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Chakraborty, Debashis and Mukherjee, Sacchidananda

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Debashis Chakraborty[1*] and **Sacchidananda Mukherjee**[2]

* *Corresponding author*

1 *Assistant Professor, Indian Institute of Foreign Trade (IIFT), IIFT Bhawan, B-21, Qutab Institutional Area, New Delhi 110016, India. Fax: +91-11-2685-3956. E-mail: debchakra@gmail.com*

2 *Assistant Professor, National Institute of Public Finance and Policy (NIPFP), 18/2, Satsang Vihar Marg, Special Institutional Area, New Delhi – 110 067, INDIA. Telephone: +91 11 2656 9780; +91 11 2696 3421; Mobile: +91 9868421239; Facsimile: +91 11 2685 2548. E-mail: sachs.mse@gmail.com*

Abstract

The inter-linkage between economic openness and environmental repercussions is a widely researched area. The current study contributes in the existing pool of research by conducting a cross-country empirical analysis for the year 2008 by exploring the interrelationship between openness indicators (trade and investment) and environmental performance of a country. For this purpose, the analysis separately considers export orientation, import orientation, FDI inwardness and FDI outwardness of the countries in different variations of the proposed empirical model. The regression results do not provide strong support to the Pollution Haven Hypothesis (PHH). The findings also confirm a relationship between socio-economic and socio-political factors in a country and its environmental performance.

Keywords: Trade and Environment, International Investment

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 # - Views expressed in this paper are personal and do not reflect the official policy or position of the respective organizations of the authors.

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1. Introduction

Over the last couple of years, the globalization phenomenon in the world economy has deepened, with rise in the volume of trade and cross-border investment. It is observed from Figure 1 that while the global FDI figure was around US $ 1400 billion in 2000, the same increased to US $ 1697 billion in 2008, decreasing from a peak of US $ 1979 billion in 2007 on the face of recession. In line with the growing trade flows, the investment coming towards the developing countries and transition economies has also been on the rise in recent period.[1] On the other hand, the volume of international trade has increased from US $ 5.16 trillion in 1995 to US $ 16.07 trillion in 2008, as reflected from Figure 2. Like the case of investment, the proportional presence of the developing countries and LDCs in the world market has also increased over the period.[2] It is observed from WTO (2010) that in 2009 several developing countries are placed among the top 30 exporting countries, with China obtaining the highest rank in terms of trade share.[3]

While on one hand, the enhanced globalization opportunities played a major role in enhancing the growth potential across countries, it also created a debate whether the changing international trade and global investment pattern were really associated with cleaner environmental regimes. In particular, the last decade has been marked by growing global concern on environmental front, covering the areas like global warming, emission of greenhouse gasses etc. It has been observed that trade policy and climate change may not be entirely unrelated

[1] WIR (2009) reports that developing and transition jointly in 2008 accounts for around 43 percent of the total global FDI inflow.

[2] The share of Central and South America, Africa and Asia (excluding middle-east) in global merchandise exports has increased from 3.01 percent to 3.73 percent, 1.93 percent to 3.47 percent and 26.38 percent to 29.29 percent respectively over 1998 to 2008.

[3] Other developing countries gaining prominence in recent period include: South Korea (Rank 9), Hong Kong (Rank 11), Mexico (Rank 15), Taiwan (Rank 17), Saudi Arabia (Rank 18), UAE (Rank 19), Malaysia (Rank 21), India (Rank 22), Brazil (Rank 24), India (Rank 25) and Indonesia (Rank 30).

(World Bank, 2007). It is clear from the recent discussions at Copenhagen that the developed countries want the next onus of reform to be on the developing countries (ICTSD, 2010) especially the ones with rising global export share. However, do trade or cross-border investment flows necessarily emerge as a major determinant of environmental degradation (both local and global environment)? The evidence from the existing literature is however ambiguous.

The trade-investment nexus can potentially cause environmental repercussions in a country in the following manner. First, the developing countries in their zeal to boost export from their territory may compromise with their local environment in the short run by allowing production of industries which are environmentally damaging. In addition, trade in response to growing global demand may cause overexploitation of resources (e.g. fishing, forestry, mining activities) and ultimately lead to environmental degradation. On the other hand, the degradation of environment may not only originate from domestic production, but could also be fueled by foreign investment. The idea is that the developing countries / LDCs may choose to grow in the short run by attracting investment in polluting sectors by maintaining a lower environmental standard. The phenomenon is termed in the literature as 'Pollution Haven Hypothesis' (PHH) (Cole et al., 2008; He, 2006; Merican et al., 2007; Wagner and Timmins, 2008; Basel Action Network, 2007).

The ambiguity in trade-investment-environment nexus can be observed more closely from the cross-country scenario reported in Table 1. The environmental scenario in a country can be captured through its ranking in a composite index of environmental quality (or performance), viz., Environmental Performance Index (EPI), constructed by Center for International Earth Science Information Network (CIESIN), Columbia University. Export inclination and FDI attractiveness is measured by the share of the country in the global export market and FDI inflow respectively.[4] It is observed from the table that an LDC like Bangladesh has increased its share of global merchandise export, while its environmental performance has simultaneously worsened. A

[4] It is to be noted that the factors considered for EPI 2006 and EPI 2008 are not the same. Hence instead of EPI scores of the countries, their rankings are reported.

similar situation is noticed for developing countries like Brazil, China, India, South Africa and Thailand as well. On the other hand, the EPI ranking has gone down for developed countries like Japan, the UK and the US; though their share in global merchandise export declined over the period. Interestingly, another developed country France witnessed an increase in EPI over this period, which was associated with its declining share in global merchandise export.

The decline in EPI rankings of both developed as well as developing countries, associated with differing performances on the export front (i.e. trade) leads to an ambiguous conclusion on trade-environment nexus. One may argue here that the income level of a country perhaps play a more significant role in determining its environmental degradation. The existing literature predicts the presence of an inverted U-shaped relationship between the two ('Environmental Kuznets Curve' hypothesis). This relationship implies that environmental degradation (negative of EPI) goes up with income upto a point (shifting focus towards manufacturing), but improves afterwards (shifting focus towards services).

Figure 3 shows an inverted U-type relationship between per capita GDP (PCGDP) of a country and its environmental performance in 2008, which is opposite to the EKC hypothesis prediction. The particular shape is caused by the lower EPI score of the high-income countries like Kuwait and UAE. In other words, though relatively poorer countries are characterized by lower EPI score, income variable alone may not be able to fully explain environmental performance of a country (Mukherjee and Chakraborty, 2009).

Given this background, the current paper is organized along the following lines. First, the relationship between trade and environmental performance of the countries is explored, where export and import are considered separately, so as to understand the difference in the response pattern of the countries. Then the analysis focuses on the relationship between investment behaviour and environment, again analyzing inward and outward investment flows separately. Finally on the basis of the findings, a few policy conclusions are drawn.

2. Trade and Environment

The complex relationship between income and environment as shown in Figure 3 brings forward the question of the relationship between trade inclination and environmental sustainability in a country. The theoretical and empirical evidence on the interrelationship between trade opportunity and environmental sustainability however is not unidirectional and portray interesting variations across countries.

First, the urge to boost export may make a government overzealous, which might deplete the stock of natural resources. This effect could be particularly stronger in developing countries and LDCs who traditionally depend heavily on handful of primary export items. Secondly, the prevalence of relatively lax environmental standards in the developing countries and LDCs might motivate the firms from developed countries to shift their production activities with higher pollution potential in the former location. Thus developing countries specialise in dirty production while developed countries shift towards cleaner goods, but the resultant trade nevertheless leads to environmental degradation. On the other hand, the need to ensure compliance with stringent environmental conditions in developed countries for export often might force the developing countries and LDCs to improve the existing level of environmental standards which could possibly be aided by transfer of environment-friendly technologies. However, if the developed countries attempt to impose higher environmental standards on developing country exports as a trade policy tool, then it might lead to suboptimal outcome.

The first type of environmental problem as mentioned above was observed in Bangladesh during mid-1980s (UNEP, 1999), when the structural adjustment programme recommended by the World Bank and IMF was in full swing. To enhance shrimp export, Bangladesh introduced a combination of tax breaks and subsidy policies to further this objective. However, the policies finally led to environmental degradation and pressure on natural resources - rise in soil salinity and soil quality related problems; reduction in grazing land and loss of livestock; destruction of mangrove forests - and adverse effects on the cropping intensity, timing and crop mix under

arable farming. Similarly, given the high energy price, Peru has recently stepped up oil and gas exploration in the Amazonian forest, leading to loss of biodiversity (Finer et al., 2008).

The second type of environmental problem has been noticed after the formation of NAFTA, where a number of US firms within the polluting industries shifted their production facilities across the Mexican border (Gallagher, 2004). Kellenberg (2009) has also observed that US MNC production is negatively influenced by more stringent environmental policy. Similarly, growing pollution intensity can considerably explain Turkey's export pattern (Akbostanci et al., 2004). North-South trade in metal waste and scrap is also worth mention, where South processes the toxic wastes and the final product reaches the North. Ship breaking industry deserves particular attention here, with Alang (India), Chittagong (Bangladesh), Aliaga (Turkey) and Karachi (Pakistan) emerging as major hubs, thanks to the comparative advantage enjoyed through low labour cost and relatively lax environmental provisions.

One additional concern is that loss of biodiversity due to overexploitation of natural resources or depletion of the ozone layer by industrial chemicals in developing countries may not necessarily be caused by local players. The distortions created by subsidy regimes in the developed countries are to be equally blamed. For instance, the EU generally obtains the fishery 'Access Rights' from some African and other LDC countries on the basis of a mutually agreed upon payment. Generally the agreement limits the volume of fishing by the European vessels during a certain period. However, the vessels, aided by fuel and other form of operating cost subsidies, always potentially tend to overfish (Mbithi, 2006). The LDCs often lack the monitoring infrastructure, which compounds the problem. For instance, University of British Columbia research has revealed that fish stocks off West Africa have halved over the last three decades.

Trade may however contribute towards environmental sustainability by providing incentives to upgrade production conditions. For instance, it can be noted that in line with the demand for 'cleaner' and 'greener' technologies, the number of ISO 14000 certified firms across developing countries has gradually increased over the last decade. However, voluntary initiatives

in developing countries are rather limited as compared to their response to policies undertaken by the North. For example, the leather firms in India have upgraded their pollution abatement system and curtailed the use of carcinogenic and other harmful chemicals in the production process considerably since late nioneties, owing to the stringent environmental standards and sanctions imposed in the EU and the US (Chakraborty and Singh, 2005).

Though several economists have argued that trade policy instruments are second-best measures to further environmental goals, they still find rampant use in present settings.[5] For instance, the US unilateral prohibition on import of certain shrimp products from India, Malaysia, Pakistan, the Philippines and Thailand (WTO DS 58, 61) on the ground of harmful effects on sea turtles could be mentioned here. The argument presented in favour of the US action was that the countries, who have already internalized environmental costs (i.e., North), need to impose an environmental protection (tax / standard) on imports from a country which has not yet internalized (i.e., South) its environmental costs. The trade literature however indicates that more often than not environmental standard in developed countries is geared towards restricting the entry of developing country firms in their markets (Gandal, 2001). For instance, eco-labeling, which attempt to ensure that exports from a country are produced through an environment-friendly process, has recently emerged as a major barrier on exports of environmentally sensitive products from the developing countries.[6]

The experience of the EU and the US in this area would not be inappropriate here. For instance, in the US, the federal agencies have adopted nearly 2,500 private-sector standards, including voluntary consensus standards (WTO, 2006). Clearly the interest of the domestic players takes precedence over the environmental concerns. On the other hand, wide variation in

[5] In fact home country policy intervention may not always ensure a better environmental outcome. For instance, Indonesia imposed an export ban on logs in 1985, which was a success during initial years. However after a decade illegal logging activities created deforestation and threats of ecological imbalance (Dillion et al, 2006).

[6] Eco-labels create significant problems as they have the important distinction of focusing on production and process related criteria, which often do not affect the intrinsic characteristic of the end product. Moreover, the set criteria may reflect the environmental preferences of the developed country granting the eco-label but not those of exporting developing countries.

eco-labeling norms (standards and certification procedures) among EU Member States adversely affects the interests of developing country exporters. For instance, the stringency in aflatoxin B1 standard on groundnuts and varying pesticide residue regulations on Indian Darjeeling tea and coffee exports could be mentioned here (Otsuki et al, 2000). Chakraborty (2008) has also noted negative influence of stringent environmental standards on India's exports.

The trade-environment nexus can also be captured through the relationship between pollution abatement expenses and net imports. The theoretical linkage here is that a developed country may invest heavily in the polluting sectors in a developing country and import the final product within its territories. In the process the local population of the North escapes the exposure to pollution load at processing stage, while the burnt is borne by the South. Some credence to this thesis is obtained from existing empirical works. Studying US trade data from 1958 to 1994, Kahn (2003) has noted that while poorer, non-democratic nations are not US pollution havens, the pollution content of Africa's exports to the US are much higher than other continents. Levinson and Taylor (2004) have also noted that for the US net imports are positively related to abatement costs.

It is observed from the literature that socio-economic and socio-political factors like income, human development, corruption and democracy significantly influence environmental performance of a country (Mukherjee and Chakraborty, 2010). Several studies have reported the presence of a non-linear relationship between income and environment, i.e., the Environmental Kuznets Curve (EKC) hypothesis (Bruvoll and Medin, 2003; de Bruyn et al., 1998). Like the case of income, non-linearity is observed between environment and human development as well (Jha and Bhanu Murthy, 2001). Democracy is generally found to positively influence environmental achievement of a country (Bernauer and Vasiliki, 2004; Morrison, 2009), though some studies report that this relationship may not necessarily hold all the times (Kelso, 2006). Similarly corruption is generally found to be negatively influencing environmental sustainability of a country (Welsch, 2004; Winbourne, 2002), although a section of the literature argues that corruption may not be environmentally destructive in a general sense (Robbins 2000). Given this

relationship, these four variables have been included as control variables in the regression analysis.

The current study is estimating variants of the following models:

$$EPI08SCR = \alpha + \beta_1 EX08 + \beta_2 EX08\text{^}2 + \beta_3 PCI08 + \beta_4 DISCORE07 + \beta_5 HDI07SCR + \beta_6 CPI08 + \varepsilon$$

….. (1)

and,

$$EPI08SCR = \alpha + \beta_1 IM08 + \beta_2 IM08\text{^}2 + \beta_3 PCI08 + \beta_4 DISCORE07 + \beta_5 HDI07SCR + \beta_6 CPI08 + \varepsilon$$

….. (2)

The full form of the variables and their source are provided in the following.

3. Investment and Environment

Given the close linkage between trade and investment in recent period, FDI may have considerable influence on environment. On one hand, 'Pollution Haven Hypothesis' (PHH) in trade literature indicates that the developed countries may attempt to virtually shift their 'dirty' industries to countries characterized by relatively weaker environmental standards / policy by enhancing FDI flow in those sectors. Several empirical analyses note that location decisions of MNCs are influenced by environmental stringency, though the degree of association between the two varied from country to country. On the other hand, FDI may facilitate adoption of modern technologies in the production process and ensure better knowledge transfers, through labour training, skill acquisition, introducing alternative management practices etc. (Acharyya, 2009).

China being the leading inward destination of FDI, a number of empirical studies has tried to estimate their environmental implications. Several studies have confirmed the adverse implications of FDI inflow on Chinese environment, i.e., existence of the PHH phenomenon (Cole et al., 2008; He, 2006). However, the working of the PHH phenomenon in the Chinese context has been rejected by certain studies as well (Rock, 2002; Temurshoev, 2006). The ambiguity in the

literature on relationship between FDI and environment in China has prompted several studies to differentiate the source and destination of FDI to understand the underlying factors. Dean et al. (2004) observed that FDI coming to China from Southeast Asian developing countries are generally motivated by weaker environmental levies prevalent in Chinese provinces. On the other hand, joint ventures from developed countries (e.g., US, UK and Japan) are found to be attracted by stronger environmental levies, regardless of the pollution intensity of the industry (Dean et al, 2004). Wang (2002) also showed that FDI coming to foreign-owned and community-owned companies are engaged in cleaner production patterns, while state owned and privately owned enterprises are leading to environmental disaster (Hua, 2002).

Thanks to the 'Flying Geese' model, a number of Southeast Asian economies have developed though huge inflow of FDI since the eighties. While the growth effect of the investment is widely acknowledged, the short run compromise on environmental front may not be ruled out. It was observed that FDI inflow from the OECD countries intensified pollution in Malaysia, Thailand, and the Philippines (Merican et al, 2007). Countries like Papua New Guinea, the Philippines and Indonesia had lowered their environmental standard for inviting FDI in mining sector (CUTS, 2003). Though PHH phenomenon is rejected for India (Mukhopadhyay 2004; Jena et al 2005; Mukhopadhyay and Chakraborty 2005; Dietzenbacher and Mukhopadhyay 2007), an increase in India's export of polluted products has been reported (Chattopadhyay, 2005).

The presence of PHH in Latin America has also been an area of extensive research. Citing the experience of Chile, Birdsall and Wheeler (1993) noted that elimination of barriers on import of new technology from abroad and the same on FDI inflow also leads to importation of industrial country pollution standards, which results better environment. A similar observation has been made by de Almeida (2008) with respect to Brazil. However, Jenkins (1998) noted that evidence on lower pollution intensity in Latin America in the phase of external sector reform is ambiguous.

The political economy angle of the interrelation between FDI, governance and environmental decisions has been another widely researched area (Fredriksson et al, 2003). It has

been empirically observed that at high (low) corruption levels, FDI leads to less (more) stringent environmental policy (Cole et al, 2006). In other words, after entering a less stringent location, MNCs may attempt to reduce the environmental obligations further.

However, it has been reported by some studies that FDI brings in best environmental practices, adoption of cleaner norms and energy efficiency (Prakash and Potoski, 2006). Smarzynska and Wei (2001) noted that evidence on PHH is at best weak in several countries. Analyzing the NAFTA experience, Grossman and Krueger (1993) argued that environment may not be the only reason for Mexico to attract US capital in post-bloc phase and the consequent greater access to US market has been beneficial for it.

The interrelationship between FDI outflow and PHH has been another interesting research question in the trade literature. The idea here is that the polluting production activities are undertaken in the South as a result of which pollution decreases in North. Like the case of FDI inflow, the empirical evidence has however been ambiguous. For instance, analysis of FDI outflow from German manufacturing sector reveals robust evidence of PHH for the chemical industry (Wagner and Timmins, 2009). A similar confirmation on US FDI outflow and PHH has been observed by other studies (Xing and Kolstad, 2002). List and Co (2000) also noted that location decisions of firms are influenced by environmental stringency. Interestingly, while Kirkpatrick and Shimamoto (2005) have showed that Japanese outward FDI usually is not going towards 'dirtier' locations, Basel Action Network (2007) has blamed Japan for pushing 'toxic' exports through regional trade agreements. A similar finding on dirty' FDI outflow for several OECD countries has also been reported (Aminu, 2005). On the other hand, Eskeland and Harrison (2003) noted that the US factories in foreign countries adopt cleaner energy usage policy as compared to local plants.

Given this background, the current study is estimating variants of the following models for estimating the relationship between investment and environment:

$$EPI08SCR = \alpha + \beta_1\ FDIIN08 + \beta_2\ FDIIN08\text{^}2 + \beta_3\ PCI08 + \beta_4\ DISCORE07 + \beta_5\ HDI07SCR + \beta_6\ CPI08 + \varepsilon$$

….. (3)

and,

$$EPI08SCR = \alpha + \beta_1\ FDIOUT08 + \beta_2 FDIOUT08\text{^}2 + \beta_3 PCI08 + \beta_4 DISCORE07 + \beta_5\ HDI07SCR + \beta_6\ CPI08 + \varepsilon$$

….. (4)

4. Data

The present analysis attempts to identify the influence of trade and investment behaviour of the countries on their overall environmental performance through a cross-section analysis. In accordance with availability of latest data, 2007-08 has been taken as the period of analysis. The data series used for the current analysis has been obtained from various reports, published by academic forums as well as international and multilateral agencies. A total of 166 countries, for which data on the environmental, trade, FDI and socio-economic and socio-political achievements in the recent period are obtainable, are considered for the analysis.

It has generally been accepted that a composite environmental index properly summarizes the environmental condition of a country, and is more meaningful as compared to individual pollution indicators (Esty et al, 2005; Jones et al., 2002). In line with this practice, the current study measures environmental achievement through the data on Environmental Performance Index from 'Environmental Performance Index 2008' by Esty et al (2008), published by Yale Center for Environmental Law and Policy. Higher EPI Score for a country implies better environmental quality. Switzerland is at the top position in the EPI scale with a score of 95.5, while Niger is placed at the bottom with a score of 39.1.

Outward orientation in merchandise trade is proxied by expressing export and import of a country as a percentage of its GDP. The data is obtained from World Development Indicator

online database.[7] The data shows that Singapore (234.34) and Hong Kong (212.46) have high export-orientation (as measured by export of goods and services as percentage of GDP), while Central African Republic (10.81) and Haiti (11.09) have low export orientation. On import front, Singapore (215.27) and Hong Kong (201.63) also have high import orientation while Brazil (14.17) and Venezuela (20.24) have low import orientation.

Similarly, external orientation in investment is measured by expressing direct inward and outward flow of Foreign Direct Investment (FDI) in a country as percentage of its GDP. The data is obtained from UNCTAD Statistics.[8] Guinea (31.38) and Hong Kong (29.24) have high FDI inward-orientation (FDI Inflow as percentage of GDP), while Iceland (-16.94), Suriname (-9.38) has low FDI inward-orientation. On the other hand, Liberia (45.85) and Hong Kong (27.81) are marked with high FDI outward-orientation while Iceland (-45.61) and Luxembourg (-45.53) are characterized by low FDI outward-orientation.

Per capita gross domestic product based on purchasing-power-parity (PPP) at current international dollar is taken as the income variable, and the data is obtained from the World Economic Outlook database of International Monetary Fund.[9] The data shows that Qatar (84,350.427) and Luxembourg (81,989.704) have high Per Capita Income and Democratic Republic of Congo (328.68) and Zimbabwe (337.219) are marked by low Per Capita Income (as measured by Per Capita GDP in PPP International Dollar).

The data on Human Development (HD) is accessed from the 'Human Development Report 2009'), published by the UNDP (2009). The HD parameters considered here for constructing the ranking include income, health profile and education achievements. It is observed from the report that Norway is at the top of the list with a score of 0.971, while Niger is at the bottom with a score of 0.34.

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7 World Development Indicator (http://data.worldbank.org/)

8 UNCTAD Online Database on Foreign Direct Investment (http://stats.unctad.org/fdi)

9 World Economic Outlook Database, April 2010 (http://www.imf.org/external/pubs/ft/weo/2010/01/weodata/index.aspx)

The data on political freedom of a country (i.e., democracy index) has been obtained from the Economist Intelligence Unit's (EIU) 'Index of Democracy 2008' report. Higher DI score secured by a country implies that it is characterized by a more democratic political framework. Sweden tops the list with a score of 9.88, while North Korea with a score of 0.86 is located at the bottom.

The effect of corruption in a country is measured through the 'Corruption Perceptions Index' for the year 2008, taken from 'Global Corruption Report 2009: Corruption and the Private Sector', published by Transparency International (2009). Higher score obtained by a country in the ranking analysis denotes a less corrupt society. Denmark tops the list with a score of 9.3, while Myanmar is located at the other extreme with a score of 1.3.

The short forms of the variables considered in the regression models of the current analysis are presented below:

EPI08SCR	Environmental Performance Index 2008 Score
EX08	Export of goods and services as percentage of Gross Domestic Product (GDP)
IM08	Import of goods and services as percentage of GDP
FDIIN08	Direct investment in reporting economy (FDI Inward Flow) as Percentage of GDP
FDIOUT08	Direct investment abroad (FDI Outward Flow) as Percentage of GDP
PCI08	Per Capita Gross Domestic Product 2008 (PPP International Dollar)
HDI07SCR	Human Development Index 2007 Score
DISCORE	Democracy Index 2008 Score
CPI08	Corruption Perceptions Index 2008 Score

5. Results

Table 2 summarizes the regression results obtained from various versions of equation 1. It is observed from model 1 that if only first order terms of export orientation (EX08) and income

(PCI08) are considered, EX08 is found to be statistically non-significant. However, model 2 shows that when second order term of export (EX08^2) is included in the analysis, EX08 is found to be statistically significant, while EX08^2, the coefficient of which bear a negative sign, is not. The result indicates that with rise in export orientation of a country, its environmental quality increases. It is further observed from model 3 that inclusion of PCI08 among the independent variables makes EX08^2 significant, but with a negative coefficient. Hence inclusion of income brings out the non-linearity in the relationship between export orientation and environment. It is observed from models 4, 5 and 6 that human development positively influences EPI08SCR, but democracy and corruption do not significantly influence the same. Interestingly, the coefficient of corruption is negative, though insignificant, which implies that environmental quality may deteriorate with rise in corruption. The obtained result does not support the PHH framework.

The diagrammatic representation of the finding is presented in Figure 4. It is observed from Figure 4 that a one-to-one correspondence exist between export orientation and environmental performance, and the linear relationship suggests that the countries characterized by lower export orientation are marked by lower EPI score as well.[10]

Table 3 summarizes the regression results obtained from various versions of equation 2. The results from models 1 and 2 show that import orientation (IM08) does not significantly influence EPI08SCR. It is found from model 3, which includes income (PCI08) and second order term of import inclination (IM08^2), IM08 is found to be statistically significant with a positive coefficient, while the same of IM08^2 bear a negative sign. The result indicates that with rise in import orientation of a country, its environmental quality increases, but at a decreasing rate. It is further observed from models 4, 5 and 6 that human development and democratic settings positively influences EPI08SCR. In other words, presence of democratic political framework as well as increasing awareness about health concerns through growing literacy might lower the possibility of degrading the environment through increased import of hazardous items like waste

[10] It needs to be mentioned here that there exist a liner relationship between PCGDP and export inclination as well. In other words, richer economies are understandably more outward oriented.

and scrap etc. Like the case of export orientation, the coefficient of corruption is found to be negative, which implies that environmental quality may deteriorate with rise in corruption. However the coefficient is statistically non-significant.

The diagrammatic representation of the relationship between environment quality and import orientation is presented in Figure 5. It is observed from the Figure that the countries characterized by lower import orientation are marked by lower EPI score as well.[11]

Table 4 summarizes the estimation results on the relationship between FDI inflow and environmental quality of a country obtained from various versions of equation 3. The results from models 1 and 2 show that FDIIN08 or FDIIN08^2 are not significantly influencing EPI08SCR. However, inclusion of income, make FDIIN08^2 statistically significant with a negative sign. However, inclusion of other explanatory variables like democracy, human development and corruption levels of a country in the later versions of the model cannot make FDIIN08 terms statistically significant, but coefficients are always with negative sign. The results indicate that FDI inflow might cause environmental degradation, unless necessary policies are adopted by a country. The saving grace is that human development and democratic settings positively influences EPI08SCR. However the coefficient of corruption is found to be statistically non-significant. Though the obtained result may not conclusively confirm existence of PHH phenomenon, the potential concern becomes obvious.

The interrelationship FDI inflow and EPI of a country is analyzed with the help of Figure 6. It is observed from the figure that a negative relationship between the two is emerging. The negativity is caused by the presence of countries like Angola, Guinea and Djibouti, characterized by low EPI ranking but high FDI inflow.

[11] It needs to be mentioned here that there exist a liner relationship between PCGDP and export inclination as well. In other words, richer economies are understandably more outward oriented.

Table 5 summarizes the regression results on the relationship between FDI outflow and environmental performance from various versions of equation 4. As expected FDI outflow is higher from the richer economies, also characterized by higher human development and better democratic framework. It is observed from model 2 that the coefficients of both FDIOUT08 and FDIOUT08^2 are found to be positive and statistically significant. The positive slope of FDIOUT08^2 is an interesting observation, which indicates increasing environmental quality as a result of outflow. The results actually provide the mirror image of the findings from the earlier analysis. While FDI inflow may cause environmental degradation is a country owing to hazardous industrial production taking place in the South, outward investment takes away that risk from the North. However, the value of R^2 in model 2 is found to be much lower. Interestingly, the coefficients of FDIOUT08 and FDIOUT08^2 are found to be negative in models 3, 4 and 5. However, the coefficients are not significant.

Figure 7 shows the relationship between FDI outflow of a country and its EPI, which is positively sloped and non-linear. In other words, the more is the outward FDI flow for a country, the higher is the environmental sustainability.

Interestingly while the analysis with trade does not support PHH (i.e., export and import not leading to environmental degradation), the examination of investment flows provides a weak support for the same (i.e., investment leading to environmental degradation). The result looks conflicting on the face of it, but reflects real world scenario closely. For instance, the complex relationship between trade, investment and environment can be explained with the recent FDI inflow from developed countries to developing countries in agribusiness, as reported by WIR (2009). The major recipients of the investment include developing countries and LDCs like Cambodia, Lao PDR, Ecuador, Tanzania, Peru, Malaysia etc. The investment comes not only in food crops, but also for bio-fuel (e.g., *Jatropha curcas* L.) cultivation. Now the idea here is that the developed countries would import the food crop and as a result trade in that category should rise. Hence the relevant SPS conditions (e.g. HACCP and the other relevant ones) are expected to be fulfilled by the developing country cultivator as far as trade is concerned. In addition, the

foreign investment is likely to enhance agricultural productivity, aided by technological improvements and research and development support, given the otherwise low level of capital formation in agriculture in the South. However, it may also lead to efforts for creation of higher export surplus and consequent water and other natural resources exploitation in the developing country. Hence the overall environmental implication of this FDI flow and the resultant trade dynamics would depend on the relative strengths of the two effects in a particular country, and can not be predicted *a priori*. The results of the current analysis perhaps highlight that ambiguity.

6. Conclusion

As observed from the earlier discussions, the interrelationship between trade, investment and environment is not unambiguous. Often the developed countries are found responsible for increase in production of polluting products in the South. Given this background, the optimality of using trade policies (i.e. higher environmental standards) in the North to further environmental objectives is questionable. The concern comes especially from the fact that higher standards imposed by developed countries always increase profitability of domestic firms; while reducing the same for firms located in developing countries (Ganslandt and Markusen, 2001).

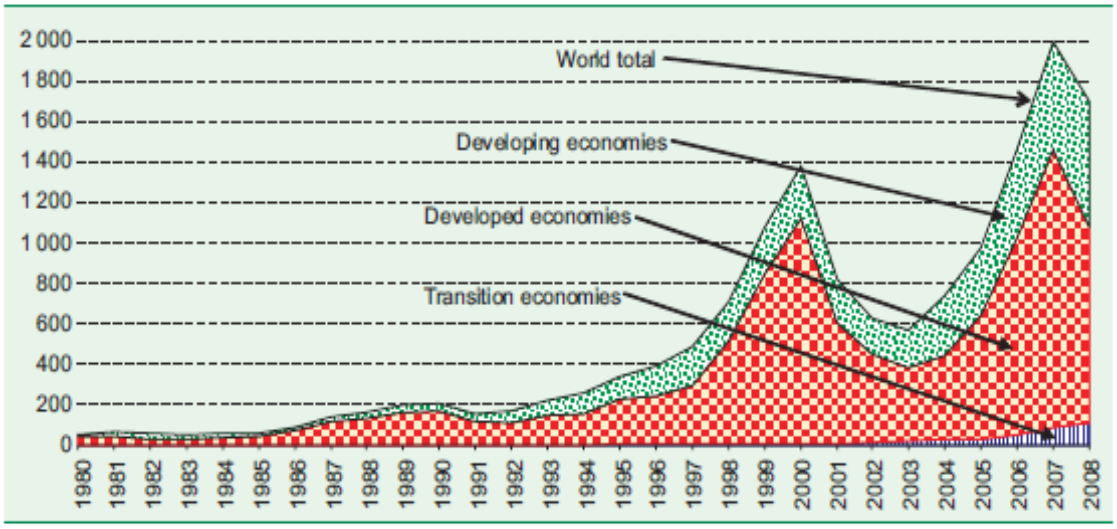
The strategic influence of environmental standards on trade often results into price correction on environmental ground, adversely affecting terms of trade for the South. It is argued that the environmental tax on pollution-intensive sector increases the price of the exportables, the mirror image of which implies that poor environmental standard acts as an export subsidy. Using this logic, the developed countries often impose price correction on developing country exports. For instance, leather export from Bangladesh to Europe or flower export from India to Japan gets lower price on the ground of the prevailing lower environmental standard (RIS, 2003). This is a way might play a crucial role in forging a positive relationship between trade and environment.

The trade literature also provides evidence on presence of duplicative and discriminatory testing and certification requirements in developed countries, which act as a substantial barrier to trade as far as the South is concerned. The standards often go beyond 'necessary scientific' measures and the time provided to developing countries for adjusting is often not adequate. For instance, in 1997, US Food and Drug Administration (FDA) decided to implement Seafood Hazard Analysis and Control at Critical Points (HACCP), and a very short notice was provided to the Indian players for ensuring compliance. According to the procedure, Indian exporters eying the US market must undertake HACCP analysis; implement Sanitation Standard Operating Procedure (SSOP) and the Current Good Manufacturing Practice (CGMP), as the US importers need to source the product only from a country implementing HACCP (Henson et al, 2004). Similarly it has been noted that the new EU regulation, "Registration, Evaluation, Authorisation and Restriction of Chemical substances" (REACH) could potentially hurt the interest of developing country exporters. These consequent compliance requirements could be cited as the reason why export is found to be positively related to environmental performance in the current empirical analysis. FDI on the other hand, still seeks a market characterized by relatively less stringent environmental regulations. This typical difference between export compliance and investment behavior has been reflected in the regression results.

One major problem for developing countries is that transfer of environmentally sound technologies and processes (ESTPs) is imperfect, given the absence of the 'market'. In general, the patent right holders set the price, based on their legal right to exclude all competition for their product or technology for a limited period of time, which limit the ability of developing countries to upgrade their production capacity. India for instance has proposed to the WTO that ESTPs should not be made obligatory until these items are freely available (GOI, 1997). If smooth transition of 'green' technologies can be ensured, trade barriers faced by the South would go down. The challenge for the developing countries therefore is to enhance trade in environmentally-sensitive categories, simultaneously maintaining environmental sustainability.

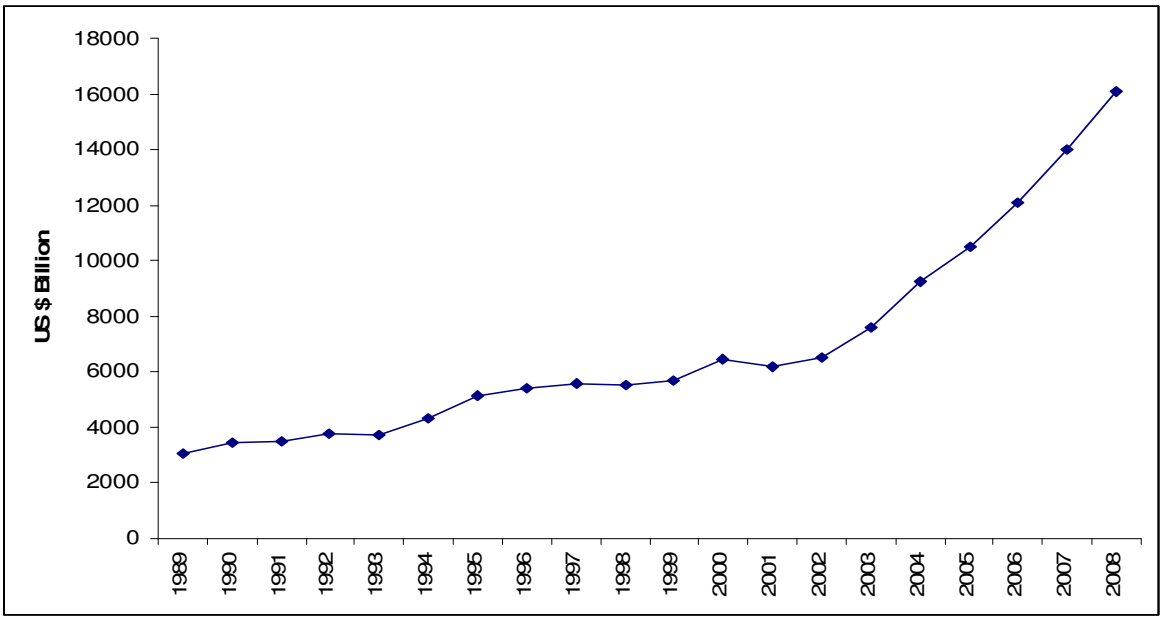
Figure 1: FDI inflows, global and by groups of economies, 1980–2008

(Billions of dollars)



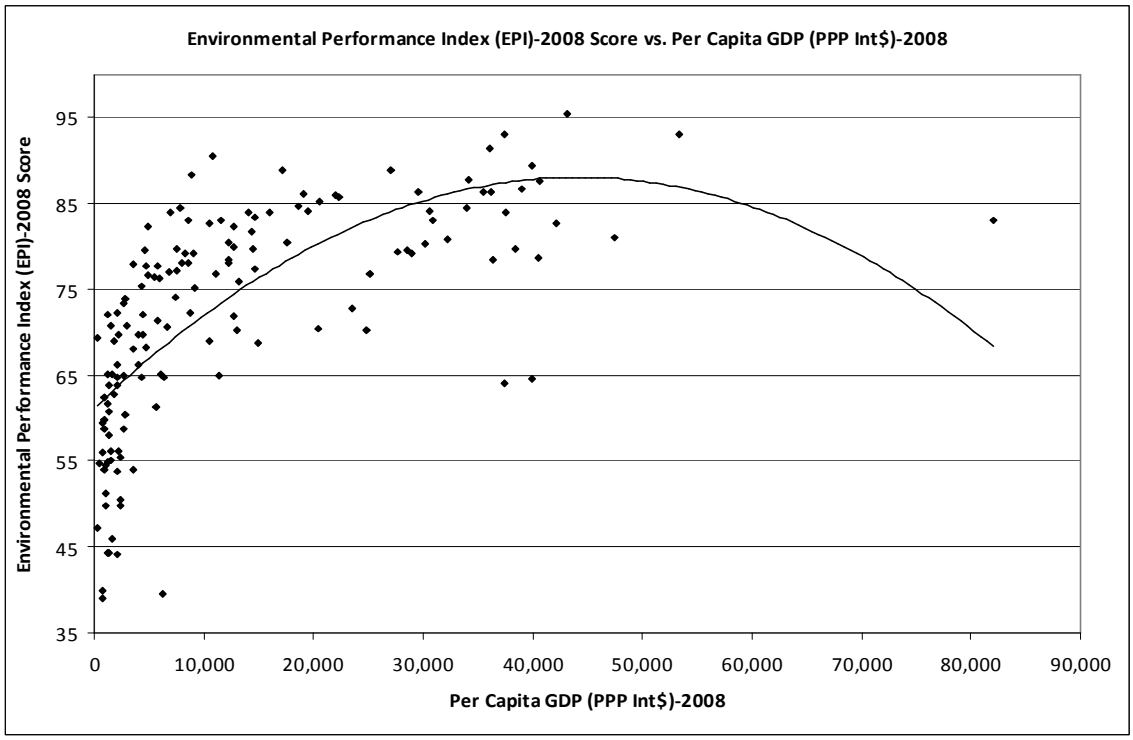
Source: World Investment Report, UNCTAD (2009)

Figure 2: Growth of Global Merchandise Exports (1989-2008)



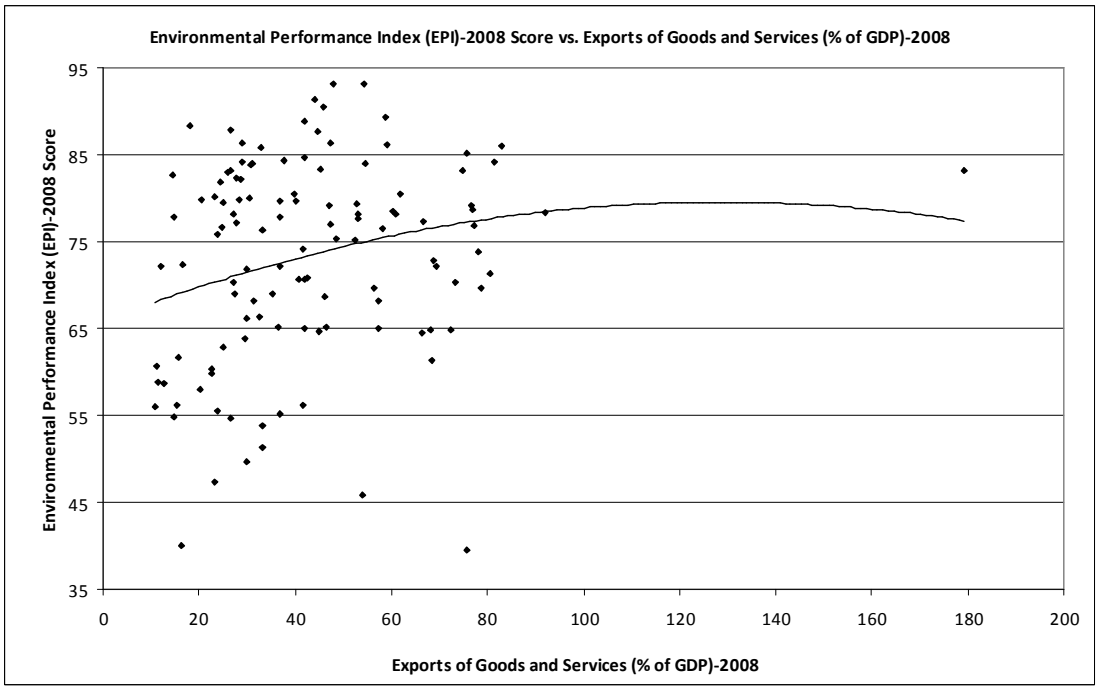
Source: Data taken from International Trade Statistics, WTO (2009)

Figure 3: Relationship between Income and Environmental Performance



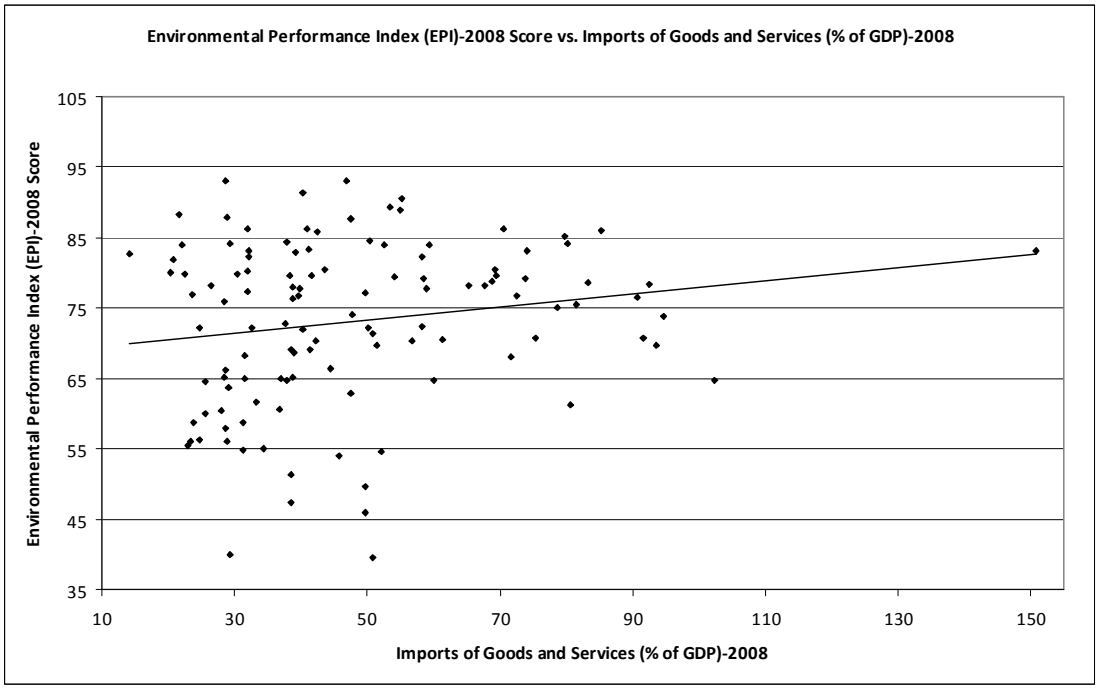
Source: Constructed by the authors

Figure 4: Relationship between Environmental Performance and Export Inclination



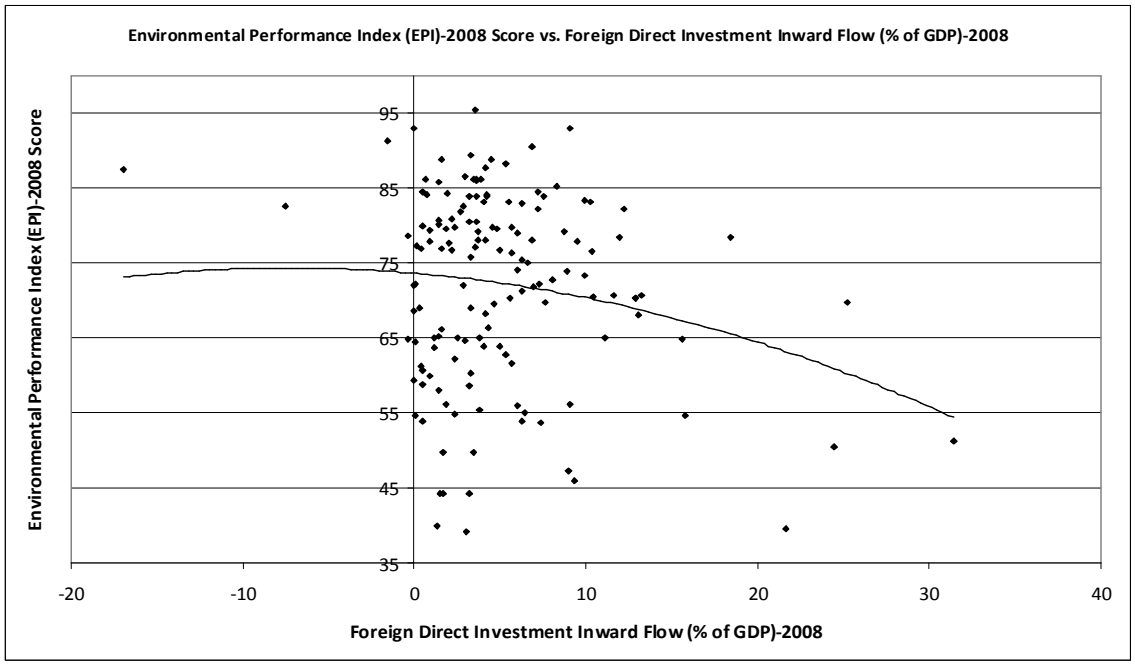
Source: Constructed by the authors

Figure 5: Relationship between Environmental Performance and Import Inclination



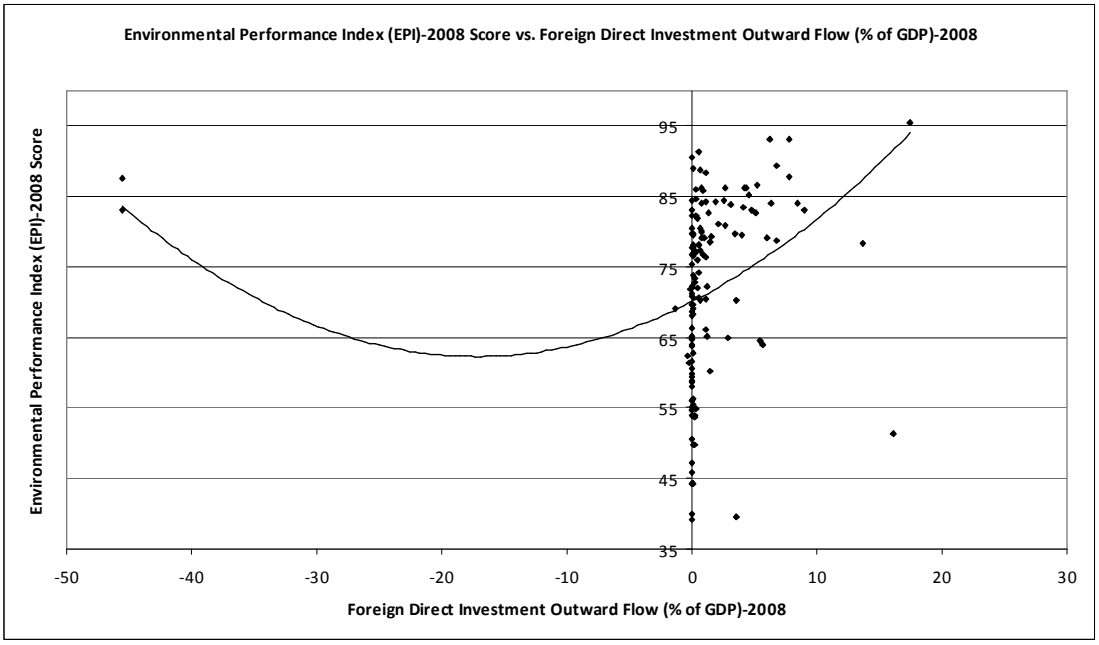
Source: Constructed by the authors

Figure 6: Relationship between FDI Inflow and Environmental Performance



Source: Constructed by the authors

Figure 7: Relationship between FDI Outflow and Environmental Performance



Source: Constructed by the authors

Table 1: Trade, Investment and Environment – Cross-Country View

(Percentage)

Country	EPI Ranking	Share in Global Merchandise Export	Share in Global Service Export	Share in Global FDI inflow	EPI Ranking	Share in Global Merchandise Export	Share in Global Service Export	Share in Global FDI inflow
	Number	%	%	%	Number	%	%	%
	(2006)	**(2005)**			**(2010)**	**(2008)**		
Bangladesh	125	0.09	0.02	0.09	139	0.10	0.02	0.06
Brazil	34	1.13	0.60	1.57	62	1.23	0.76	2.65
China	94	7.26	2.98	7.55	121	8.89	3.88	6.38
France	12	4.42	4.89	8.86	7	3.77	4.25	6.92
India	118	0.95	2.10	0.79	123	1.10	2.72	2.45
Japan	14	5.67	4.12	0.29	20	4.87	3.88	1.44
Russia	32	2.32	1.00	1.34	69	2.93	1.34	4.14
South Africa	76	0.49	0.44	0.69	115	0.50	0.32	0.53
Thailand	61	1.06	0.81	0.84	67	1.11	0.88	0.59
UK	5	3.67	8.23	18.56	14	2.85	7.49	5.71
US	28	8.59	14.60	10.93	61	8.01	13.80	18.62

Source: Compiled from Environmental Performance Index scores, CIESIN; International Trade Statistics, WTO and World Investment Report, UNCTAD.

Table 2: Export-Orientation and Environmental Performance

Dependent Variable:	***EPI08SCR***					
Independent Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	68.018 ***	65.845 ***	61.206 ***	29.314 ***	29.346 ***	29.106 ***
	(2.539)	(3.352)	(2.865)	(2.564)	(2.576)	(2.657)
EX08	-0.043	0.213 **	0.216 ***	-7.7E-02	-0.059	-0.059
	(0.052)	(0.101)	(0.082)	(0.056)	(0.056)	(0.056)
EX08^2		-0.001	-0.002 ***	2.0E-04	9.7E-05	1.04E-04
		(5.6E-04)	(4.4E-04)	(2.6E-04)	(2.5E-04)	(2.5E-04)
PCI08	0.001 ***		0.001 ***			
	(7.0E-05)		(6.6E-05)			
HDI07SCR				62.876 ***	58.312 ***	58.751 ***
				(3.739)	(5.174)	(5.17)
DISCORE07					0.490	0.558
					(0.344)	(0.433)
CPI08						-0.128
						(0.409)
No. of observations	117	117	117	117	117	117
Adjusted R^2	0.346	0.038	0.402	0.761	0.764	0.762
Durbin-Watson Stat	2.186	1.948	2.159	2.393	2.382	2.376
F-Stat	31.748	3.308	26.952	124.405	94.889	75.302
Prob (F-Stat)	0.000	0.040	0.000	0.000	0.000	0.000

Note: Figure in the parenthesis shows the White Heteroscedasticity consistent standard error for the estimated coefficient
****, ** & * implies the estimated coefficient is significant at 0.01, 0.05 and 0.10 level.*

Table 3: Import-Orientation and Environmental Performance

Dependent Variable:	***EPI08SCR***					
Independent Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	65.238 ***	67.58 ***	53.58 ***	25.697 ***	26.133 ***	25.733 ***
	(3.258)	(4.37)	(4.502)	(2.94)	(2.996)	(3.069)
IM08	0.032	0.132	0.455 ***	1.0E-01	0.100	0.098
	(0.051)	(0.134)	(0.141)	(0.071)	(0.069)	(0.069)
IM08^2		-3.1E-04	-3.4E-03 ***	-7.6E-04 *	-7.6E-04 *	-7.4E-04 *
		(8.7E-04)	(1.0E-03)	(4.5E-04)	(4.4E-04)	(4.4E-04)
PCI08	4.9E-04 ***		5.7E-04 ***			
	(9.0E-05)		(5.7E-05)			
HDI07SCR				60.157 ***	55.249 ***	56.091 ***
				(3.427)	(4.717)	(4.861)
DISCORE07					0.576 *	0.695 *
					(0.334)	(0.416)
CPI08						-0.225
						(0.404)
No. of observations	117	117	117	117	117	117
Adjusted R2	0.344	0.015	0.394	0.755	0.759	0.758
Durbin-Watson Stat	2.233	1.887	2.275	2.598	2.54	2.522
F-Stat	31.436	1.876	26.153	119.986	92.522	73.566
Prob (F-Stat)	0.000	0.158	0.000	0.000	0.000	0.000

Note: Figure in the parenthesis shows the White Heteroscedasticity consistent standard error for the estimated coefficient
****, ** & * implies the estimated coefficient is significant at 0.01, 0.05 and 0.10 level.*

Table 4: FDI Inflow and Environmental Performance

Dependent Variable:	***EPI08SCR***											
Independent Variable	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
Constant	65.382	***	73.663	***	64.514	***	27.363	***	27.413	***	26.296	***
	(1.749)		(1.542)		(1.864)		(2.289)		(2.343)		(2.436)	
FDIIN08	-0.112		-0.194		0.286		-0.064		-0.017		-0.054	
	(0.175)		(0.308)		(0.265)		(0.100)		(0.103)		(0.107)	
FDIIN08^2			-0.013		-0.023	**	-5.7E-03		-6.4E-03		-4.9E-03	
			(1.3E-02)		(1.1E-02)		(5.4E-03)		(5.6E-03)		(5.7E-03)	
PCI08	5.4E-04	***			5.5E-04	***						
	(8.2E-05)				(8.7E-05)							
HDI07SCR							6.2E+01	***	5.6E+01	***	5.9E+01	***
							(2.9E+00)		(4.6E+00)		(4.5E+00)	
DISCORE07									0.704	**	1.013	**
									(0.351)		(0.426)	
CPI08											-0.647	
											(0.400)	
No. of observations	145		145		145		143		143		142	
Adjusted R2	0.374		0.027		0.389		0.774		0.781		0.784	
Durbin-Watson Stat	2.069		1.775		2.027		2.284		2.229		2.205	
F-Stat	44.017		3.007		31.541		163.189		127.657		103.08	
Prob (F-Stat)	0.000		0.053		0.000		0.000		0.000		0.000	

Note: Figure in the parenthesis shows the White Heteroscedasticity consistent standard error for the estimated coefficient
****, ** & * implies the estimated coefficient is significant at 0.01, 0.05 and 0.10 level.*

Table 5: FDI Outflow and Environmental Performance

Dependent Variable:	***EPI08SCR***									
Independent Variable	Model 1		Model 2		Model 3		Model 4		Model 5	
Constant	64.368	***	70.086	***	25.485	***	25.617	***	24.939	***
	(1.243)		(1.201)		(2.283)		(2.332)		(2.41)	
FDIOUT08	2.0E-01		0.909	**	-0.147		-0.189		-0.135	
	(0.179)		(0.444)		(0.182)		(0.185)		(0.184)	
FDIOUT08^2			0.026	**	-3.8E-03		-5.5E-03		-3.8E-03	
			(1.0E-02)		(4.3E-03)		(4.4E-03)		(4.5E-03)	
PCI08	5.6E-04	***								
	(6.4E-05)									
HDI07SCR					63.976	***	57.553	***	59.354	***
					(3.035)		(4.307)		(4.374)	
DISCORE07							0.825	**	1.044	**
							(0.342)		(0.411)	
CPI08									-0.492	
									(0.409)	
No. of observations	144		144		142		142		141	
Adjusted R2	0.382		0.078		0.77		0.78		0.781	
Durbin-Watson Stat	2.014		1.79		2.384		2.298		2.291	
F-Stat	45.164		7.088		158.171		125.947		100.596	
Prob (F-Stat)	0.000		0.001		0.000		0.000		0.000	

Note: Figure in the parenthesis shows the White Heteroscedasticity consistent standard error for the estimated coefficient
****, ** & * implies the estimated coefficient is significant at 0.01, 0.05 and 0.10 level.*

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