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Is Pakistan Really a Pollution Haven Country?

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ABSTRACT

In this study, the Pollution Haven Hypothesis (PHH) validity has been tested for Pakistan and its impact on exports of Pakistan has been investigated as well. The PHH predicts that environmental regulations' variability among countries affects polluting industries location and trade flows. Autoregressive Distributed Lag (ARDL) or bound test of cointegration is used to investigate the short and long-run relationships. We found positive and statistically significant short-run and long-run relationships between CO2 (proxy for lax environmental policy) and FDI inflows. Finally, Trade Balance Index (TBI) of metal and mining, primary iron & steel, chemicals and rubber products does not support the PHH. While the pulp & paper and the textile industry validated the existence of pollution haven effect. We can conclude that PHH does exist for Pakistan and therefore such policies are needed that encourage FDI inflows that do not adversely affect the environment.

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1. Introduction

Inflows of FDI have increased almost in every region of the world but major trend is observed towards the developing countries (Ullah, Shah, & Khan, 2014). FDI inflows to Asian region increased to $541 billion in 2016 due to significant growth in the East and South Asian Economies (World Investment Report, 2016). FDI is like a doubled-edged sword for economies as if it enhances economic growth, labor productivity and innovation but also harms environment (Wang, Gu, David, & Yim, 2013). Many developing countries are already facing severe water scarcity, poor air quality and floods. The unchecked FDI inflows may further worsen environmental conditions (Gamso, 2018; Cole & Elliott, 2005). Conversely, some studies argue that an increasing level of FDI inflows reduce the air pollution by adopting more advance technology (Kirkulak, Qiu, & Yin, 2011).

Air quality in Pakistan is deteriorating due to increase in CO_2 emissions. The highest temperature recorded in Pakistan reached to 53.5 ^{0}C in 2017 causing many deaths (Ellis, Saifi & Martinez, 2015; Wasif, 2017). Annual cost of environmental degradation has increased to Rs. 450 billion (Ali, waqas & Ahmad, 2015). The gravity of the problem can be gauged from pattern of CO2 emissions and FDI in figure 1. The graph shows that CO_2 emissions in Pakistan have been showing an increasing trend over a period of time. Pakistan' emission per unit of output (emission intensity) is almost double of the average world intensity (Qureshi, 2006).

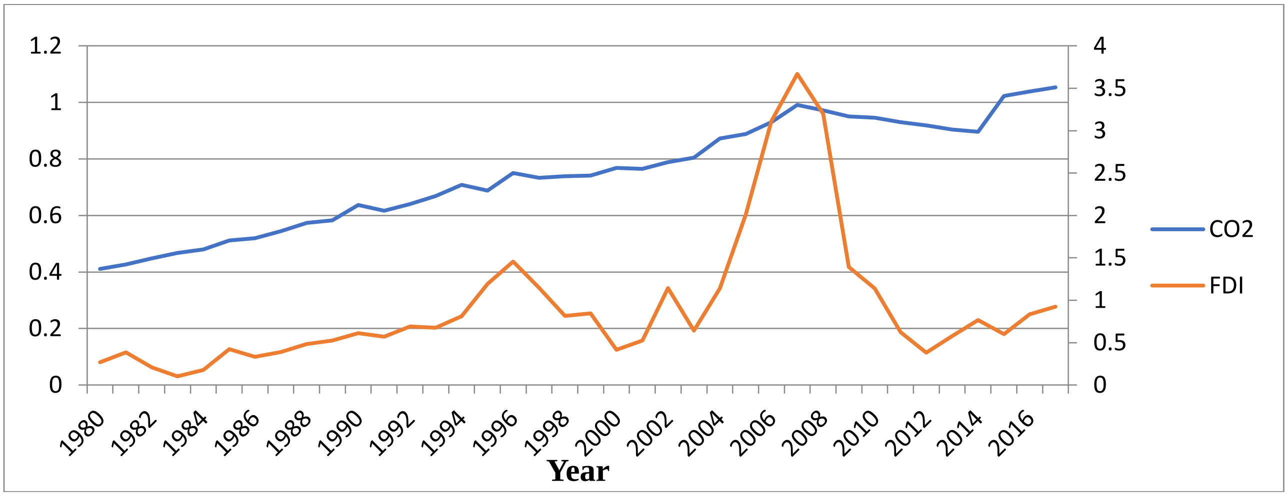

Figure 1: FDI and CO2 Emissions in Pakistan (Compiled from the World Bank, 2017).

In Pakistan, major investment has taken place in the polluted sectors of oil & gas, textile, construction, power, chemicals & transport (Board of Investment, 2018). A $33 billion investment in energy projects under the China Pakistan Economic Corridor (CPEC) of which some is based on coal is an environmental concern too. While exports are pre-requisite for economic growth, environment quality is also important for good quality of life. The larger FDI inflows coupled with the existing environmental deterioration in developing countries raise questions of pollution havens. To answer this question, this study empirically investigates the FDI-environment and trade-environment relations in case of Pakistan.

2. Literature Review

The nexuses between FDI and economic growth is explained through either endogenous growth theories (Romer, 1986) or the Environmental Kuznets Curve (EKC). Further related to FDI flows there are two prominent theories, the one is the Porter hypothesis and another is the pollution haven hypothesis (Baek & Koo, 2009). The empirical work on PHH has been generally with mixed results. Birdsall and Wheeler (1993) found contradictory results to PHH for Latin America. Levinson (1996) found that if state differences in environmental regulations are large, then pollution haven effect can be observed, however, if differences between states are very small then the pollution haven effect fades. However, Eskeland and Harrison (2003) reported that foreign firms are less polluted compared to domestic plants. Cole and Elliott (2005) used data of 59 developed and developing countries on FDI and found no evidence for PHH. Fan (2012) studied the FDI-investment decision in Chinese provinces based on enviornmental stringency and found no evidence that investor favor lax enviornmental enforcmemt. Keho (2015) used CO_2 emission as a proxy for measuring environmental pollution and no long run effect of FDI on country's environment was found. Contrary to the above, Aliyu (2005), Hoffmann, Lee, Ramasamy, and Yeung (2005), Beak and Koo (2008), Ridzune, Avazalipour, Zandi, Saberi, Hakimipour, and Damankeshideh (2013), Noor and Ahmad (2014), and Aliyu and Ismail (2015) reported the existance of the PHH. that pollution haven hypothesis existed.

3. Research Methods

Grossman and Krueger (1991) pioneered the work on PHH explaining the trade flows and environmental quality between the United States and Mexico. The Heckscher-Ohlin (H-O) and the factor endowment theories also provide a framework for trade-environment nexus and that how environmental regulations affect trade patterns and multinational investment decisions. These theories predict that country will specialize in production and exporting the products that uses the locally abundant factor. Also, they envisage environment to be treated as a productive resource and its assimilative and regenerative capacities as natural endowments. Therefore, jurisdictions with stricter environmental regulations may inflict additional cost on pollution-intensive sectors. However, such firms may relocate to the less stringent regions to gain comparative advantage (Ratnayake & Wydveled, 1998). Following the Kolstad (2011), we present the PHH as follows:

$$Y_i = \delta_i R_i + X_i \beta_i + \mu_{it} \qquad (1)$$

where Y_i is economic activity and could be exports, FDI or employment while R_i corresponds to environmental regulations, X_i is a matrix of other control variables and the last term μ_i is the error term. Based on Asghari (2012), Hassaballa (2014), Ratnayake and Wydeveld (1998), Sarmidi, Noor and Ridzuan (2015), Yoon and Heshmati (2017), and Zhang (2005) equation (1) can be represented as follows:

$$FDI_{it} = \delta_i Env_{it} + \beta_i X_{it} + \mu_{it} \qquad (2)$$

where FDI_{it} is the FDI inflow in Pakistan in year t in sector i and Env_{it} represents the environmental regulation, X_{it} is the vector of independent variables, while δ_i and β_i are the parameters to be estimated and μ_{it} is the random stochastic error term, and the subscript i denotes country while t is for time period. Equation (2) is further extended as follows.

$$FDI_{it} = \beta_0 + \beta_1 CO_{2it} + \beta_2 GDPGR_{it} + \beta_3 Lab_{it} + \beta_4 SKL_{it}$$
$$+\beta_5 CAP_{it} + \beta_6 ENG_{it} + \beta_7 OPEN_{it} + \mu_{it} \qquad (3)$$

The variables used in the estimation are summarized in the table 1 as follows:

TABLE 1: VARIABLES DESCRIPTION

Variable	Description
FDI	Foreign direct investment (% age of GDP)
CO_2	Carbon dioxide emissions (metric ton per capita) used as proxy of pollution level; High levels of CO_2 represent laxity of environmental standards. According to PHH, relationship between FDI and CO_2 must be positive.
$GDPGR$	Gross domestic product (% age annual growth rate) measuring the wellbeing of the country and market size. Based on previous literature and theories expected relationship between FDI and GDPGR is positive.
Lab	Labor force participation (% of total population) and expected relationship between FDI and Lab is positive
SKL	Gross secondary school enrollment used as a proxy for skilled labor
CAP	Gross capital formation (% age of GDP)

ENG	Energy import (% age of energy use) to reflect the energy availability and expected sign for this variable is negative
$OPEN$	Trade openness (export plus import as a proportion of GDP), more liberalize the trade is the more confidence the investor will have in this market.

Data on the relevant variables have been collected from the World Development Indicators (WDI) for 1980-2017 period. Covariates have been selected on the basses of Dunning 'eclectic' theory which states that FDI is attracted due to the reasons such as (a) location specific advantages which include availability of raw material at low cost, (b) advantages due exclusive ownership of certain assets such as technology, patents, trademarks and skills and (c) internalization advantage which protects them against the market failures. Lax environmental regulations offer location specific advantage (Ratnayake & Wydeveld, 1998).

Trade Balance Index (TBI) can be used to test the export competitiveness in polluting industries. A country specializes in export (as net-exporter) or import (as net-importer) in dirty products for group of products based on the TBI of Lafay (1992). This study used products that are classified as per the Standard International Trade Classification (SITC) specifically the 3-digit SITC Revision 2. TBI index is formulated as follows:

$$TBI_{ij} = \frac{(x_{ij} - m_{ij)})}{x_{ij} + m_{ij}} ------------(4)$$

where x_{ij}stands for exports and m_{ij} imports of country i for agroup of goods j. The TBI takes value from minus one to one. A negative value indicates that the country is "net-importer" and a positive one as "net-exporter".

4. Results and Discussions

Dickey & Fuller (1979, 1981) and Phillips & Perron (1988) tests are used to examine the stationarity of the time series data. Following the Engle and Granger (1987), Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests both with and without trend are provided in Table 2. The unit root test demonstrates that the labor force participation rate and gross domestic product growth rate are stationary at level while rest are stationary at first difference.

Table 2: ADF and PP Stationarity Tests

Variables	ADF methodology				PP methodology			
	Without Trend	Probability	With Trend	Probability	Without Trend	Probability	With Trend	Probability
FDI (%age of GDP)	-2.80	0.06	-3.05	0.13	-1.86	0.34	-1.85	0.66
CO_2 emission (MT/PC)	-1.65	0.44	-4.62	0.00	-0.74	0.82	-2.68	0.25
GDP (Annual Growth rate)	-3.89	0.00	-3.81	0.02	-3.85	0.00	-3.81	0.02
LAB (%age total population)	-4.78	0.00	-5.47	0.00	-4.80	0.00	-5.47	0.00
SKL (Gross Percentage)	-0.71	0.83	-2.90	0.17	-0.38	0.90	-2.86	0.18
CAP (%age of GDP)	-1.68	0.43	-2.62	0.27	-1.76	0.39	-2.69	0.24
ENG (%age of energy used)	-2.01	0.28	-2.87	0.18	-2.04	0.26	-2.33	0.41
Trade Openness (%age of GDP)	-1.71	0.41	-2.44	0.43	-1.77	0.38	-2.56	0.30
ΔFDI (%age of GDP)	-4.03	0.00	-3.98	0.01	-4.00	0.00	-3.95	0.02
ΔCO_2 emission (MT/PC)	-5.97	0.00	-4.11	0.01	-6.66	0.00	-6.48	0.00

ΔGDP (Annual Growth Rate)	-7.67	0.00	-7.70	0.00	-10.73	0.00	-16.57	0.00
ΔLAB (%age total population)	-9.87	0.00	-9.82	0.00	-19.99	0.00	-33.58	0.00
ΔSKL (Gross Percentage)	-6.32	0.00	-5.22	0.00	-9.52	0.00	-9.55	0.00
ΔCAP (%age of GDP)	-6.07	0.00	-5.98	0.00	-6.07	0.00	-5.98	0.00
ΔENG (%age of energy used)	-5.17	0.00	-5.12	0.00	-5.16	0.00	-5.10	0.00
ΔTrade Openness (%age of GDP)	-7.73	0.00	-7.78	0.00	-7.75	0.00	-7.84	0.00

Note: Δ indicating unit root at first difference.

ARDL bounds test developed by Pesaran, Shin & Smith, (1996) and Pesaran et al., (2001) does not require same order of integration for all the variables. This approach is even valid for *I*(0), or *I*(1) or even if some are *I*(0) and some are *I*(1). ARDL model based on equation (3) can be specified as follows:

$$\Delta FDI_t = \beta_0 + \sum_{i=1}^{q} \beta_1 \Delta FDI_{t-i} + \sum_{i=0}^{q} \beta_2 \Delta CO_{2t-i} + \sum_{i=0}^{q} \beta_3\, \Delta GDPGR_{t-i} + \sum_{i=0}^{q} \beta_4 \Delta LAB_{t-i} + \sum_{i=0}^{q} \beta_5\, \Delta SKL_{t-i} + \sum_{i=0}^{q} \beta_6 \Delta CAP_{t-i} + \sum_{i=0}^{q} \beta_7 \Delta\, ENG_{t-i} + \sum_{i=0}^{q} \beta_8\, \Delta OPEN_{t-i} + \partial_1 FDI_{t-i} + \partial_2 CO_{2t-i} + \partial_3 GDPPC_{t-i} + \partial_4 LAB_{t-i} + \partial_5 SKL_{t-i} + \partial_6 CAP_{t-i} + \partial_7 ENG_{t-i} + \partial_8 OPEN_{t-i} + \mu_t \text{------------------------------}(5)$$

where Δ represents first difference operator, $\beta_0$is a drift element, $\mu_t$is a white noise error term. The terms with summation show error correction for short-run estimates, while rest of the terms shows the long-run relationship. The first step in ARDL method requires a selection of optimal lag length. A lag length one had the lowest Schwarz information criterion (SC) value and thus selected. The second step entails the estimation of ARDL model and then computing of F-statistics using ARDL bound test methodology. Both the calculated F-statistics and its critical values are provided in Table 3. The F-statistic (4.33) is greater than the upper bound critical value (4.26), and the null hypothesis of no long-run associations is rejected.

Table 3: Testing the Long-Run Associations

Model	F-Statistic	
$FDI = f(C0_2, GDPGR, Lab, Skl, Cap, Eng, Open)$	4.33***	
Critical value Bounds		
Significance	**Lower Bound**	**Upper Bound**
1%	2.96	4.26
5%	2.32	3.50
10%	2.03	3.13

*** INDICATE 1% SIGNIFICANCE LEVEL

Table 4 reveals strong positive and statistically significant long run relationship between CO_2 and *FDI* inflows. The effect of *GDP* growth on *FDI* inflow, as expected, is positive. Also, *FDI* inflow is positively affected by energy imported (*ENG*), gross capital formation (*CAP*), trade openness (*OPEN*) and labor force participation rate (*LAB*), although insignificantly. The secondary school enrollment ratio (*SKL*) affects *FDI* inflow significantly at five percent which is contrary to the general expectation.

Table 4*: ARDL* Long-Run Estimation (Dependent Variable FDI)

Regressor	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
CO_2	7.6589	1.8163	4.2168	0.0003***
GDPGR	0.3151	0.1541	2.0447	0.0511*

Lab	0.0089	0.0425	0.2115	0.8342
SKL	-0.1064	0.0497	-2.1406	0.0419**
CAP	0.1288	0.1263	1.0197	0.3173
ENG	0.1315	0.0785	1.6742	0.1061
OPEN	0.0911	0.0603	1.5097	0.1432
C	-12.1214	4.1691	-2.9074	0.0074***

***, **, * INDICATE 1%, 5% AND10% SIGNIFICANCE LEVELS

Short-run error correction ARDL results are provided in table 5. In short-run there exists a positive and significant relation between CO_2 and *FDI* inflows as well. Similarly, *ENG* positively affects FDI inflow. GDP growth does not affect FDI inflow significantly. Unlikely in the long run, secondary school enrollment ratio affects *FDI* inflow in short run. Likewise, in the long run, trade openness, labor force participation rate, gross capital formation affects FDI insignificantly with positive signs in the short run. Highly significant error correction term with negative sign indicates the presence of long-run relationship with 45 percent speed adjustment from previous year's disequilibrium in *FDI* inflow to current year's equilibrium. No evidence of serial correlation and hetroscadasticity is found.

Table 5: Short-run ARDL Model (Dependent Variable Δ (FDI))

Cointegrating Form				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Δ(CO2)	3.4659	0.9652	3.5907	0.0013***
Δ (GDPGR)	0.0591	0.0476	1.2416	0.2255
Δ (LAB)	0.0041	0.0193	0.2113	0.8343
Δ (SKL)	0.0230	0.0283	0.8155	0.4222
Δ (CAP)	0.0583	0.0613	0.9513	0.3502
Δ (ENG)	0.0595	0.0315	1.8907	0.0699*
Δ (OPEN)	0.0412	0.0259	1.5867	0.1247
CointEq(-1)	-0.4525	0.1089	-4.1545	0.0003***
R-squared		0.886025		
Adjusted R-squared		0.842189		
Breusch-Godfrey Serial Correlation LM Test:				
F-Statistic= 0.065662		Probability = 0.7999		
Obs*R-squared= 0.96925		Probability = 0.7556		
Heteroskedasticity Test: : **Breusch-Pagan-Godfrey**				
F-Statistic=1.519100		Probability =0.1885		
Jerque Bera Normality Test				
Jerque Bera statistic = 4.1978		Probability = 0.1225		

***, **, * INDICATE 1% , 5% AND10% SIGNIFICANCE LEVELS

The ARDL model stability is tested using CUSUM and CUSUM square tests. Figure 2 and figure 3 shows plots of the CUSUM and CUSUM squares indicating that all coefficients of the model are stable.

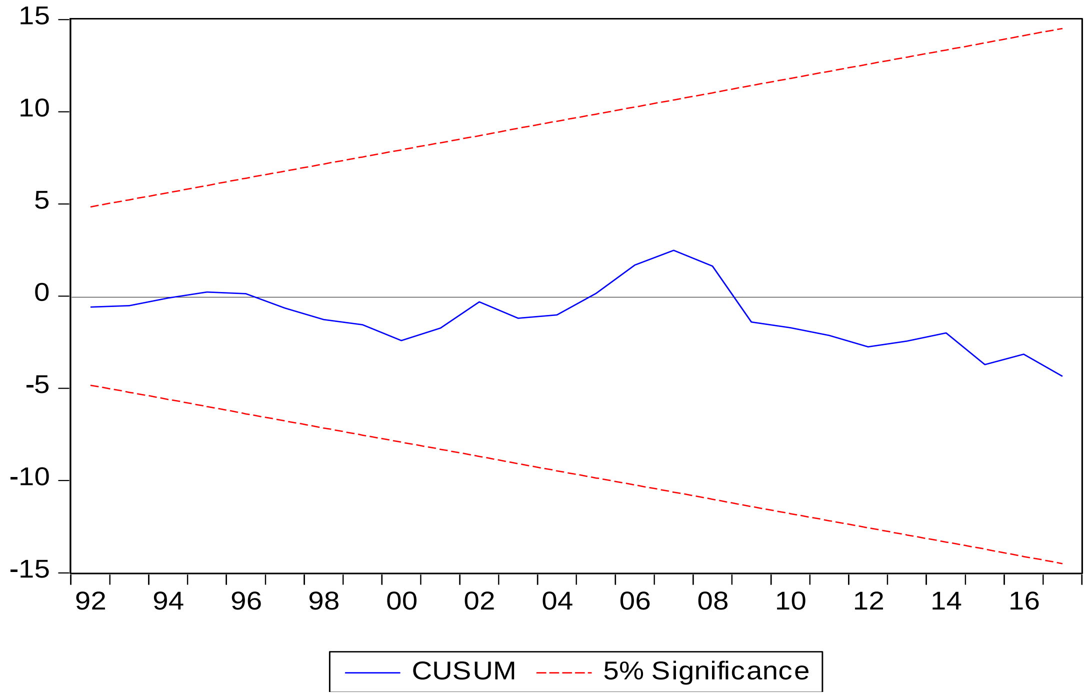

Figure: 2. Plot of CUSUM

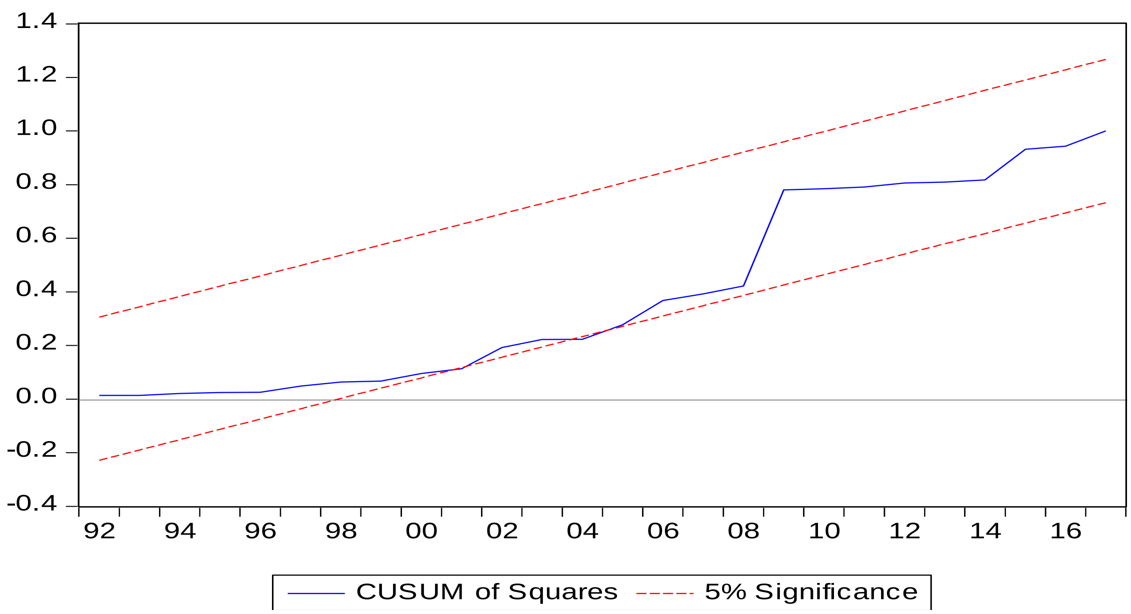

Figure: 3. Plot of CUSUMSQ

Table 6 exhibits the outcomes of Granger pair wise causality analysis between the variables. We find that CO_2 emissions granger causes FDI inflows and similarly the FDI inflows granger cause CO_2 emissions (Bi-directional causality). The results can be interpreted that on one side lenient environmental regulations (higher levels of CO_2 emissions) attracts the FDI while on another side FDI inflows are one of the major factors responsible for increasing level of pollutions. Results validate the unidirectional causality in case of GDPGR and FDI inflows running from GDPGR to FDI inflows. No casual evidence was found in case of labor force participation rate and foreign direct investment inflows. Skill labor granger causes FDI indicating that Pakistan's skill labor affects the foreign direct investment inflows. Causality from FDI inflows to gross capital formation exhibits that level of FDI affect the gross capital formation. Similarly, unidirectional causality was observed from energy imported to foreign direct investment inflows. Lastly, in case of openness and foreign direct investment no causality was found from either side.

Table 6: Pair wise Granger Causality Tests

Granger Causality Results			
	F-value	**Prob.**	**Result**
$CO_2 \rightarrow FDI$ $FDI \rightarrow CO_2$	5.84697 3.23312	0.0020*** 0.0280**	$CO_2 \leftrightarrow FDI$
$GDPGR \rightarrow FDI$ $FDI \rightarrow GDPGR$	2.30987 1.53678	0.0788* 0.2194	$GDPGR \rightarrow FDI$
$Lab \rightarrow FDI$ $FDI \rightarrow Lab$	0.13613 0.32434	0.9821 0.8929	$Nodirection$
$SKL \rightarrow FDI$ $FDI \rightarrow SKL$	3.32343 0.61702	0.0219** 0.6881	$SKL \rightarrow FDI$
$CAP \rightarrow FDI$ $FDI \rightarrow CAP$	0.83776 2.69508	0.5372 0.0479**	$FDI \rightarrow CAP$
$ENG \rightarrow FDI$ $FDI \rightarrow ENG$	2.14192 0.11800	0.0982* 0.9870	$ENG \rightarrow FDI$
$OPEN \rightarrow FDI$ $FDI \rightarrow OPEN$	0.55852 0.54038	0.7305 0.7436	$Nodirection$

***, **, * INDICATE 1%, 5% AND10% SIGNIFICANCE LEVELS

Sector wise per capita emission data is not available for Pakistan and therefore aggregate level data were used. To study the prediction of pollution haven hypothesis that FDI contributes to developing countries exports due comparative advantage in polluting products. This study uses Pakistan trade statistics for most polluting industries to find if Pakistan exports increase due to its lax environmental regulations. Table 7 shows the seven most polluting sectors of Pakistan along with the product codes. Furthermore, figure 4 shows calculated TBI values for the said products. Table 8 reports the unit root results of TBI. The TBI index of metal and mining, primary iron and steel, chemicals and rubber products does not support the pollution haven hypothesis because the value of TBI is between 0 and -1 which shows that Pakistan imports more as compare exports. While the pulp and paper industry provide evidence for the pollution haven effect as the TBI value reached to 1 in 1994 showing the country became net exporter and thereafter TBI value have been continuously increasing showing an increase in exports. Pulp & paper industry TBI has unit root so pollution haven does exist. The TBI values of textile industry from 1982 till 1996 shows Pakistan as net exporter of textile products with varying from 1997 to 2017. TBI values for textile industry has unit root which also validate the existence of pollution haven effect.

Table 7: Selected Pollution intensive industries of Pakistan

Industry	**Product Code**
Metal & Mining	281, 282, 287, 288, 289
Primary Nonferrous Metals	681, 682, 683, 684, 685,686, 687,689
Pulp & Paper	251, 641, 642
Primary Iron & Steel	671, 672, 673, 674, 675, 676, 677, 678,679
Chemicals	512, 513, 514, 582, 583, 584, 585
Textile	261, 262, 263, 264, 265, 266, 267, 268, 269
Rubber Products	621, 625, 628

Source: (Qureshi, 2006; Indriya & Widodo, 2011)

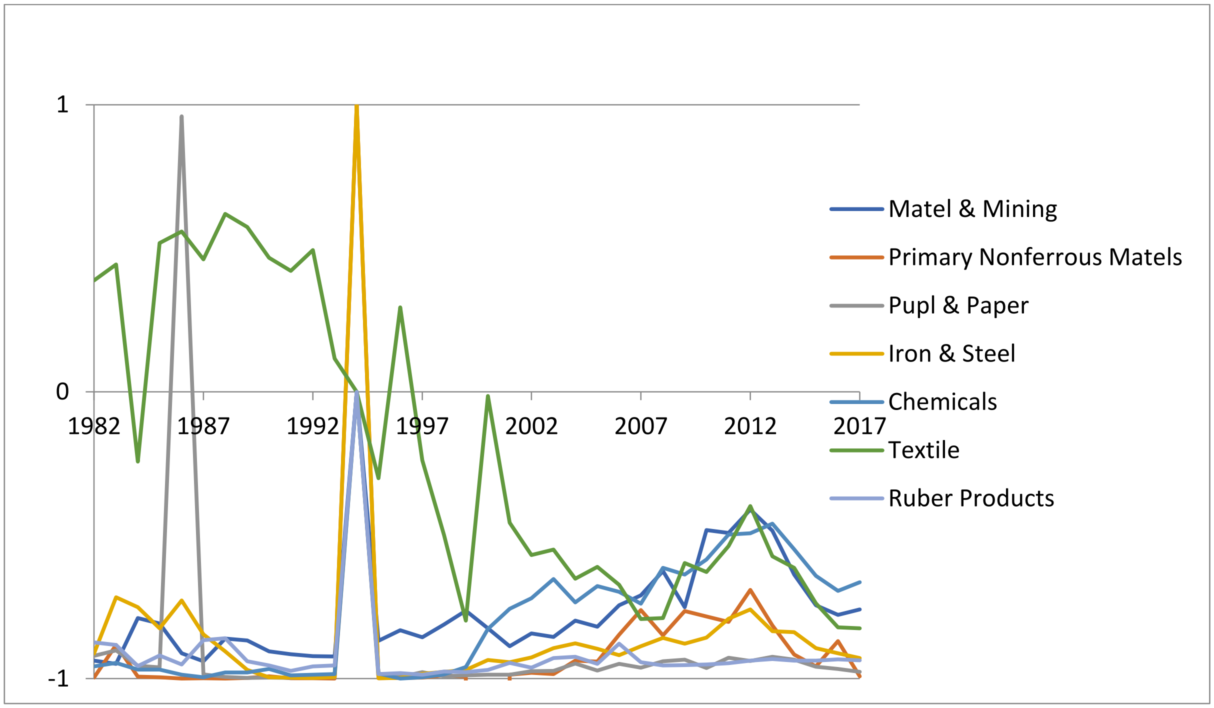

Figure 4: Pollution Intensive Industries Trade Performance, TBI values

Table 8: Unit Root Results of TBI

Unit Root Test of TBI		
Industry	t- values (Prob.*)	Decision
Metal and Mining	-4.4* (0.0013)	Stationary (does not support PHH)
Primary Nonferrous Metal	-5.92* (0.0000)	Stationary (does not support PHH)
Pulp and Paper	-2.30 (0.1777)	Has unit root (Confirm PHH)
Primary Iron and Steel	-6.3* (0.000)	Stationary (does not support PHH)
Chemicals	-3.7* (0.0084)	Stationary (does not support PHH)
Textile	-0.58 (0.8612)	Has unit root (Confirm PHH)
Rubber Products	-6.16* (0.0000)	Stationary (does not support PHH)

5. Discussions and Conclusions

This study investigated the pollution haven hypothesis which predicts that environmental regulations variability among countries or regions affect polluting industries location and trade flows. A positive and statistically significant relationship between CO_2 emissions and FDI inflows both in short-run, and long-run was found. Therefore, we can conclude that lenient environmental policy of Pakistan may attract polluting industries from other countries. Similar conclusions are drawn by Aliyu (2005), Acharyya (2009), Baghebo & Apere (2014), Hoffmann, et al. (2005), Hassaballa, (2014), Leslie (2016) and Ridzune, Noor & Ahmad (2014). We found weak evidence of pollution havens from exports side except for the textile, paper and pulp industries of Pakistan similar to the results of Akbostanci, Tunc, & Turut-Asik (2007), Indriya & Widodo (2011), and Qureshi, (2006). Pakistani government needs to invest in human capital and make their labour force more competitive and efficient to attract the foreign investment.

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