eternal cost for expansion in international trade exhausts the natural resources and the natural environment [Ali et.al. (2015)]. The environment will be damaged when country promote dirty industrial goods in order to enhance the trade and does not change the technique of production. [Ling et.al. (2015)].

After 1970s, the effect of environment regulation on trade gained importance especially in developed countries and it is observed that environmental policies have strong impact on trade [Beers and Bergh (2003)], whereas Costantini and Crespi (2008) defined that with enforcing environmental regulations, a country become technologically innovative which decreases the cost of production. South Asian countries created acceptable development on free trade policies and decreases tariff on trade since 1990 when some of the sectors familiarize with structural reforms.

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South Asian countries have also initiate substantial drive for industrial liberation in extension to other organizational improvement. Both the public and private sectors have accepted that strengthened exports are necessary for comprehensive economic development [Jabeen (2011)].

International trade has direct and indirect effect on the environmental quality. [2] Researchers have developed the four main components that indicate the indirect effect of trade on environment. These are scale, technique, composition and comparative advantage effect (Grossman& Krueger, 1991).

The scale effect shows the change in pollution emission as a result of the change in total output keeping technique and composition effect constant, the composition effect represents the changes in the mix of goods being produced after opening to trade as an outcome of comparative advantage, specialization and factor reallocation. The technique effect shows the changes in the technology i.e. mainly adoption of cleaner technology (Grossman and Krueger, 1991). Comparative advantage occurs when a country produces goods relatively cheaper than other country. In the presence of strict environmental policies less degradation of natural environment would be expected and also lead to increase the cost of production.

In order to examine the impact of trade on natural environment it is necessary to analyze the effects of each individual on the economy. When the economy is specialized in pollution intensive goods, the increase of the output as a result of expansion of trade will cause environmental degradation through scale effect. Moreover, after opening to international trade if the economy still has comparative advantage in pollution intensive goods the environmental quality will further decline as the pollution sector will increase at the expense of clean goods which will contract, Furthermore, when the economy loses its comparative advantage in pollution intensive goods, the composition effect could enhance the environmental quality as the economy could specialized in clean goods. The technique effect is treated to be environmentally improving as regardless of preceding two effects the invasion of more efficient technology will decrease the pollution emission. The environmental quality will be determined by the proceeding impact of dominant effect.

The studies on the impact of international trade on environment are numerous, but the results are heterogeneous as the environmentalists focus on the negative impact of generated pollution, whereas the trade supporters show that it has positive effect on environment. Low and Yeats (1992) and Dinda (2006) investigated that trade liberalization has impact on environment in developing countries whereas in developed economies the trade liberalization enhances the environmental quality. Moreover, Cole (2006) examined that developing countries do not implement the rules of World Health Organization (WHO) thus environmental quality is affected. Taylor & Copeland (2001) studied the linkage between trade and pollution and found that income effect plays vital role to determine the effect of liberalization on

[2] Direct effect includes the increase in transportation level due to NAFTA which degrades the environment [Gallagar& Taylor (2003)].

environmental quality. Jabeen (2011) studied that net impact of trade liberalization policies damages the environmental quality by using Co_2 emission.

Rezazadeh et al. (2014) found that there is long run positive relationship between international trade and environment. On the other hand, Ali et al. (2015) studied the relationship between trade and environmental quality and examined that there is negative impact of trade on environmental quality but at the same time the study showed the beneficial impact of trade.

The objective of the study is to examine the effect of international trade on environment by decomposing scale, technique, composition and comparative advantage effect. Panel ARDL model is applied to examine the relationship between International trade and environment. In literature we have found various studies, such as Ling et al. (2015), Kakakhel (2012), Jabeen (2011), Halicioglu, and Ketenci (2015), which decomposed the effect of international trade on pollution emission into three components that is scale effect, composition effect and technique effect. Given that now comparative advantage effect on environmental quality depends upon combined effect of overall composition of trade of South Asian countries. It is important to examine the impact of international trade on environment by decomposing four components: scale effect, composition effect, technique effect and comparative advantage effect in case of selected South Asian countries including Pakistan, India, Sri Lanka and Bangladesh. Our study will contribute to extensive regulations for trade economist to establish environmentally strengthen trade policies and regulations, which facilitate environmental policy maker in developing countries.

The results indicate that selected South Asian countries including Pakistan, India, Bangladesh and Sri Lankan are developing countries, so their short run results are much related to each other.

Organization of the study as follows; Section 2 sheds the light on theoretical framework, section 3 discusses the data and econometric approach, section 4 reports the results and discussion and the last section 5 contains the conclusion and policy implications

2. THEORETICAL FRAMEWORK

The theoretical model which is used in our study is pollution model of Tayebi and Younespour (2012). According to Tayebi and Younespour (2012) the relationship between environment and economic growth is complicated however it is helpful to examine the relationship by decomposing the scale, technique, composite and comparative advantage effect. Scale effect of the economic output (S) is defined as the value of total output of economy at given price:

$$S = Px + Y \quad (1)$$

Composite effect is defined as the relative supply of X. It can be written as x/y and denoted with χ, following Tayebi and Younespour (2012):

$$\frac{X}{Y} = C_w^y k - \frac{C_r^y}{C_r^x} - C_w^x k \equiv \chi[k, \tilde{p}] \quad (2)$$

Whereas k represents (K/L) capital labour ratio, χ represents the increasing trend in k and $\tilde{p}$, thus rise in price will decrease the taxes τ. The output of an economy that changes $\chi[k, \tilde{p}]$can create the composite effect. The pollution tax rely on the size of population, per capita income, taste of consumers, then the pollution model can be written as:

$$\hat{E} = y_1\hat{S} + y_2\hat{K} - y_3\hat{I} - y_4\hat{N} - y_5\hat{\delta} - y_6\widehat{K.O} \quad (3)$$

Whereas $\hat{E}$ represents pollution, $\hat{S}$ represents the scale effect, $\hat{K}$ represents capital labour ratio which is also known as composition effect. Capital intensive goods generate more pollution. The other terms $\hat{I}, \hat{N}, \hat{\delta}$, shows the effects of changes in the pollution emission and known as technique effect. $\widehat{K.O}$ represents comparative advantage effect. Government impose strict pollution policies when the per capita income rises and it will result in rise in the demand of environmental quality, I> 0), increase in the size of population ($\hat{N}$>0) give rise to impose strict policies by government via Samuelson model[3]. Rise in pollution disutility ($\hat{\delta}$>0 may rise from the more knowledge about emission of pollution. It results in increase in pollution tax and the demand for environmental quality [Tayebi and Younespour (2012)].

The government adopts strict policies when there is rise in per income, pollution disutility and increase in the size of population in order to overcome pollution. Tayebi and Younespour (2012) further generalized the equation (3) by adding the domestic prices and world prices to examine the consequences of increased openness on pollution levels. Given a fixed price Pw, the domestic price can be written as:

$$p = \beta p^w$$

Whereas, β represents the measure of trade friction. In log form the above equation can be written as to allow for both trade friction and world prices to change;

$$\hat{p} = \hat{\beta} + \widehat{p^w}$$

Rewrite the emission equation (3) as;

$$\hat{E} = y_1\hat{S} + y_2\hat{K} - y_3\hat{I} - y_4\hat{N} - y_5\hat{\delta} - y_6\widehat{K.O} + y_7\hat{\beta} + y_8\widehat{pw} \quad (4)$$

According to equation (4) pollution in an economy may rise due to trade friction and world fixed prices. The value of β rises with trade openness for exporting the goods that produces more pollution and the value of β falls when importing the goods that are less polluted. Thus, when an economy has comparative advantage in dirty goods or world price($\widehat{pw} > 0$), the price of pollution intensive commodity increases. Given the pollution tax, rise in the price of good X increase the abatement cost and also increases the pollution. In opposite case where $\hat{\beta}$<0 for an economy having comparative advantage in clean good or world price ($\widehat{pw} < 0$), the response of an economy toward trade depends on the comparative advantage. This theory explains

[3] Samuelson model explains the relationship between relative prices of output and relative factor rewards specifically, real wage and return to capital.

the technique to determine the composition effect derive by trade openness. Comparative advantage is examined by the interaction of factor endowment and distinguishes in pollution policies (due to discrepancy in income per capita). Pollution policies are affected by income per capita.

Factor endowment theory assumes that capital intensive goods are exported by capital intensive economies. Pollution haven hypothesis is another theory of trade, according to this theory poor countries produce dirty goods and they have comparative advantage in dirty goods due to poor pollution policies, whereas rich countries have comparative advantage in clean goods, and they have tight pollution policies.

It has been shown that trade has an impact on the natural environment that changes with the comparative advantage of an economy. When we compare the economies that have identical per capita income and scale, we believe to find that trade openness related with greater pollution in economy with a comparative advantage in producing polluted goods and lower pollution in economy related with the clean goods. The outcomes show that when a country is rich than the impureness motive for trade exceeds the factor endowment and thus the country will export the clean goods. Likewise, when a country is capital intensive than factor endowment for international trade will exceeds the pollution haven motive and thus the country exports dirty good. This theory is possibly weak because it does not explain either rich or capital abundant, but it explains that these concepts functions for the whole distribution of both real per capita income and factor abundant in the world [Tayebi and Younespour (2012)].In the light of above discussion, following model from the equation (4) has been proposed:

$$E = f (S, T.E, K, O, K.O, FDI, N)$$

We have transformed all the variables into their natural logarithms following [Ling et al. (2015)]. The regression equation can be written as:

$$lnE_{it} = \gamma_0 + \gamma_1 lnS_{it} + \gamma_2 lnT.E_{it} + \gamma_3 lnK_{it} + \gamma_4 \ln K_{it}.O_{it} + \gamma_5 lnO_{it} + \gamma_6 lnFDI_{it} + \gamma_7 lnN_{it} + U_{it} \quad (5)$$

Where, E represents carbon dioxide emission, S is the scale effect, T.E denotes technique effect, K denotes composition effect, K.O represents the comparative advantage effect, O represents trade openness. We have included some other control variable from the existing literature in above model such as population density (N), and Foreign Direct Investment (FDI).

3. DATA AND EMPIRICAL RESULTS

We have collected 37 years of data from 1980 to 2016 on carbon dioxide emission E, real GDP, real GNP, trade openness, capital-labor ratio (K/L), Gross fixed capital formation is used as a proxy for capital and total labor force is used for labor, FDI, Population density, Area per square km for country Pakistan, India, Bangladesh, Sri Lanka. The data is taken from World Development Indicators (WDI) and International Monetary Fund (IMF). The construction of variables is reported in appendix.

To examine the impact of international trade on natural environment, the empirical investigation in this paper follows two steps. First step is to test the non-stationarity of variables. Prompted by the existence of unit root, we test for long run relationship between variables at the second step of estimation by using the panel ARDL technique proposed by Pesaran et al. (1999).

3.1. Panel Unit Root Result

The absence of I(2) variable is confirmed by using Im, Pesaran and Shin (IPS) test (2003) and Levin, Lin and Chu (LLC) test (2002). From Table 1, it can be observed that the null hypothesis of panel unit root can be rejected at level for foreign direct investment whereas other variables such as carbon dioxide mission (E), scale effect (S), technique effect (TE), composition effect (K), comparative advantage effect (K.O) and trade openness effect (O) are stationary at the first difference. So the data set comprises of mixture of I(1) and I(0) and there is no I(2) variable thus panel ARDL cointegration technique is appropriate to investigate the long run relationship among variables.

Table 1. Results of Panel Unit Root Test with Individual Intercept and Trend

Variable	Im, Pesaran & Shin (2003)		Levin, Lin & Chu (2002)		Order of Integration
	At Level	At First Diff.	At Level	At First Diff.	
Carbon dioxide	0.818	-3.306*	0.693	-2.331*	I(1)
Scale Effect	1.966	-3.544*	0.046	-2.313*	I(1)
Technique Effect	3.221	4.016*	0.8551	1.821***	I(1)
Composition Effect	0.497	-5.725*	0.304	1.845***	I(1)
Comparative Av. Effect	0.780	-4.559*	2.376	-2.185***	I(1)
Foreign Direct Inv.	-2.612*	-8.100	-1.878***	-5.877	I(0)
Population	-3.121*	-3.519	-5.446*	-4.855	I(0)
Trade Openness	1.223	-3.657*	2.452	-2.332*	I(1)

Note: and *** indicate the significance at 1% and 5% level.*

3.2. Panel ARDL Cointegration Results

The ARDL technique for cointegration analysis in the single equation model suggested by Pesaran et al. (1997; 2004), it has two steps for estimating the long run relationship. Firstly, it examines the existence of long run relationship between variables. If there is long run cointegration among variables, the next step is to investigate the long run coefficient through ARDL results. According to Pesaran et al. (1999), Panel ARDL is the intermediate technique that enables the short run

parameters to be distinguished among groups while applying equality on the coefficients of long run relationship among countries. The pooled mean group (PMG) has been proposed by Pesaran et al. (1999) in panel ARDL approach, it is best substitute to other estimations in panel data such as Dynamic OLS (DOLS) and Fully Modified OLS (FMOLS).

The benefit of PMG is that, it can enable the dynamic of short run specification that vary from country to country by constructing the same coefficients of long run. Contrary, the DOLS and FMOLS, the PMG estimator emphasize the adjustment dynamic among the long run and short run relationship. The purpose of supposing the short run dynamic and the error variance should be identical trend to be less compelling. While not applying the equality of short run slope coefficients enables the dynamic specification to be vary across countries. Therefore, the long-term relationship among international trade and environment is expected to be the same across countries but the short run coefficients are predicted to be country specific.

In panel ARDL the long run relationship among variables can be describe through standard log-linear function of ARDL-UECM model.

$$\Delta \ln E_{it} = \delta_0 + \delta_1 \ln E_{it-1} + \delta_2 \ln S_{it-1} + \delta_3 \ln T.E_{it-1} + \delta_4 \ln K_{it-1} + \delta_5 \ln O_{it-1} + \gamma_6 \ln k_{it-1}.O_{it-1} + \gamma_7 \ln FDI_{it-1} + \gamma_8 \ln N_{it-1} + \sum_{l=1}^{n1} \gamma_1 \Delta \ln E_{it-l} + \sum_{l=0}^{n2} \gamma_2 \Delta \ln S_{it-l} + \sum_{l=0}^{n3} \gamma_3 \Delta \ln T.E_{it-l} + \sum_{l=0}^{n4} \gamma_4 \Delta \ln K_{it-l} + \sum_{l=0}^{n5} \gamma_5 \Delta \ln O_{it-l} + \sum_{l=0}^{n6} \gamma_6 \Delta \ln K_{it-l}.O_{it-l} + \sum_{l=0}^{n7} \gamma_7 \Delta \ln FDI_{it-l} + \sum_{l=0}^{n8} \gamma_8 \Delta \ln N_{it-l} + v_{it} \quad (6)$$

3.3. Panel ARDL Results

Table 2 shows the long run results of Panel ARDL, the findings confirm that scale effect has significant and positive relation with pollution emission whereas technique effect has significant and negative relationship with pollution. The result reveals that while acquiring the economies of scale, 1% increase in scale effect will increase Carbon dioxide emission by 2.48%. When there is shift in economic transitions due to change in technology, the positive effect change into the negative effect, where 1% increase in technology will decrease the pollution emission by 2.29%. The results suggest that increase in the economic activity will increase the pollution emission and it can be overcome through income effect encourage modern technology to decrease pollution emission. The results are closer to Grossman (1991), Dinda (2006) and Copeland and Tylor (1994).

Population density has significantly positive relation with pollution. Comparative advantage has positive and significant relation with the pollution emission, 1% increase in comparative advantage effect will increase emission by 0.99%. The result suggests that comparative advantage affects the environmental quality, because of lacking technical competitiveness in directed markets due to outward shift of human capital and physical capital. Foreign direct investment has significantly positive relationship with pollution emission, 1% increase in FDI will increase pollution emission by 0.02%. When net inflow in the economy increases it will also increase the pollution emission. These results are similar to Copeland and Taylor (1994) and He (2006). Composition effect has significantly negative relation with carbon dioxide

emission. If we increase composition effect by 1%, it will decrease pollution emission by 0.80%. The result suggests that change in composition effect by using less capital abundant goods in the existence of technique effect decreases the pollution emission. These findings are consistent with Managi and Tsurumi (2010). Trade openness has significantly negative relation with carbon dioxide emission, 1% increase in trade openness will decrease pollution emission by 0.97%. Trade openness sufficiently supports change in technology, capital formation and economic development in South Asian countries. The long run policies are required to enhance the trade volume and to improve environmental quality.

Table 2: Long run Coefficients of Panel ARDL Model

Dependent variable: carbon dioxide emission (E)

Variables	Coefficient	p values
LNS	2.487**	0.004
LNTE	-2.294**	0.005
LNN	1.170**	0.001
LNKO	0.993**	0.001
LNK	-0.802**	0.001
LNFDI	0.020**	0.002
LNO	-0.974**	0.002

Note: All the variables are significant at 5% level of significant in long run relationship.

Table 3 shows the short run relationship between the variables. Result shows that current scale effect has significant and negative relation with the carbon dioxide emission, If there is 1% increase in scale effect, it will decrease the carbon dioxide emission by 1.98%, it shows that increase in economic activity will not degrades the natural environment in short run, whereas the scale effect of the previous year has insignificant relation with carbon dioxide emission. Technique effect of the current year has insignificant relation with carbon dioxide emission, whereas, the technique effect of the previous year has significantly positive relation with carbon dioxide, when we increase 1% in technique effect of the previous year, it will increase carbon dioxide by 0.41%. The results suggest that technological change enhances the pollution emission in short run. Population density has insignificant relation with carbon dioxide emission.

Comparative advantage effect of the current year has significant and negative relation with carbon dioxide emission, 1% increase in comparative advantage will decrease carbon dioxide emission by 0.65%, it shows that comparative advantage in clean goods may not affect the natural environment, whereas the comparative advantage of the previous year has insignificant relation with carbon dioxide emission. Composition effect of the current year and previous year has significantly positive

relation with carbon dioxide, 1% increase in composition effect will increase carbon dioxide emission by 0.92 and if we increase 1% in composition effect of previous year, it increased carbon dioxide emission by 0.72%. The results explain that adoption of more capital abundant means of production in the absence of modern technologies may enhances the pollution emission. These results are similar to Cole (2006). Foreign direct investment has insignificant relation with carbon dioxide in short run. Trade openness of the current year has significantly positive relation with carbon dioxide emission, it will increase carbon dioxide by 0.77%, the short run results reveal that trade openness do not supports the change in technology and capital formation, the trade policies in the short run enhances the trade volume may increases the pollution emission. These results are similar to Shahbaz etal. (2013) for Malaysia and Bangladesh, whereas trade openness for the previous year has insignificant relation with carbon dioxide.

Table 3: Short run Results for Overall Panel

Dependent variable: Carbon dioxide

Variables	Coefficient	p values
ECM	-0.525	0.003
D(LNS)	-1.988*	0.001
D(LNS(-1))	-0.611	-0.562
D(LNTE)	0.556	0649
D(LNTE(-1))	0.414	0.001
D(LNN)	-33.415	0.344
D(LNN(-1))	24.255	0.457
D(LNKO)	-0.659*	0.002
D(LNKO(-1))	-0.595	0.117
D(LNK)	0.924*	0.000
D(LNK(-1))	0.729**	0.052
D(LNFDI)	0.004	0.795
D(LNFDI(-1))	-0.003	-0.702
D(LNO)	0.775*	0.006
D(LNO(-1))	0.580	0.135
C	14.925	0.010

Note: and ** indicate the significance at 1% and 5% level.*

Furthermore, the coefficient of Error Correction Term ECM is -0.525, that shows the adjustment speed towards equilibrium and it has negative sign and significant at 5%

level. Therefore, the coefficient of ECM ascertained the adjustment speed is low, thus after a shock in economy, the deviation from long run equilibrium to short run is corrected by 52%.

Short run results for Pakistan are reported in Table 4. The overall results for short run relationship between international trade and environmental quality pointed out the negative relation between scale effect and carbon dioxide, comparative advantage effect and carbon dioxide emission, our short run results for Pakistan also shows the same negative relationship. Literature pointed the positive relation between technique effect and carbon dioxide, composition effect and carbon dioxide, trade openness and carbon dioxide, our results also confirm the same positive relation.

Table 4: Short run Results for Pakistan

Variables	Coefficient	p values
ECM	-0.588	0.000
D(LNS)	-0.924**	0.042
D(LNS(-1))	-2.037*	0.008
D(LNTE)	1.689*	0.002
D(LNTE(-1))	0.458*	0.001
D(LNN)	32.604	0.915
D(LNN(-1))	-12.852	0.953
D(LNKO)	-0.4141*	0.001
D(LNKO(-1))	-0.339*	0.001
D(LNK)	0.508*	0.002
D(LNK(-1))	0.345*	0.001
D(LNFDI)	-0.003*	0.001
D(LNFDI(-1))	0.013*	0.001
D(LNO)	0.434*	0.001
D(LNO(-1))	0.348*	0.001
C	16.572	0.538

Note: and ** indicate the significance at 1% and 5% level.*

Short run results for India are reported in Table 5. Accordingly, the relationship between international trade and environmental quality pointed out the negative relation between scale effect and carbon dioxide, comparative advantage effect and

carbon dioxide emission, our short run results for India also shows the same negative relationship. Literature pointed the positive relation between technique effect and carbon dioxide, composition effect and carbon dioxide, trade openness and carbon dioxide, our results also confirm the same positive relation.

Table 5: Short run Results for India

Variables	Coefficient	p values
ECM	-0.892	0.001
D(LNS)	-1.990***	0.076
D(LNS(-1))	-2.775	0.633
D(LNTE)	3.360	0.572
D(LNTE(-1))	0.097***	0.070
D(LNN)	-115.592	0.953
D(LNN(-1))	10.345	0.956
D(LNKO)	-0.669*	0.001
D(LNKO(-1))	-0.191*	0.001
D(LNK)	0.489*	0.001
D(LNK(-1))	-0.008	0.901
D(LNFDI)	-0.0178*	0.001
D(LNFDI(-1))	-0.005*	0.001
D(LNO)	0.715*	0.001
D(LNO(-1))	0.349*	0.001
C	28.963	0.841

Note: and *** indicate the significance at 1% and 10% level.*

In case of Sri Lanka (Table 6), the overall results for short run relationship between international trade and environmental quality pointed out the negative relation between scale effect and carbon dioxide, comparative advantage effect and carbon dioxide emission, our short run results for Sri Lanka also shows the same negative relationship. Literature also pointed the positive relation between composition effect and carbon dioxide, trade openness and carbon dioxide, our results also confirm the same positive relation. As far as relationship between technique effect and carbon dioxide is concerned, literature shows positive relation between the international trade and environmental quality but our results show that technique effect is negatively affects carbon dioxide in the current year.

Table 6: Short run Results for Sri Lanka

Variables	Coefficient	p values
ECM	-0.051	0.001
D(LNS)	-1.352**	0.138
D(LNS(-1))	1.049	0.737
D(LNTE)	-2.098	0.543
D(LNTE(-1))	0.718*	0.138
D(LNN)	-67.567	0.922
D(LNN(-1))	50.501	0.947
D(LNKO)	-1.247**	0.037
D(LNKO(-1))	-1.715*	0.009
D(LNK)	1.434*	0.009
D(LNK(-1))	1.693*	0.005
D(LNFDI)	0.050*	0.000
D(LNFDI(-1))	0.004*	0.004
D(LNO)	1.574**	0.048
D(LNO(-1))	1.695**	0.021
C	1.326	0.619

Note: and ** indicate the significance at 1% and 5% level.*

Lastly, in case of Bangladesh the results are reported in Table 7, accordingly short run relationship between international trade and environmental quality pointed out the negative relation between scale effect and carbon dioxide, comparative advantage effect and carbon dioxide emission, our short run results for Bangladesh also shows the same negative relationship. Literature also pointed the positive relation between composition effect and carbon dioxide, trade openness and carbon dioxide, our results also confirm the same positive relation. As far as relationship between technique effect and carbon dioxide is concerned, literature shows positive relation between the international trade an environmental quality, but our results show that technique effect is negatively affects carbon dioxide in the current year, whereas it has same positive relationship in the previous year.

Table 7: Short run Results for Bangladesh

Variables	Coefficient	p values
ECM	-0.569	0.000
D(LNS)	-3.686	0.260
D(LNS(-1))	1.319	0.831
D(LNTE)	-0.728	0.690
D(LNTE(-1))	0.383	0.613
D(LNN)	16.891	0.955
D(LNN(-1))	-42.969	0.922
D(LNKO)	-0.303*	0.001
D(LNKO(-1))	-0.135*	0.005
D(LNK)	1.262**	0.019
D(LNK(-1))	0.889**	0.047
D(LNFDI)	-0.013*	0.000
D(LNFDI(-1))	-0.025*	0.000
D(LNO)	0.376*	0.000
D(LNO(-1))	-0.070**	0.530
C	12.836	0.747

Note: and ** indicate the significance at 1% and 5% level*

3.4. Comparative Analysis of South Asian Countries

The scale effect has negative relationship with carbon dioxide in case of all selected South Asian countries; Pakistan, India, Sri Lanka and Bangladesh.When scale is increased, the pollution generated from that production, do not damages the environmental quality. It will be beneficial for the economy.

Technique effect has positive relationship with carbon dioxide emission in Pakistan and India as when modern technology is used and it produces the commodities which are toxic for environment creates more pollution in the country thus it has perverse impact on the natural environment. Moreover, there is negative relationship in case of Sri Lanka and Bangladesh as the modern technology produces less pollution while manufacturing of goods thus it would be beneficial for the economic development and do not degrades the environmental quality.

Composition effect has positive relationship with carbon dioxide emission in case of all selected South Asian countries; Pakistan, India, Sri Lanka and Bangladesh. This shows that adoption of capital abundant means of production in the absence of modern methods may enhances the carbon dioxide emission.

Comparative advantage effect has negative relationship with carbon dioxide emission in case of all selected South Asian countries including; Pakistan, India, Sri Lanka and Bangladesh. It shows that comparative advantage may not affect the environmental quality due to inward shift of human and physical capital. The results indicate that selected South Asian countries are developing countries, so their short run results are much related to each other.

4. CONCLUSION

The purpose of this study was to examine the effect of international trade on natural environment in selected South Asian Countries: Pakistan, India, Sri Lanka and Bangladesh over the time period from 1980 to 2016. This study focused in the first step on theoretical framework and later on development of trade and environment nexus that explains the decomposition of the international trade impact on pollution emission by decomposing scale, composition, technique effect and comparative advantage effect.

The panel ARDL results evaluated that international trade significantly impacts the environmental quality in the long run. The scale effect increases the carbon dioxide emission, but the technique effect reduces the carbon dioxide emission. The scale effect measures the increase in pollution emission that would be generated when the economy is scaled up keeping the composition and production technique constant. The positive coefficient of scale effect represents a positive effect of increasing GDP on pollution in the long run whereas the negative coefficients represents decreasing the pollution emission when the economy is scaled up. The technique effect shows the negative relationship with pollution emission. The negative coefficient of technique effect represents that South Asian countries could benefit from its trading earning. The composition effect is determined by a country's comparative advantage. When a country has comparative advantage in clean goods, thus clean industries expands with the trade and if the country has comparative advantage in dirty industry goods thus pollution intensive industries expands. The positive coefficient of composition effect represented by capital intensity has shown that South Asian countries have comparative advantage in dirty goods. The composition effect lowers the carbon dioxide emission but the comparative advantage adds in carbon dioxide emission in the long run, but in the short run when the international trade enhances and if the economy still have comparative advantage in pollution intensive industries the environmental quality will further decline as the pollution sector will increase at the expense of clean goods which will contract.

The coefficient of variables in short run of overall panel data set is negative and the error correction term is statistically significant. ECT determines the adjustment speed that shows the deviation from long run equilibrium to short run is corrected by 52%. In short run results for overall panel reveals that scale effect reduces the carbon dioxide emission whereas technique effect increases the carbon dioxide emission. The composition effect decreases the carbon dioxide emission, but comparative advantage effect adds in carbon dioxide emission.

The country wise short run results are much related to each other as scale effect decreases the carbon dioxide emission in all the selected South Asian countries; Pakistan, India, Sri Lanka and Bangladesh but the technique effect increases the carbon dioxide emission in Pakistan and India whereas technique effect reduces carbon dioxide emission in Sri Lanka and Bangladesh. The composition effect adds in the carbon dioxide emission in all selected South Asian countries whereas comparative advantage effect reduces the carbon dioxide emission in all selected

South Asian countries. The selected South Asian countries have approximate same results because all selected countries are developing countries.

This study provides the useful intuitions relating to international trade-environment nexus. The estimated model determines some policy applicability for policy makers. In context of policy implications, the findings of this study suggest that environmental quality lost due to scale effect and improved later because of technique effect. This approach suggested that the current environmental policies sufficiently decrease environmental consequence of economic development in South Asian countries in long run. However, the policy makers should focus on such policies which promote the use of environmental friendly technologies and efficient use of natural resources in the production.

The other channel shows the negative and favorable impact of trade on environmental quality comprises of scale effect and comparative advantage effect. This points out the issues, such as significance and constructive role of acknowledgment as well as economical and governance in boosting the environmental quality. Such features are required to be developed through policy formulations.

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Appendix:

Table A:Description of Variables:

Variable name	Proxy	Description	Unit
Environmental degradation	E	Emission of carbon dioxide	Metric ton per capita
Scale effect	S	Real GDP per square kilometer is proxy for scale effect	US$
Technique effect	TE	We observe the scale of economy within the country i-e GDP whereas the income related to technique effect indicate the income of a nation wherever it is attained i-e GNP. Hence we can use the difference between GDP and GNP measure to distinct technique effect from scale effect. The income variable I_t is the lag of three year average of y_t=GDP-GNP per capita .three year moving average is taken to smooth the business cycle variation. For year t, that is $I_t = (y_t + y_t + y_t)/3$, it captures technique effect.	US$
Composite effect (capital/labour ratio)	K	Capital-labor (K/L) ratio is composite effect. (Gross fixed capital formation is used as a proxy for capital and total labor force is used for labor).	__
Comparative advantage effect.	KO	Capital-Labor ratio and trade openness is comparative advantage effect. When there is reduction in trade barrier, the developed economies having tight environmental policies exchange the dirty goods to the developing economies with having not severe environmental policies, thus the production of these goods enhances pollution in the developing economies.	__
Foreign direct investment	FDI	Foreign Direct Investment relative to GDP.	Net inflows, percentage to GDP
Population density	N	Population density	Per square km of land area
Trade openness effect (export + import)	O	Real trade openness (export + import) is trade effect relative to GDP.	Percentage to GDP