

International Trade and Carbon Emissions (CO₂): The case of Bangladesh

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Abstract

The relationship between the environmental problems and international trade has been subject of considerable debate over these years. There are little knowledge and agreement on the nature of interactions among the international trade, environmental quality and development process. This paper deals with the assessment on the intensity of the relationship between the international trade and environmental pollution regarding the carbon (CO₂) emissions of a developing country, Bangladesh. The paper deals with the exploration of the situation only and consequently draws attention on the environmental regulations without causing harm to international relation. The flow and essence of the paper have been drawn from the empirical analyses of the data of 32 years (1976 – 2008). Sector wise scenario has been explored to understand the situation more clearly.

Keywords: International trade, Carbon (CO₂) emissions, Sustainable Development, International Relation, Environmental Regulation

1. Introduction

Theories of international trade use natural resources and climate as variables that affect labor productivity, as suggested by the Ricardian model. It is agreed that environmental issues can influence the production costs, trade pattern, industry location, gains from trade and even the international relation. Hence, an intricate and multidimensional situation is raised regarding the international trade and environment.

The change in comparative price advantage suggests variations in potential trade flows and location advantage (Siebert, H., 1992). As a result unacceptable business trends are rising in some cases e.g., migration of dirty industry. Copeland and Taylor (1995) argued that under certain circumstances the pollution intensive industries migrated to countries with weaker environmental regulation.

Researchers mainly draw attention on these issues from the three categories of spatial environmental problems resulting from production and consumption activities: intra-country (local), inter-country (trans-boundary), and global environmental problems. It is agreed that in first case, environmental problems rises because of trade interact through exchange of goods and services. However, in certain cases, these categories can overlap. Consisting with that, the aim of the paper is to explore the current scenario regarding the relationship between international trade and environmental pollution, basically the CO₂ emissions.

2. Research Methodology

This paper mainly depended on the secondary data. Data have been collected for 32 (1976 – 2008) years. Data have been collected from several reliable sources. Data related to the exports and imports of Bangladesh, have been collected from the Bangladesh Bureau of Statistics (BBS) (www.bbs.gov.bd). Data related to the environmental pollution, especially carbon (CO₂) emissions, have been collected from the Carbon Dioxide Information Analysis Center (CDIAC) (www.cdiac.ornl.gov).

To analyze the data, mathematical model have been developed from the previous research. Data have been analyzed systematically consisting with the rules and regulation of statistics. STATA (version 10) has been

used to analyze the data. To explain the result, different contemporary views have been used.

3. Literature Review

During the last five decades environmental issues get considerable attention from various fronts. Probably, environmental concern rise from the industrial pollution for the first time. In the late 1970s, environmental concerns started appearing in trade analysis (Jayadevappa Ravishankar and Chhatre Sumedha, 2000). As mentioned earlier, researchers focus on interactions between trade and environmental quality from three perspectives: intra-country (local), inter-country (trans-boundary), and global environmental problems.

But, problems rise among the researchers regarding the draw of decisions about the trade effects on environment. There is conflicting results among most of the empirical studies on effects of trade on the environment (Dean, J.M., 1992; Gale, L.R., 1995). Basically, World Bank studies (e.g., Birdsall and Wheeler, 1992; Lucas et al., 1992) on trade and environment found lower rates in pollution intensity of production for countries that pursue more open trade policies. In contrast, researchers also reveal the opposite result of the World Bank research. Rock (1996) showed that open trading policies are more pollution intensive compared with inward trading policies. Basically, it is assumed that there is some environmental externality. Ayres and Kneese (1969) showed that pollution (gaseous, liquid or solid) is inherent to the production and consumption activity of an economy and a tradeoff exists between the forms of pollution.

Researchers explain trade and environment from various perspectives. Grubel (1975) showed the effects of environmental externality on production and consumption by using modified Heckscher – Ohlin (HO) model (the HO model states that each country has a comparative advantage in the good which is relatively intensive in the use of the country's relatively abundant factor). His studies indicate that if the environmental costs are not reflected in the domestic production of the commodities in the trading countries, it will increase production of commodities normally imported and decrease the production of exports. Koo (1979) also noticed the positive impact of trade on the real income and suggests a part in the form of cleaner environment. Copeland and Taylor (1994) analyzed the linkage between national income, pollution, and trade. They showed that income gains from trade can affect pollution in a different way than those from economic growth. Free trade enhances the growth, raises real incomes, but it also changes the composition of national output and therefore alters the incidence and level of pollution.

4. Mathematical Model Consisting with the Objective of the Paper

The objective of the paper is to explore the intensity of the relationship between the international trade and environmental pollution regarding the CO₂ emissions in Bangladesh.

Researchers like Walter (1974) used the general equilibrium condition to explore the impact of trade on the pollution. He analyzed the impact of trade using modified HO model with three goods (imports, exports, and environmentally friendlier goods) considering the environmental quality as a factor of production. Anderson and Blackhurst (1992) analyzed the effects of trade liberalization on environmental quality of a small and large country using partial equilibrium analysis. Consisting with these studies, this paper aims to explore the effect of trade on the environmental pollution regarding CO₂ emissions. It is agreed that after the independence of Bangladesh, trade is liberalizing day by day. Consequently volume of trade is increasing. The developed equation is -

$$y = \alpha + \beta_{ij}x_{ij} + u \quad \text{-----} \quad (1)$$

Where, y = Carbon emissions (CO₂) from different phenomena

X_{1j} = Amount of export, X_{2j} = Amount of import

β_{ij} = Measure the strength/effect of export or import on the carbon emissions (CO₂)

U = Unobserved factors

5. International Trade and Bangladesh

Bangladesh is a small country of South Asia. High density of population of that country results high consumption and production. As a result, international trades take place as an inevitable phenomenon to that country. Bangladesh has various multi-lateral, regional and bi-lateral trade agreements in the international trade area. Bangladesh is the active member of the World Trade Organization (WTO). Bangladesh has been pursuing liberalization through many regional free-trade agreements like South-Asian Free Trade Area (SAFTA), BIMSTEC (comprising of Bangladesh, India, Myanmar, Sri Lanka and Thailand, including new members Nepal and Bhutan), Free Trade Agreement and the Asia Pacific Trade Agreement (APTA). Bangladesh has signed Preferential Trade Agreement with D-8 member countries.

Data of Bangladesh Bureau of Statistics (BBS) indicates that volume of international trade is increasing at a high rate in Bangladesh. Both export and import is increasing simultaneously. Bangladesh's main export items are garments, jute and jute related goods, ship scrap metal, fertilizer, pharmaceuticals, ceramic tableware, textile, leather, fish, seafood, rice, tea, sugar, wheat etc. To produce and preserve these products, power and energy is required. And in most cases these consumes carbon (CO₂) emissions highly. Bangladesh's main import items are Plastic Articles, Iron and steels, Machinery and equipment including electrical appliance, man-made staple fibre, raw cotton, material for consumer goods, Edible oil, fertilizer, Cement (different types), petroleum products, cotton yarn and synthetic yarn etc. Notable thing is that a good portion of these items imported for the production of final goods. The mechanism of production and consumption also consumes carbon (CO₂) emissions highly.

At 2008, the amount of export from Bangladesh was 985,931 million BDT (67 BDT=1 USD) and the amount of import was 1496,722 million BDT. At 2008, the amount of carbon emission (CO₂) in Bangladesh was 12388 thousand metric tons.

5.1 Data Analysis and Findings

As mentioned earlier 32 year's (1976 – 2008) data has been collected. The collected data shows that the total amount of carbon emissions (CO₂) can be categorized in four groups; carbon emission (CO₂) from Gas Fuels, Liquid Fuels, Solid Fuels and Cement production.

The collected data have been analyzed rigorously consisting with the rules of statistics and econometrics. After prediction of error of residuals, Breusch-Godfrey LM test for autocorrelation have been executed. Consisting with the statistical rules, Durbin-Watson "d" statistics has been shown in table 1 to represent the real situation. However, to explain deeply Dickey-Fuller test have been used to represent the stochastic trends of Carbon Emissions (CO₂) by figure.

5.2 Interpretation

Table 1 shows that international trade impact on the carbon emission (CO₂) from Gas Fuels most highly (0.9281 for export, 0.9287 for import) with the significant statistical level from the perspective of ecological balance. The R-squared is 0.8614 (export), meaning that approximately 86.14% of the variability of the carbon emissions (CO₂) from Gas Fuels considering the change of export is accounted for by the variable in the model. Adjusted R-squared indicates that about 85.69% of the variability of CO₂ emissions from Gas Fuels is accounted for by the model; even after taking into account the number of predictor variables in the model. In case of import, the scenario is same. Table 1 shows that cement production, Liquid Fuels and solid Fuels are in second, third and in fourth position respectively to generate CO₂ emission in terms of the relationship with the international trade.

Table 1. Durbin-Watson “d” Statistics

Variable (Dependent Variable)	Trade (Independent variable)	Coef.	Std. Error	T	p> t	Beta	R- squared	Adj-R squared
Gas Fuels	Export	0.00861	0.0006	13.88	0.000	0.9281	0.8614	0.8569
	Constant	1517.49	193.93	7.82	0.000	-		
	Import	0.00611	0.0004	13.95	0.000	0.9287	0.8626	0.8581
	Constant	1387.65	198.83	6.98	0.000	-		
Liquid Fuels	Export	0.0023	0.0002	8.55	0.000	0.8379	0.7022	0.6926
	Constant	1523.67	86.931	17.33	0.000	-		
	Import	0.0017	0.0001	8.82	0.000	0.8454	0.7148	0.7056
	Constant	1483.80	87.597	16.94	0.000	-		
Solid Fuels	Export	0.00037	0.0001	5.67	0.000	0.7137	0.5093	0.4935
	Constant	115.694	20.501	5.64	0.000	-		
	Import	0.0002	0.0000	5.87	0.000	0.7257	0.5266	0.5113
	Constant	108.85	20.735	5.25	0.000	-		
Cement Production	Export	0.00096	0.0000	9.70	0.000	0.8673	0.7523	0.7443
	Constant	43.8567	31.100	1.14	0.168	-		
	Import	0.00069	0.0000	9.73	0.000	0.8679	0.7534	0.7454
	Constant	29.295	31.95	0.92	0.366	-		
*n=32 (statistical results that are capable to presents the real situation have been presented only)								

However, as more production will generate more CO₂ emissions proportionately, Dickey-Fuller test may be used to analyze the situation more keenly. Figure from the Dickey-Fuller test has bee shown below;

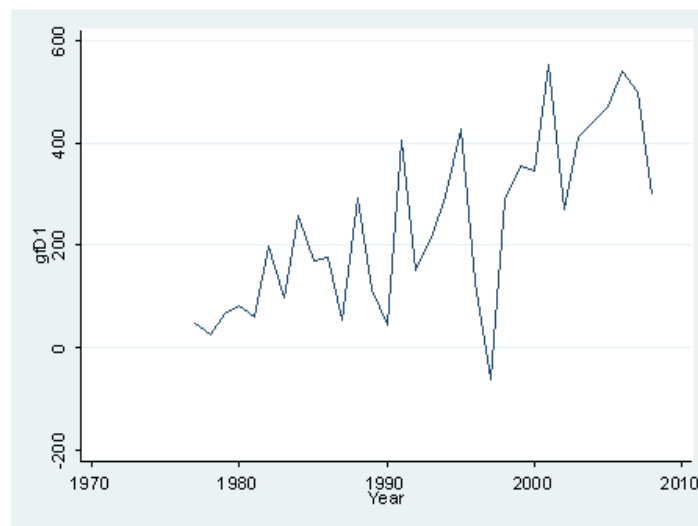


Figure 1 Stochastic trend of CO₂ from Gas Fuels

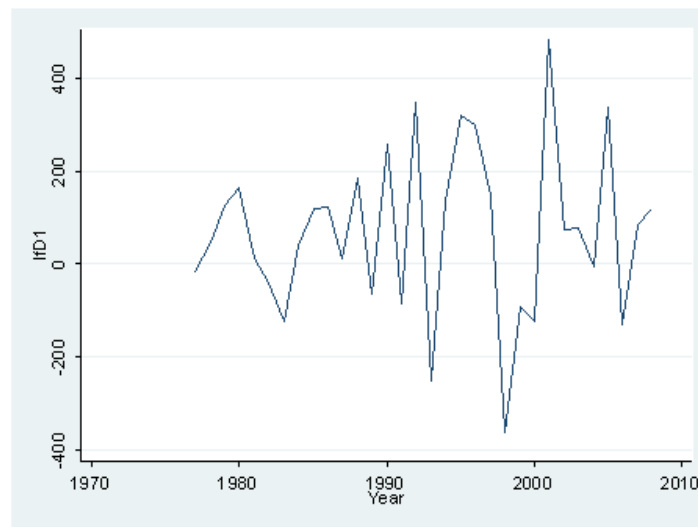


Figure 2 Stochastic trend of CO₂ from Liquid Fuels

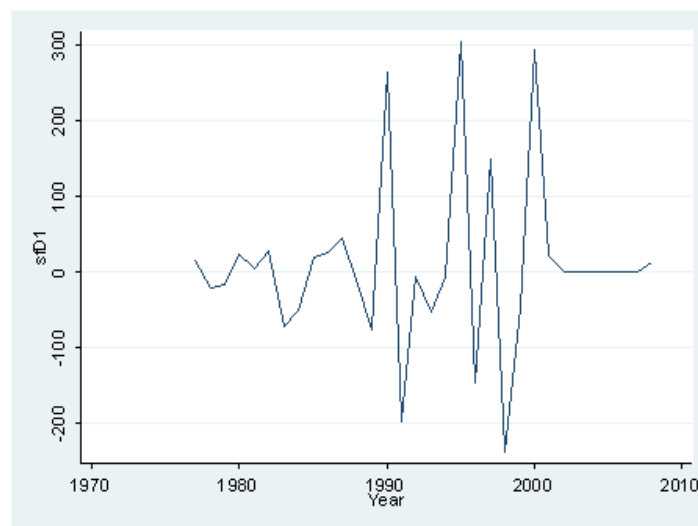


Figure 3 Stochastic trend of CO₂ from Solid Fuels

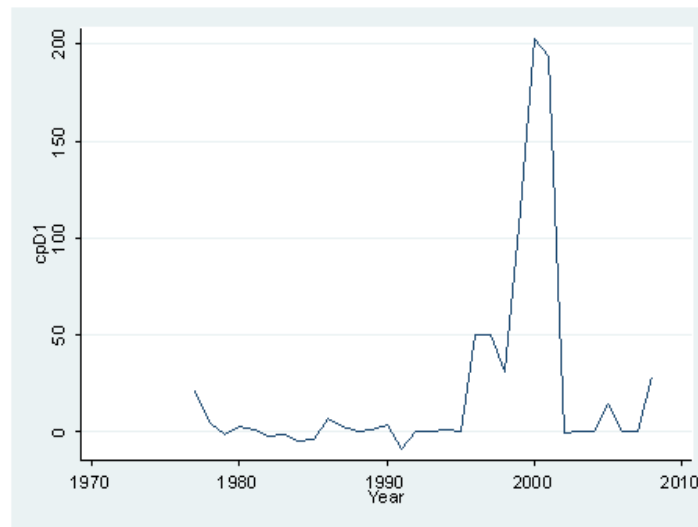


Figure 4 Stochastic trend of CO₂ from Cement Production

Figure 1, Figure 2, Figure 3 and Figure 4 are the output of Dickey-Fuller test. Figures indicate that trends of carbon emission from Gas Fuels is higher than the normal proportion and also higher than carbon emission from other (liquid fuels, solid fuels, cement production) areas. It indicates that the trends of relative ecological payments are higher from the Gas Fuels sectors.

In Bangladesh, it is agreed that Gas Fuels is generally used in industry to produce the goods rather than in domestic use. Basically in Bangladesh gas is using in fertilizer industry, ceramic tableware, textile, processing metal, pharmaceuticals and in power generating sector. Liquid fuel is mainly used in transportation and in some small power areas. Solid fuel is mainly used in domestic purpose. This total scenario together with the empirical analysis indicates that international trade is strongly influencing to generate carbon (CO₂) emissions in Bangladesh. Consequently, international trade is strongly affecting on the ecological balance of payment in Bangladesh. The findings of Sajib Q.U., et al. (2011) support the result of this paper also. They find that the fertilizer sector of Bangladesh is enjoying the growth without ensuring the ISO 14000 properly.

These scenarios may be originated from the intra-country (local), inter-country (trans-boundary), and global activities. Till now, Kyoto Protocol has achieved little in terms of global emissions reductions (Carbon Jared C., 2009). The last summit at Cancun of Mexico has achieved little also. Analysis of Siebert (1992) showed that a small country, lacking environmental measures, will produce more of the pollution intensive commodities and its environmental quality will decline.

The total scenario ultimately indicates that there is a lack of proper environmental measurement systems as well as the management and control systems in Bangladesh. The ultimate result of the paper draws attention to pursue effective environmental regulation. But, as mentioned earlier, international trade is an inevitable matter for Bangladesh. It is not the solution to reduce the amount of trade. To continue with the current growth and enhance the growth of the country, international trade as well as maintaining good international relationship is required.

6. Future Research

The way of handling of carbon (CO₂) emissions from the gas fuels may be developed at future with continuing the good international relationship for Bangladesh. It is agreed that a complex combination of technical change, market structure, income effects, public demand for environmental quality and political systems has significant impact on pollution intensity (Barbera, A.J. and McConnel, D.V., 1990; Bailey, N.A., 1993; Beghin J. et al., 1994). Hence research may conduct on these areas also.

7. Conclusions

This paper explores the nature of carbon emissions by considering the mechanism of international trade only. The quantitative analysis of this paper indicates that there is a strong positive relationship between international trade and carbon (CO₂) emissions from the gas fuels. Ultimately carbon emissions from gas fuels indicate the carbon emission from various manufacturing sector of Bangladesh that are involved with the international trade. Hence, the empirical analyses suggest the reinvestigation of environmental policy of Bangladesh and ensure the application with the environmental management systems of the organizations.

References

- Anderson, K., & Blackhurst, R. (1992). *The Greening of World Trade Issues*, The University of Michigan Press, Ann Arbor
- Ayres, R.U., & Kneese, A.V. (1969). Production, Consumption and Externalities, *American Economic Review*, LIX, 282 – 297
- Bailey, N.A. (1993). Foreign Direct Investment and Environmental Protection in the Third World, In: Zaelke, D., Orbuch, P., Housman, R.F. (Eds.), *Trade and the Environment – Law Economics and Policy*. Center for International Environmental Law, Island Press, Washington, DC
- Barbera, A.J., & McConnel, D.V. (1990). The Impact of Environmental Regulations on Industry Productivity: Direct and Indirect Effect, *Journal of Environmental Economics and Management*, 18, 50 – 65
- Beghin, J., Roland-Holst, D., & Ven Der Mensbrugge, D. (1994). A Survey of the Trade and Environment Nexus: Global Dimensions, *OECD Econ. Stud.* 1994, 23, 169 – 192
- Birdsall, N., & Wheeler, D. (1992). Trade Policy and Industrial Pollution in Latin America: Where are the Pollution Havens? In: Low, P. (Eds.), *International Trade and Environment*. In: World Bank Discussion Paper, Washington, DC, page. 159
- Carbon Jared C., Helm Carsten., & Rutherford Thomas F. (2009). The Case for International Emission Trade in the Absence of Cooperative Policy, *Journal of Environmental Economics and Management*, 58, 266 – 280
- Copeland, B.R., & Taylor, M.S. (1995). Trade and the Environment: A Partial Synthesis, *American Journal of Agricultural Economics*, 77, 765 – 771
- Copeland, B.R., & Taylor, M.S. (1994). North-South trade and the Environment, *Quarterly Journal of Economics*, 109(3), 755 – 787
- Dean, J.M. (1992). *Trade and the Environment – A Survey of the Literature*, Working Papers – Policy Research: Background Research for the World Development Report. World Bank, Washington, DC
- Gale, L.R. (1995). Trade Liberalization and Pollution: an Input – Output Study of Carbon dioxide Emissions in Mexico, *Economic Systems Research*, 7(3), 309 – 320
- Grubel, H.G. (1975). Some effects of Environmental Controls on International Trade: The Heckscher – Ohlin Model, In: Walter, I. (Ed.), *Studies in International Environmental Economics*. Wiley-Interscience, New York
- Jayadevappa. Ravishankar., & Chhatre. Sumedha. (2000). International Trade and Environmental Quality: A Survey, *Ecological Economics*, 32, 175 – 194
- Koo, A.Y.C. (1974). Environmental Repercussions and trade theory, *Review of Economics and Statistics*, 56(2), 235 – 244
- Lucas, E.B.R., Wheeler, D., & Hettige, H. (1992). Economic Development, Environmental Regulation and International Migration of Toxic Industries, In: Editor, A. (Eds.), *International Trade and the Env.*, In: World Bank Discussion Papers, World Bank, Washington, DC., page. 159

Rock, M.T. (1996). Pollution Intensity of GDP and Trade Policy: Can the World Bank be wrong? *World. Dev*, 24(3), 471 – 479

Sajib. Md. Qutub Uddin., Rajib. Md. Salah Uddin., & Alam, Md. Shariful. (2011), An Assessment on the Adaptation of ISO 14000 in the Fertilizer Sector of Bangladesh for the Sustainable Development, *Energy Procedia*, 11, 2480 – 2488

Siebert, H. (1992). *Economics and Environment*, Springer-Verlag, New York

Walter, I. (1974). International Trade and Resource Diversion: The Case of Environmental Management. *Review of World Economics*, 110(2), 482 – 493

www.bbs.gov.bd/Home.aspx (May 10, 2011)

www.cdiac.ornl.gov/trends/emis/ban.html (May 9, 2011)

Appendix

Serial Correlation test

Breusch-Godfrey LM test for autocorrelation

Carbon Emission (CO₂) from Gas Fuels

Lags(ρ)	Chi2	df	Prob > chi2
1	29.372	1	0.0000
2	29.457	2	0.0000
3	29.479	3	0.0000
4	29.488	4	0.0000

H0: no serial Correlation

Carbon Emission (CO₂) Liquid fuels

Lags(ρ)	Chi2	df	Prob > chi2
1	23.411	1	0.0000
2	23.412	2	0.0000
3	23.503	3	0.0000
4	23.010	4	0.0000

H0: no serial Correlation

Carbon Emission (CO₂) Solid Fuels

Lags(ρ)	Chi2	df	Prob > chi2
1	1.376	1	0.2407
2	1.396	2	0.4975
3	2.341	3	0.5047
4	3.635	4	0.4577

H0: no serial Correlation

Carbon Emission (CO₂) Cement Production

Lags(ρ)	Chi2	df	Prob > chi2
1	27.088	1	0.0000
2	30.527	2	0.0000
3	30.527	3	0.0000
4	30.996	4	0.0000

H0: no serial Correlation

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