Trade Liberalization and Environmental Quality: A Case Study of Pakistan

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Abstract

This research is designed to empirically test and verify the presence of a relationship between trade liberalization and environmental quality in Pakistan and then, to suggest some policy recommendations on the basis of empirical evidences. In this study, an attempt is made to build linkages between trade and environment. The sustainable development is on the top-most agenda of all nations; therefore, the urgent need for developing economies is to modify their policies accordingly. This study's results show that with the economic growth, environmental impacts may be lower. Trade expansion helps also to improve and import technologies to control pollution. Pakistan may follow liberal trade policies but it is necessary to maintain delicate balance between them and environment policies.

I. Introduction

Economic modeling has made easy to combine various inputs produced and to generate better and efficient output. However, this global economy provides many opportunities, as well as challenges, in the form of possibilities for large scale production along with pollution associated with them. Hence a delicate equilibrium is required between the current uses of resources and resources saved for future sustainable development. According to the World Commission on Environment and Development, "sustainable development is a

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development that meets the needs of the present without compromising the ability of future generations to meet their own needs"[2]

Therefore, the sustainability is the main factor that incorporates the issue of environmental preservation in economic development. For long lived development, it must be ensured that we have enough natural capital to hand over the future generations for their development. A typical production function shows that out put depends on land, labor, capital and entrepreneur. Here land represents all natural resources, so it is essential to preserve the environment for the economic growth of future generations.

The non-environmentalist school of thought's argument is that the modern era has less need to preserve the nature due to technology progress. This modern era has been divided into: Information Age (1971-91), Knowledge Age (1991-02), and Intangible Economy (2002-present). The last, Intangible Economy Era has factors of production in the form of knowledge, collaboration, process-engagement, and time quality; hereby ignoring the dependency of production on the tangible factors. But during the late eighteenth century, the labor productivity was adversely affected by the pollution generated by the excessive use of coal during Industrial Revolution.

At last but not least, we can say that an economy's output in a given year depends on labor, environmental quality and capital available during the year. All these are affected by climate change through; the adverse effect on the human health which lead to low productivity of the labor force, the loss and damage to agriculture and infrastructure and at last, through lower quality of investment and capital. As the output and factors of production of an economy are affected, so its growth projections are also likely to be change.

The current world is greatly threatened by the ongoing climate changes which are mainly due to unawareness and non-harmonizing technological advancements with the environmental standards. The environmental impact of trade liberalization deserves a special attention which leads to the steady deterioration of the global environment. Therefore, trade agreements need to be reassessed with their associated environmental consequences. At the dawn of this

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[2] *World Commission on Environment and Development's (WCED), report (1987), "Our Common Future".*

millennium, it is high time to decide that all rules concerning the international trade and environmental issues must be equally treated. In this study, we tried to analyze the consequences of trade liberalization on the environment. We also tried to produce quantitative results and some policy recommendations based on these results, especially for Pakistan.

The remaining part of the study is planned as follows: Section II gives an overview of the literature, Section III provides analytical framework for the study, Section IV discusses the variables and data issues, Section V contains empirical results and finally, section VI presents the summary of results and relevant policy implications.

II. Review of Literature

The debate on the effects of international trade on environment has been disputed; as environmentalists show their serious concerns whereas proponents of free trade believe that it generates positive environmental effects. Thus a single conclusion is not possible since the outcome depends on many country-specific factors such as development level of the country, its comparative advantage, the factor intensity of the traded products, the ongoing level of environmental awareness and the presence of environmental policies. The pioneers of this literature began publishing their work as early as 1971[3] by analyzing the impacts of growth on environment.

There are three channels by which international trade can affect the environment. Grossman and Krueger (1991), first time decomposed these in the forms of Scale Effect, Composition Effect and Technique Effect. The scale effect represents the changes in the size of the economic activities, the composition effect shows the changes in the mix of goods being produced and the technique effect represents the changes in the technology i.e. mainly adoption of cleaner technology. Hence, trade liberalization will only generate positive environmental consequences if technique effect outweighs the scale and composition effects.

Among the earlier works, Lucas et al. (1992) found that countries with faster rates of GDP growth had lower rates of increase in toxic intensity, and higher for low & middle income countries. The low level of trade distortions has further reduced the growth of toxic intensity. A similar study has been carried out by Anderson (1992) on world food and coal industry; showing that liberalizing

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[3]. *For detail see; Baumol 1971, Magee and Ford 1972, and Walter 1973.*

global trade in coal and food products will reduce the global pollution associated with these products.

Investigating the same subject from a different angle, Birdsall and Wheeler (1992) concludes that trade liberalization has brought higher environmental standards of industrialized countries for developing countries; more open economies experienced faster growth in clean industries. Grossman and Krueger (1991) added the effect of trade and concluded that countries that have more trade liberalization have lower levels of sulfur dioxide. In another study, Grossman and Krueger (1995) determine an inverted-U type relationship between economic development and environmental degradation for most of the environmental indicators they have used. The turning point of the inverted-U type relationship is less than $8000 per capita in most cases.

In an analogous EKC study, Shafik and Bandyopadhyay (1992) found mixed and weak evidence that more open economies pollute less for eight different indicators of environmental quality. Ferrantino (1997) shows protection in developing countries generates environmental problems usually as they cannot adopt expensive and cleaner techniques of production; these problems may be avoided by trade liberalization, which would shift these industries to developed countries where cleaner technologies are in place.

One of the most comprehensive studies in the literature is Antweiler et al. (1998) that has a sound theoretical linkage of trade with environment. It builds a reduced form equation that relates the three effects of trade to pollution emissions. The coefficient of the degree of openness turns out to be negative in the estimated model, indicating that higher openness result in lower sulfur dioxide emissions.

In another comprehensive study, Ferrantino and Linkins (1999) that considers two trade liberalization scenarios; one is trade liberalization arising from Uruguay Round and another is agreement that will eliminate all tariffs of manufacturing sector. It finds that trade liberalization and environmental protection are complementary on the global scale.

A collection of papers that are highly critical of the gains from trade argument from an environmental perspective have been edited by Ekins et al. (1994). Their most significant conclusions are: (i) for economic growth to benefit the environment, it is not enough to generate additional resources but those resources must be targeted towards environmental quality (ii) even if some of these additional resources are directed to environmental protection, nothing can be done about irreversible damages of economic growth to the environment and (iii) increases in the volume of transportation generated by trade liberalization will contribute substantially to energy-related environmental damage.

The study Perroni and Wigle (1994) developed a numerical general equilibrium model of the world economy with home and worldwide environmental externalities. The model is used to investigate the relationship between trade and environment. Its results suggest that international trade has little impact on environmental quality. At the same time the gains from trade liberalization appear to be little affected by changes in environmental policies. Although free trade may have a negative impact on environmental quality but its relative contribution to environmental degradation appears to be limited. On the other hand, Copeland and Taylor (1995) considered the case of large and small number of countries to isolate the effects of terms of trade motivations for pollution policy from purely environmental motives. Main results of the above study are; (i) if human capital levels differ substantially across countries, then a movement from autarky to free trade raise world pollution. (ii) When free trade in goods raises world pollution then pollution permits can counteract for international trade to reduce the global pollution.

In an empirical analysis conducted for Ghana, Lopez (1997) provided empirical evidences for the impact of trade liberalization on environment. It shows that the impact of deepening of trade liberalization on biomass depletion is quite significant. Using computable general equilibrium model for Indonesia and Japan, Lee and Roland-Holst (1997) assesses the linkage between trade and environment. If Indonesia removes nominal tariffs from all imports from Japan then this unilateral trade liberalization would increase the ratio of emission levels to real output for almost all major pollution categories. If tariff removal policy is combined with a uniform effluent tax policy then twin objectives of welfare enhancement and environmental quality improvement appear to be feasible from the simulation studies they have done.

Analyzing the linkages between growth, trade and the environment for Mexican agriculture sector, Beghin et al. (1997) empirically investigates trade liberalization, environmental policy reform and their coordination. Outward orientation induces pollution growth in some agricultural sectors. Its main result is that more liberal trade combined with targeted effluent taxes can achieve significant environmental mitigation and efficiency gains but with it, agricultural sectors contract. In another study Beghin et al. (1999) examines the linkages between trade integration, environmental degradation and public health for Chile using a 72-sector CGE model. This model incorporates 13 effluents as independent variables that are regressed on a variety of mortality and morbidity indicators and also others like; production, consumption, investment, exports, imports, labor supply, capital supply, real income and absorption. It shows that opening to world markets bring on a sizeable aggravation of pollution emissions and an increase in dependency on sectors that are resource based.

Evaluating the impact of the Uruguay Round of trade negotiations Cole et al. (1998) finds that most developing and transition regions will experience an increase in emissions of all five pollutants; for the developed regions three local air pollutants are predicted to decrease, whilst the other pollutants increase. It not only estimates monetary cost associated with this impact but also computes the composition effect, the scale effect, and the technique effect explicitly. Another important result of the study is that the environmental impact will be considerably greater if the Uruguay Round affects the rate of economic growth. A similar conclusion is drawn by Abler et al. (1999) that examines the environmental impacts of trade liberalization in Costa Rica in a CGE model. It shows that the impacts of trade liberalization on the environmental indicators are generally negative in sign but small or moderate in magnitude, both when technology is constant and when technology is allowed to vary.

In its analysis, Suri and Chapman (1998) consider the environment-trade linkage in environmental Kuznut curve (EKC) type modeling. It uses commercial energy consumption per capita as the dependent variable as a proxy for environmental stress. The signs of the estimated coefficients for terms of trade are positive for export manufacturing and negative for import-manufacturing ratio as expected.

III. Theoretical Framework

In this study, we use theoretical model proposed by Antweiler et al. (2001) that builds simple demand and supply equations for pollution emission and end up with a reduced form equation for estimation and for empirical adjustments[4].

3.1. Pollution Demand and its Decomposition

We consider a population of N agents living in a small open economy that produces two final goods X and Y, using only two factors of production K and L. the good X is the capital-intensive commodity that pollutes the environment

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[4]. *For detail see, Antweiler et al. (2001).*

whereas good Y is relatively labor intensive. The production function follows constant returns to scale and can be described by the unit cost functions $c^X(w, r)$ and $c^Y(w, r)$. Let Y be the numeraire good whose price is set equal to 1, and the relative price of X is denoted by p. The profit function of the firm is given by

$$\pi^x = p^N x - wL_x - rK_x \tag{1}$$

where $p^N = p(1-\theta) - \tau\, e(\theta)$

$$p = \beta\, p^w \tag{2}$$

Here p^N is the net producer's price for gross output, τ is the pollution tax used by the government to reduce pollution emissions, θ stands for the pollution abatement intensity as explained ahead, p^w is the world common relative price of the commodity X and β measures the trade frictions. So if the value of β exceeds 1 then that would imply that domestic prices are higher and hence the country becomes an importer of X. in the same way if the prices are less than 1 then the country becomes an exporter of the commodity X. As β approaches 1 then this implies that the trade frictions are reducing and there is trade liberalization. Pollution emissions resulting from production of ***x*** are given as,

$$z = e(\theta)x \tag{3}$$

where z stands for the total emission of pollution, e stands for emission per unit of X and x stands for the total productive capacity of the industry to produce X commodity. θ stands for the pollution abatement intensity that the industry employs. Suppose that the firm is aware of some pollution abatement techniques; in that case if the firm employs the expenses of producing x_a units of X in abatement technology then θ can be written as:

$$\theta = \frac{x_a}{x} \tag{4}$$

Note that e is decreasing in θ i.e. as the abatement techniques increase emission levels decrease. The first order condition of the profit equation becomes,

$$p = -\tau\, e'(\theta) \qquad (5)$$

Hence, we have from it $\theta = \theta(\tau / p)\ with\ \theta' > 0$ and we can write emissions per unit output as

$$e = e(\tau / p) \qquad (6)$$

Now our purpose is to derive an equation here that links trade to the pollution emissions. As already described trade effects the pollution levels through three channels: scale, technique, and composition effects. Now we define scale of the economy as:

$$S = p_x^0 x + p_y^0 y \qquad (7)$$

Where this scale S is determined by the value of the economy's output at base year prices p^0. Following this the emission levels can now be written as;

$$z = ex = e\varphi S \qquad (8)$$

Where φ indicates the proportion of X commodity in the total output. Equation (8) shows dependence of the pollution levels on: pollution intensity e of the dirty industry, the overall scale S of the economy and relative importance of the pollution-producing commodity φ in the industry.

In differential form we have

$$\hat{z} = \hat{S} + \hat{\varphi} + \hat{e} \qquad (9)$$

The above equation gives us a simple division of the pollution levels into the scale effect, technique effect and the composition effect. $\hat{S}$ denotes the %age change in emission levels following the scaling up of the economy holding the proportion of goods, production and abatement techniques constant. $\hat{\varphi}$ denotes the %age changes in emission levels because of the relative importance of the polluting industry in the economy holding $\hat{S}$ and $\hat{e}$ constant. In the same way $\hat{e}$ represents the %age changes in emissions due to the techniques of production employed (as e depends on the abatement technology θ) holding the other changes constant. We can solve for the share of X in total output φ as a function of the capital labor ratio κ = K/L, the net producer price p^n and base year world prices (suppressed here). That is, the composition of output is $\varphi = \varphi\ (\kappa, p^n)$, and we have the composition effect, shown by equation (9).

$$\hat{\varphi} = \varepsilon_{\varphi k}\hat{K} + \varepsilon_{\varphi p}\hat{P}^N \tag{10}$$

3.2. Pollution Supply and its Decomposition

This study divides the consumers into two categories: N^g Green consumers who care greatly about the environment (Greens) and $N^b = N - N^g$ Brown consumers (Browns) who care less about the environment. Each consumer maximizes utility, treating pollution as given. Their indirect utility functions are given as follows:

$$V^i\left(p, G/N, z\right) = u\left(\frac{G/N}{\rho(p)}\right) - \delta^i z \tag{11}$$

Where their utilities are a function of real per capita income *(G/N/ρ (p))* and their preferences for pollution levels are given by δ^i value. So we have $\delta^g > \delta^b \geq 0$.

3.3.2. Government: The government chooses a tax that maximizes the utility of the total population i.e.

$$\max N\left[\lambda V^g + (1-\lambda)V^b\right] \tag{12}$$

Where λ is weight put on greens and varies from country to country. This helps in specifying the country type within the model.

The overall income of the economy is given as

$$G = R\left(p^N, K, L\right) + \tau z \tag{13}$$

Where R is private sector revenue which is the function of net prices, capital endowment and the labor endowment and τz is the government tax revenue. From the first order conditions and simplifying we get[5],

$$\tau = T\phi(p, I) \tag{14}$$

Similarly, using (2) and (6) we find

$$\hat{e} = \varepsilon_{e,p/\tau}\left(\hat{\beta} + \hat{p}^{w} - \hat{\tau}\right) \tag{15}$$

Combining (9) and (15) we get

$$\hat{z} = \hat{S} + \varepsilon_{\varphi,K}\hat{K} + \left[(1+a)\varepsilon_{\varphi,p} + \varepsilon_{e,p/\tau}\right]\hat{\beta} + \left[(1+a)\varepsilon_{\varphi,p} + \varepsilon_{e,p/\tau}\right]\hat{P}^{w} - \left[a\varepsilon_{\varphi,p} + \varepsilon_{e,p/\tau}\right]\hat{\tau} \tag{16}$$

All elasticities are positive.

From equation 2 and 14 we get a decomposition of the pollution supply

$$\hat{\tau} = \hat{T} + \varepsilon_{MD\varphi}\hat{\beta} + \varepsilon_{MD\varphi}\hat{p}^{w} + \varepsilon_{MDI}\hat{I} \tag{17}$$

Combining the equations 16 and 17 we finally get a reduced form equation that links pollution emissions to some economic variables.

$$\hat{z} = \pi_1\hat{S} + \pi_2\hat{k} - \pi_3\hat{I} + \pi_4\hat{\beta} + \pi_5\hat{p}^{w} - \pi_6\hat{T} \tag{18}$$

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[5]. *For detailed derivation see Antweiler et al (2001).*

IV. Framework for Estimations and Data Description

In our model, dependent variable is pollution emissions. Following Anweiler et al. (1998), we use sulfur dioxide emissions per capita as the measure of pollution emissions. However the data for Pakistan's sulfur emissions is unavailable. Therefore, we constructed a proxy for sulfur emissions, which has following properties; firstly it is a by-product of goods production, secondly it is emitted in greater quantities per unit of output in some industries, thirdly it is known to have strong local effects and fourthly, internationally it has been subject to regulations because of its noxious effect on the population. It is also known to have abatement technologies available for implementation. A suitable proxy was fuel consumption since it is the major source of sulfur dioxide emissions. Then again the model would have seemed as if it was measuring fuel trends with change in trade liberalization. Therefore, the next solution was to some how narrow down the fuel consumption to sulfur consumption. For this purpose, it was multiplied with its respective percentage sulfur contents. It is to be noted here that sulfur during the process of fuel burning is completely converted to sulfur dioxide after combining with the oxygen in the air. We also considered only those fuels that are known to have a relatively higher amount of sulfur in them.

The next step was to convert these sulfur figures into sulfur dioxide. A simple bit of chemistry proved to be helpful here. All the elements listed in the form of the periodic table are weighed in the unit, g/mol. This implies that if sulfur weighs 32.065 g/mol then one mole of sulfur in grams equivalent weighs 32.065 grams. Similarly, one mole of sulfur dioxide weighs 64.06 grams. Converting grams into metric tons (since consumption data were given in tons) we can easily get the tons/mol weight of sulfur and sulfur dioxide. The rest is easy mathematics i.e. knowing that if 0.000032065 tons/mol of sulfur produces 0.00006406 tons/mol of sulfur dioxide, then how much tons/ mol of sulfur dioxide is produced by x tons of sulfur? In this way, we calculate the tons of sulfur dioxide emissions in the economy. For sulfur dioxide emissions in metric tons per capita, we just divide them by the population of the respective years.

The indicator used in the article for measuring $\hat{S}$, the scale effect, is real GDP/Km^2. However, since our study is for Pakistan only therefore we use only real GDP.

The next explanatory variable is the capital labor ratio of the economy. Pakistan's capital-labor ratio had to be computed since the data was not available. The formula for the construction of the KL ratio is as follows:

$$K_1 = I_1 / (\eta + \delta) \quad (19)$$

$$K_2 = K_1 (1 - \eta) + I_1 \quad (20)$$

Where η is the depreciation rate and δ is the compound growth rate for the entire set of years. K_1 gives the capital stock for the first year. The capital stock for the next year is taken as K_2 and so on the series is generated. The labor force per year then divides the capital stock per year and in this way the capital-labor ratio is attained.

The next variable is per capita income. The problem here is that per capita income is most likely to show very strong co-relations with GDP, to avoid that we use GNP per capita's one period lagged three years moving average. The advantage in doing so is that we are able to remove any co-relations amongst the measure of scale effect and the GNP per capita and also distinguish between the scale and technique effects since the per capita incomes appear as a measure of the technique effect. The technique effect should be dependent on the incomes of all the residents of a nation where ever it is earned whereas the scale effect is better measured by the amount of economic activity taking place within the borders of a country.

A very crucial proxy is for trade liberalization, for this, we follow the Antweiler (2001), and it represents β and p^w in our reduced form equation. It is measured by trade intensity in the economy given by sum of exports and imports divided by total GDP.

Here $\hat{T}$ appears as a measure of the country type and is virtually unobservable as it relies both on knowledge of the degree to which the government weighs greens and browns (pollution despisers and pollution neutrals respectively) and the share of each type of consumers in the economy. Since data on this is unavailable hence this term becomes a part of the error term.

Now in order to relax the linearity assumption of the model we introduce the squares of GDP, capital-labor ratios and lag per capita incomes in the model. So our final model takes the following shape:

$$z_t = \alpha_0 + \alpha_{1t} GDP + \alpha_{2t} (GDP)^2 + \alpha_{3t} KL + \alpha_{4t} (KL)^2 + \alpha_{5t} LPCI + \alpha_{6t} (LPCI)^2 + \alpha_{7t} TI + \varepsilon_{it} \quad (21)$$

Where z_t are the emissions of sulfur dioxide per capita, GDP is gross domestic product, KL is capital labor ratio, LPCI is one period lagged three year moving averages of GNP per capita and TI is trade openness of an economy; as measured by the ratio of sum of exports and imports to GDP.

This study used the data series for the period of 1972-2006 for Pakistan. All the variables used, are in local currency units. The World Development Indicators (WDI) is used for the data series like; GDP, Gross Fixed Capital Formation, Exports, Imports, GNP, Carbon Dioxide (in metric tons per capita) and Population. Data for the labor force has been taken from the Pakistan Economic Survey (various issues). The Fuel consumption figures have been taken from Pakistan Energy Year Book (various editions) and sulfur contents of various fuels quoted in Pakistan Energy Year Book are as in shown following table-1 below.

Table: 1. Sulfur Contents in Fuel

Fuel Type	Sulfur Content	Fuel Type	Sulfur Content
Crude Oil	1.0%	Natural Gas	0.01%
Aviation Fuel	0.05%	Biomass (Fuel wood)	0.2%
Gasoline	0.01%	Biomass (Crop Residue)	0.01%
Kerosene	0.2%	Biomass (Animal Residue)	0.00225%
High Speed Diesel (HSD)	1.0%	Biomass (Wood Charcoal)	0.0%
Light Diesel Oil (LDO)	1.8%	Coking Coal	0.5%
Furnace Oil	3.0%	Lignite and Sub-Bituminous Coal used in Power Generation	4.9%
Liquefied Petroleum Gas (LPG)	0.00016%	Lignite and Sub-Bituminous Coal used in other sectors	5.1%
Other Non-Energy Oils	0.0%		

Source: Pakistan Energy Year Book

V. Empirical Findings

Equation (21) has been estimated for Pakistan's sulfur emissions. Annual data series for the period of 1972-2006 was used. The data series for Sulfur emission is constructed from the annual fuel consumption patterns of Pakistan. The Ordinary Least Squares (OLS) method is used for estimation and results are presented in the table-2. The regression estimates shown by the above table provide summary statistics for the economy of Pakistan. By and large, like other developing countries, it remains relatively closed to the world competition as for as trade is concerned. As explained earlier, in methodology section that effect of trade on environment can be decomposed into scale, composition, and technique effects. In this analysis, real GDP is used as a proxy for the scale effect of the trade on the level of emissions of SO_2. The coefficient of GDP is positive and significant, indicating that the scale effect increases the emissions of SO_2 as the level of GDP increases at the initial stages of development in the economy.

Table: 2. Results for Sulfur Emission

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.022324	0.010292	2.169115	0.0398
GDP	7.27E-15	2.82E-15	2.579379	0.0162
GDP-squared	-9.83E-28	3.83E-28	-2.567274	0.0166
KL	-9.93E-08	8.42E-08	-1.179894	0.2491
KL-squared	2.49E-13	1.96E-13	1.268980	0.2161
LPCI	-1.67E-06	5.71E-07	-2.924230	0.0072
LPCI-squared	3.31E-11	1.13E-11	2.925672	0.0072
Trade intensity	0.000517	0.001834	0.281921	0.7803
AR (1)	0.183882	0.211241	0.870487	0.3923
R-squared	0.960272	Mean dependent var		0.003841
Adjusted R-squared	0.947559	S.D. dependent var		0.001165
Log likelihood	236.7791	F-statistic		75.53517
Durbin-Watson Stat.	2.212739	Prob-(F-statistic)		0.000000

However, further increase in GDP will reverse the process of emissions after reaching a certain level of domestic output. This phenomenon is evident from the significance and sign of the coefficient of the variable GDP square. The sign is negative indicating that rate of change of emissions of SO_2 is decreasing and they follow the pattern like environmental Kuznut's curve. These results are also consistent with the theoretical expectations of our model that is scale effect is increasing function of the level of GDP. These results are supported by the findings of Grossman and Krueger (1995).

Literature related to the impact of composition effect of trade on environment is largely ambiguous. Some researchers consider it to be helpful for environmental improvement while others are having view point contrary to them. In our study, capital-labor ratio is used as an indicator for composition effect. The estimator of KL is insignificant and negative, reveals that empirical results for Pakistan support the second school of thought. There are marginal effects of changes in the composition of labor and capital due to trade but despite their small magnitude, they lead to environmental deterioration. The composition effects like our results are also found by Shafik and Bandyopadhyay (1992).

The third channel to show the impact of trade on environmental quality is the technique effect. An economy is importing environmental friendly technology as her trade with the rest of the world is increasing. The proxy which we used for technique effect is one period lagged three year moving averages of GNP per capita. This proxy shows that as the level of income in an economy is increasing, people as well as producers become more aware about environment deterioration and in result, they increase the demand for imports of environmental friendly technology. These results are analogous to the findings of Antweiler et al. (1998), and Ferrantino and Linkins (1999).

Both the estimates of LPCI and LPCI-squared are significant and consistent to the theory. The coefficient of LPCI is negative which reveals that technique effect has a positive impact on environmental quality. It may be concluded that trade leads to the importation of environmental friendly technology. However, the coefficient estimate of LPCI-squared is positive, which indicates that the level of SO_2 emissions is decreasing at an increasing rate. The variable of trade intensity reveals the overall consequences of trade on the level of SO_2 emissions per capita. The coefficient of this variable is positive but it is insignificant, discloses the fact that there is no strong evidence for such effect of trade on the level of environmental deterioration in the economy of Pakistan. These are consistent with the findings of Agras and Chapman (1999).

VI. Conclusion and Policy Implications

The objective of the study is to provide an understanding of environmental linkages and test relationship between trade and environment by comparing with the views of proponents of free trade and environmentalists. That is, if there exists any, either positive or negative effect of trade on environmental quality in Pakistan economy over time. The main findings of the study are: (i) The scale effect of trade is positive but is diminishing. This reveals that as an economy becomes richer, it will experience lower level of emissions of pollution. (ii) The composition effect of trade is negative but it is insignificant. Nevertheless, its rate of change on the reduction of pollution emission is increasing in nature. (iii) The most important one is the technique effect that shows favorable influence on the protection of environment. The increase in trade that leads to the importation of environmental friendly technology improves environmental quality and it is also valid for Pakistan (iv) The overall impact of trade on environmental quality is negative but still our study indicates encouraging effects of trade on environment. This is evident from the rates of changes, as the factor responsible for environmental degradation are showing diminishing trend and others are having increasing rates.

The main policy implications of this study includes: (i) the policy makers need to focus on accelerating GDP growth, as the scale effect has positive impact on pollution. (ii) The Policy makers should also focus on those policies which promote the use of environmental friendly technology and efficient use of natural resources in production; since both effects, composition and technique effect have improving consequences on the emission of SO_2 (iii) at last but not the least, Pakistan needs to open its borders for trade and technological transfers to benefit from its policies in the form of consumer surplus and other related gains.

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