Trade Openness, Public Sector Corruption, and Environment:

Data Analysis for Asian Developing Countries

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Abstract

This study used panel OLS, fixed and random effects models to check the effect of trade openness and public sector corruption on the environment. Government effectiveness has been used as a measure of public sector corruption. CO_2 and methane gas emissions are used as the measure of environmental degradation. Different specification tests, such as F-test and Hausman specification test are used to make selection among ordinary least square, fixed effect and random effect model. Random effect model seems best to handle such a situation. In this study the random effect framework is the preferred model, but this study also presents the results from the fixed effects model for comparison purpose. The results of the random effect model are the main finding of this study which concluded that there is negative and significant effect of trade openness, government effectiveness on both CO_2 and methane gas emissions. In this way the world trade openness has also brought to the fore the importance of regulation of government policies towards openness because results has already warned that government effectiveness is volatile and is expected to become more tense thus the strategy needs to identify aspects of government corruption which are hurting economies.

Keywords: *Environmental Pollution, Fixed and Random Effects Model, Openness to Trade, Public Sector Corruption, Pooled OLS.*

I. Introduction

During recent years, economists, social scientists and policy analysts have focused on checking the relationship among trade openness, government effectiveness and the environment. For over a decade researchers have found the possible rise in openness to trade which negatively impact on the environmental protection. Most of the previous empirical work has focused on the relationship among

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trade openness, public sector corruption and the environment which make the main factors of policy discussions. As abatement cost rises with the severity of environmental policy regulation has most certainly been a larger factor for making changes in trade liberalization policy and public sector corruption. For instance the analysis about public sector corruption, trade openness and environmental degradation showed that the increased pollution is due to globalization which can be controlled by domestic political institutions[1]. Big industrial countries do not cut their spending in response to decreasing trade openness. Andonova, Mansfield & Milner (2007), Kaufman & Segura-Ubiergo (2001), Rudra (2002) and Wibbels (2006) have suggested that trade openness is associated with weaker environmental policy even if the government is effective. Hillman and Ur Sprung (1994) estimated the relationships between environmental protection and trade policies with the help of political corruption. They examined that trade openness policy depends on the nature of the externality, and the environmental condition do not depend upon the global trade. The aim of this study is to examine fixed and random effects models to check the effect of trade openness and public sector corruption on the environment.

The structure of this paper is organized as follows. Section 2 consists of review of the existing literature. Section 3 outlines the structure of the model and discusses about theoretical framework. Section 4 presents data sources. Section 5 demonstrates the econometric methodology. Section 6 reveals the empirical results, and Section 7 concludes and presents some policy recommendations.

2. Review of Theoretical and Empirical literature

This section briefly summarizes few important working papers and articles in the literature looking at the relationship among trade openness, government effectiveness and environment for giving clear concept about relationship among trade openness, government effectiveness and environment through literature on the subject. The relationship among trade openness, government effectiveness and environment is a highly debated topic in the environmental growth and development literature.

Yet, this issue is far from being resolved. Theoretical studies found very complex and ambiguous relationship among trade openness government effectiveness and environment. The phenomenal differences among environment condition in the South and East Asian, the Latin American, and Sub-Saharan African countries in several decades have encouraged a renewed interest in the effects of trade openness and government effectiveness on environmental degradation. The debate on different countries has often been fruitless because they differ in their belief on government actions against environmental degradation. The purpose of this study is set out what we currently know about the environmental pollution and international trade with the help of government corruption through theoretical and empirical literature of different studies conducted by authors

[1]see Adsera & Boix (2002) and Garrett (1998) for full issue

from different countries.

The model of this paper is developed in Section 3 with the help of Damania, Fredriksson, and List (2002) model[2]. Much of the earlier literature focuses on issues like on environmental and international trade issues. Although this paper also focuses on how trade openness and public sector corruption affects environmental degradation. So this study focuses on these issues as crucial to resolving current policy questions, with the help of few literatures which check relationship among trade openness, public sector corruption and environmental degradation in their own countries.

Leidy and Hoekman (1994) discovered the relationship between environmental tools and trade policy, they founds that polluting industries favors inadequate environmental policy because it boosts the level of trade barriers.

Copeland (1994) investigated the beneficial effects of trade on environmental policy reforms. He also includes the case of global factor mobility. Further, the argument to assess globalization and environment is in line with Copeland and Taylor (1995) who analyzes the intentional interaction between developed and poor countries that moves from autarky to free trade, permitting trade-income related environmental policies.

Strutt and Anderson (2000), reported a case study of Indonesia till 2020, through global economic growth and structural changes they used an extended dataset for the periods 1992–2010 and 2010–2020. They concluded that trade policy reforms for the next two decades would improve and reduce the depletion of natural resources.

Antweiler, Copeland and Taylor (2001) researched using data for 43 countries over the 1971-1996 period. Their estimates result showed that trade has positive impact on environmental growth. Therefore they conclude free trade is good for environment.

Lopez and Mitra (2000) providing an excellent literature review on the relationship among corruption, income and pollution [the Environmental Kuznets Curve (EKC)]. They found evidence that if Govt is implementing good governance, it tend to increase economic growth then it would result in higher turning point in pollution.

Damania, Fredriksson, and List (2002) have analyzed Organization for Economic Co-operation and Development (OECD) countries using panel random and fixed effect model for the 1982 to 1992 period to examine the causal relationship among corruption trade liberalization and environment. Their results interpreted that, countries with more open trade regimes tend to have stricter environmental regulations on average.

Fredriksson and Svensson (2002) investigated the effect of public sector corruption and political instability on environmental policy by using cross-country data for 63 developed and developing countries. Their results

[2]See full articles of Damania, Fredriksson, and List for understanding of full issue

collaborated that there is strong correlation between corruption and political instability, and corruption is significantly negatively correlated with the environmental policies.

Managi (2004) using panel data for 63 developed and developing countries for the period from 1960 to 1999 to check whether free trade is harmful or beneficial for the environment. He concluded that trade openness is found to have harmful effects on environment.

Frankel and Rose (2002, 2005) taking data set of cross-section countries in 1995 to check the impact of openness to trade on the environment. But their result confirms negative and insignificant relationship between trade openness and environment degradation in capital abundant countries.

Copeland and Taylor (2004) examined the environmental consequences of economic growth and international trade by using static model of production-generated pollution. Their result shows that increasing integration of the global economy tends to increase income and it has positive impact on domestic environmental policy regulation.

Morse (2007) estimated the relationship between the corruption and Environmental Sustainability in cross-national countries. Their study employed the Environmental Sustainability Index (ESI) taken index for the period 2001, 2002, and 2005, and Corruption Perception Index (CPI) of 2002 created by Transparency International (TI). Their research results concluded that there is significant relationship among corruption, income and environmental degradation.

Antweiler et al., (2001) observed that the effect of trade openness on pollution emissions depend on a country's comparative advantage. Their study described that trade liberalization always increases the pollution tax due to positive income effect. They suggested that the level of corruption determines the relative importance of bribery versus social welfare.

The model by Grossman and Helpman (1994) closely characterizes a form of high-level corruption. Coate and Morris (1996) also pointed out that a reduction in corruption unambiguously leads to an increase in the pollution tax. Khagram (2004) taking cross-country studies, evidenced that high public sector corruption have also been related with inequality and low environmental taxes, but there is another debate that poor countries tolerate corruption more than rich countries.

3. Theoretical Framework and Model Specification

Despite the discussion about the link among trade openness, government effectiveness and environmental degradation, the existing literature in economics has failed to examine the consequences of trade liberalization policy on environmental change. This study develops a model with the help of Damania, Fredriksson, and List (2002) model in which the trade openness, government effectiveness, some relevant socio-economic variables and interaction terms reveals that how

it affect environment thorough random and fixed effect model. The random effect model is the best model of the study and random effect model results showed that there is negative and significant effect of trade openness, government effectiveness on both CO_2 and methane gas emissions in this study.

The model of the present study can be described as follows:

Y=F(TO,GE,RGDP,UP,LF,I,YS,K,M,N, E).....1

Where

Y: Carbon dioxide and Methane gas emissions

TO: Ratio of exports plus imports divide by GDP

GE: Government Effectiveness is measure of public sector corruption. Its value lies between +2.5 to -2.5. +2.5 means government is highly efficient, -2.5 means Government is highly corrupted.

RGDP: Real GDP per capita

UP: Urbanization or Urban population (% of total population exposed to industrial pollution/damages)

LF: Labor force participation rate (% of total population)

I: Investment (% of total investment in industries)

YS: Years of schooling which indicates education increases income which raises luxurious commodities demand and hence pollution.

K: $RGDP^2$ represents Environmental Kuznets Curve (EKC) hypothesis which described that if income rises, in first stage environmental damages increases but after reaching maximum point income tends to reduces environmental damages as people pay taxes for regulation that's why Environmental Kuznets curve is inverted 'U' shape

Whereas interaction terms are defined as:

*M: (TO*RGDP) characterizes as output generated by trade openness*

*N: (GE*RGDP) stands for implementation of environmental regulation*

*E: (GE*TO) symbolizes as trade openness generated by government efficiency.*

4. Data sources

The time series data on the CO_2 and methane gas emission in kilo ton (kt), trade openness (as %), real GDP per capita in constant 2000 US $, investment (as % of total investment in industries), urbanization or urban population (as % of total population exposed to industrial pollution/damages), labor force participation (as % of total population) and enrollment in secondary school collected from the World Development Indicators (WDI: an expanded set of international comparisons, Version-2012). The government effectiveness index is taken from World Governance Indicators. The panel consists of 12 Asian developing countries spanning the years from 1995 to 2012.

5. Econometric Methodology

There are basically three types of panel models namely Pooled Ordinary least square regression, a panel model with fixed effect and panel model with random effect. This study used pooled ordinary least square (OLS), fixed effect model (FEM) and random effect model (REM) for estimation of the effect of trade openness, government effectiveness and all other explanatory variables on carbon dioxide emission and methane gas emissions. But the best model is random effect model in this study. The models are specified as follows:

$$Y_{it}=ó_{it}\Omega_{it}+\mu_{it} \quad \text{..... (2)}$$

Where Y is the dependent variable (CO_2 and methane gas emission), ó represents a vector of explanatory variables, Ω is slope coefficients, i denotes for the countries t de-

[3]See Gross man and Helpman publications for full issue

notes time and μ_{it} is the error term which is assumed to be white noised and varies over both country and time. While using a pooled OLS regression, countries' unobservable individual effects are therefore not controlled. According to Bevan and Danbolt (2004), heterogeneity of the countries under consideration for analysis can influence measurements of the estimated parameters. The fixed-effects model can be derived from equation (2) relative to the notations used in the study as follows:

$$Y_{it} = \alpha_i + \lambda_i + \beta_1 TO_{it} + \beta_2 GE_{it} + \beta_3 RGDP_{it} + \beta_4 UP_{it} + \beta_5 LF_{it} + \beta_6 I_{it} + \beta_7 YS_{it} + \beta_8 Kit + \beta_9 M_{it} + \beta_{10} N_{it} + \beta_{11} E_{it} + \mu_{it} \quad \ldots\ldots (3)$$

In equation (3), Y is the dependent variable (CO_2 and methane gas) α_i captures unobserved country-specific effects assumed fixed over time, *i* –1 dummy variables are used to designate the particular country, this model is sometimes called the least square dummy variables model (LSDV). The dummy for Pakistan is used as comparison country. The year-effects represented by λi are included to account for shocks that are common to all countries in the sample, year 2012 dummy taken as comparison year in this study. From equation (2) study derives the random-effects model as follows:

$$Y_{it} = \lambda_i + \beta_1 TO_{it}\,\gamma_i + \beta_2 GE_{it}\,\gamma_i + \beta_3 RGDP_{it}\,\gamma_i + \beta_4 UP_{it}\,\gamma_i + \beta_5 LF_{it}\,\gamma_i + \beta_6 I_{it}\,\gamma_i + \beta_7 YS_{it}\gamma_i + \beta_8 K_{it}\gamma_i + \beta_9 M_{it}\gamma_i + \beta_{10} N\gamma_{iti} + \beta_{11} E_{it}\gamma_i + \mu_{it}, \gamma_i = (\gamma)\,\bar{\gamma} + \sigma i \quad \ldots\ldots (4)$$

The explanatory variables remain as defined in equation (1). In equation (4) μ is the error term, σi represents for random country effect while $(\gamma)\,\bar{\gamma}$ is the mean of the coefficient vector. The slope coefficients are allowed to vary randomly across countries, under the random-effects model. Hsiao (1996) argues that the OLS procedure yields biased and inconsistent estimates, especially when the omitted country-specific variables are correlated with the explanatory variables. This model is a generalized, group-wise heteroscedastic model. For the selection of best model among these models, F test and Hausman specification are conducted in this study.

6. Empirical Analysis

This section begins with the empirical analysis by examining the results from the Hausman test with regard to the selection of the most appropriate model between the fixed (FEM) and random effects (REM) frameworks. The Hausman test statistics presented in Table 1 and 3 indicate that the random effect model should be preferred over the fixed effect model. In each model (1-8), the test statistic suggests that the null hypothesis is the FEM and REM estimators differ substantially should not be rejected at the 1 percent level. Although the random effect framework is the preferred model, but this study also presents the results from the fixed effects model for comparison purposes.

Tables 1-4 display the results of CO_2 and methane gas emissions from the pooled OLS, fixed effects and random effect model. The first column of Table 1 and 3 list the explanatory variables followed by several statistics. The diagnostic statistics include the R2, Hausman test and F test statistics. The number of countries in the panel, and the total number

of observations both across country and over time also written in the first column. The columns in Tables 1-4 present the results of separate regression models. For easy identification, the regression equations are named in columns. Column 2 to 5 of Table 1 & 3 and column second, forth & sixth of Table 2 & 4, the study present the results of pooled OLS, country fixed effect, period fixed effect and random effect models for CO_2 and methane gas emissions respectively.

In Table 1, model 1 results indicate that coefficient of trade openness and implementation of environmental regulation has negative and statistically significant impact on CO_2 emissions. This result implies that increase in trade openness and improvement in environmental regulation would reduce CO_2 emissions. Coefficient of government effectiveness, urbanization, investment & trade openness generated by government efficiency have positive and significant effect on CO_2 emissions. This result provide evidence that if government policies are ineffective i.e. corruption level is high, urbanization creates employment in industries and people invest in industries then consequently level of CO_2 emissions would be high.

Model 2 reports that the coefficients of government effectiveness, real GDP per capita, urban population, years of schooling and dummies for countries in column 2 of table 2: China, India and Indonesia have positive and statistically significant and dummies of countries Bangladesh, Malaysia, Sri Lanka, Philippines, Singapore & Honk Kong have negative and statistically significant effect on CO_2 emissions. This result indicates that if government policies are ineffective, consequently CO_2 emission would increase. The rapid urbanization creates congestion and employment in industries in urban areas which increase pollution. The increased level of education increases income, also real GDP per capita raises demands for luxurious goods, such as automobiles, air conditioners and other electrical appliances (pollution intensive goods) therefore CO_2 gas emissions would be increased.

The results of model 3 indicate that coefficient of government effectiveness, real GDP per capita, years of schooling, implementation of environmental regulation and all period dummies (column 4 of Table 2) have statistically significant and positive while trade openness, labor force participation, environmental Kuznets curve, output generated by trade openness and trade openness generated by government efficiency have negative and statistically significant effect on CO_2 emissions. It means trade openness, labor force participation, and environmental Kuznets curve (higher per capita income) beneficial for environment tends to reduce CO_2 emissions. If government does not efficiently implement environmental regulation policies due to corruption, income and higher education level also tends to increase CO_2 emissions.

The results of random effect model for CO_2 are reported in column 5 of table 1. The results of model 4 interprets that the coefficients of trade openness, government effectiveness, urbanization, investment, years

of schooling, output generated by trade openness, implementation of environmental regulation and trade openness generated by government efficiency have positive and significant effect on CO_2 emissions. Although trade openness, output generated by trade openness and implementation of environmental regulation have negative impact on CO_2 gas emissions. This result suggests that trade openness, government effectiveness for implementation of environmental regulation and output produced by trade are beneficial for environment. Conversely urbanization, investment and years of schooling tend to increase CO_2 emissions. Years of schooling increases income and demand for goods which increase industrial production, investment in industries increases pollution through production and hiring of work force, urbanization increases employment in industries which raises pollution. These results support the strength of the results from the random effects model (i.e. the preferred model). Although according to these results, these models (1-4) results favors Faiz-ur-Rehman, Ali and Nasir (2007) results who also concluded that trade openness have positive and significant effect on environment regulation but also reduces government corruption.

To measure the random deviation (error component) of individual intercept from mean value of all cross-sectional intercept which is $(\gamma_i) \bar{\gamma}$ is reported in Table 2, column 6. The mean value of the random error component $(\gamma_i) \bar{\gamma}$ is the common intercept value of 2.45. The cross-section's random value for Pakistan is 2.72E-08 tells how much the random error component of Pakistan differs from the common intercept value. Similarly Cross-section random value of Bangladesh = -7.23E-07, China = 2.58E-07, India = 4.57E-08, Indonesia = 2.84E-08, Iran = 2.55E-07, Malaysia = -1.29E-07, Sri Lanka = -1.05E-07, Philippines = -1.15E-07, Thailand = 6.47E-07, Singapore = 6.47E-08 and Hong Kong = -2.55E-07 differs from the common intercept value as given in the table 2.

For model 5 the study reports the results from pooled regression for methane gas emissions. The regression coefficients of trade openness, real GDP per capita and implementation of environmental regulation have negative and statistically significant effect but government effectiveness, urbanization, labor force participation, investment and years of schooling have positive and statistically significant effect on methane gas emissions. So if trade is more open, increased income generates awareness and effective environmental regulation reduces pollution.

In model 6 and 7, study analyzed fixed effect model for methane gas emissions. In this way the results of model 6 reported that the coefficient of government effectiveness, trade openness, labor force participation, investment, environmental Kuznets curve, output generated by trade openness, implementation of environmental regulation and trade openness generated by government

[4]See Faiz-ur-rehman, Ali and Nasir (2007) article 'Corruption, trade openness, and environmental quality: a panel data analysis of selected South Asian countries' for understanding of full issue.

efficiency have statistically insignificant effect on methane gas emissions. The coefficients of real GDP per capita, urbanization, years of schooling and countries dummies (column 2 of table 4) for Bangladesh, China, India, Indonesia, Iran, Malaysia, Philippines and Thailand have positive and significant effect on methane gas emissions whereas Sri Lanka, Singapore and Honk Kong have negative and statistically significant effect on methane gas emissions. It means GDP, urbanization and years of schooling create more income so people spend more on luxurious goods, which increase methane gas emission.

Countries dummies for all time periods of model 7 (column 4 of table 4) shows significant effect on methane gas emissions but time dummies 1996, 1997, 2009 and 2010 have negative signs. In model 7 coefficient of urbanization and years of schooling have statistically significant and positive while all remaining variables have insignificant effect on methane gas emissions. It concludes that if urbanization creates jobs in industries and no. of years of schooling or education make more demand of luxurious items i.e. cars so methane gas emission also increases.

Model 8 comprises results of random effect model in which the period effect is assumed fixed. Furthermore random effect model results are more appropriate than fixed effect results. In this way results reported that regression coefficient of trade openness, Govt. effectiveness, real GDP per capita, urban population, labor force participation, investment, years of schooling, environment Kuznets curve, output generated by trade openness, implementation of environmental regulation and trade openness generated by Govt. efficiency have significant effect. Trade openness, real GDP per capita and implementation of environmental regulation have negative impact on methane gas emissions. This result implies that trade openness reduces methane gas emissions and Govt. policies are effective so people pay more tax out of their income so environment quality improves. Richard Damania , Per G. Fredriksson and John A. List also support these results as their results concluded that trade openness policy and environment has negative relationship only if government policies are strong. Per G. Fredriksson and Jakob Svensson (2003) also discussed the trade policies and government corruption issues for environment regulation in their study. They also supports this present study results and concluded that government corruption has positive relationship with environment degradation and when corruption is low environment condition will improve.

The mean value of the random error component $(\gamma)\ \bar{\gamma}$ (column 6 of table 4) is the common intercept value of 1.65. The cross-section's random value for Pakistan is 2.50E-08 tells how much the random error component of Pakistan differs from the common intercept value. Similarly Cross-section random value of Bangladesh=-4.85E-08, China = 3.16E-08, India = -1.24E-08, Indonesia = -3.15E-08, Iran = 1.47E-08, Malaysia = 2.11E-08, Sri Lanka = -1.63E-08, Philippines = 1.20-E-08, Thailand = 5.34E-08, Singapore = -2.18E-08 and Hong Kong = -1.53E-08 differs from the common intercept value as given in the table 4.

7. Conclusions and Policy Implications

There has been a long debate among policy makers and economists at the national and international levels about whether trade openness and public sector corruption have any impact on environmental degradation. This study focuses on an empirical analysis in the framework for panel of 12 Asian countries by employing data from 1995 to 2012. This study employed fixed and random effects model for the analysis. This study also examined pooled OLS regression model to show that if country-specific features, such as law and order situations and tax structures are omitted then the pooled OLS procedure yields biased and inconsistent results especially when the omitted country and time specific variables are correlated with the explanatory variables which might affect environmental regulation. The paper tried to minimize the country and time specific heterogeneity by imposing dummies, such as, in case of fixed effect model the study used time and country specific dummies. Although the random effect framework is the preferred model, but this study also presents the results from the fixed effects model for comparison purpose.

The result of the random effect model concludes that there is negative and significant effect of among trade openness, government effectiveness on both CO_2 and methane gas emissions. The study also suggests that trade openness generated by government efficiency concluded that the public sector corruption influence trade openness by their beneficial trade policies. Government may import pollution abatement devices according to green policies which will reduce gas emissions. Moreover, output generated by trade openness also have negative impact on both gas emissions which means trade openness is good for environmental health. Finally, implementation of environmental regulation depends upon on the level of corruption. If government policies are effective then environment regulations are conducive for people.

In light of above results, the main policy recommendations are that government should adopt green policies for pollution abatement. Government must strengthen its monitoring capability against pollution and regulate abatement technologies or devices in the light of their strategy. Side by side government should also provide proper guidance for pollution abatement by different research programs. For openness of trade, government should create trade zones, corridors and boundaries which will enhance environmental health and stability. The world trade openness policies should also brought the importance of regulation of government policies towards openness because government effectiveness is volatile mostly so strategies needs to be identify about government corruption that are hurting many countries economy. So with the help of trade openness policies through adopting pragmatic approach and by removing government corruption environment regulation should improves in a better way.

[5]See Per G. Fredriksson and Jakob Svensson (2003) for full issue

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Table 1: Pooled and Panel data Models: Dependent variable CO_2

Independent Variables	Model 1	Model 2	Model 3	Model 4
	Pooled OLS	Countries Fixed Effect (CFE)	Periods Fixed Effect (PFE)	Random Effect (RE)
C	2.434* (1.683794)	-0.306 (-0.136)	4.024*** (3.065)	2.434*** (4.276)
TO	-0.593*** (-3.095)	-0.033 (-0.238)	-0.137 (-0.931)	-0.593*** (-7.8601)
GE	0.638*** (4.129)	0.264*** (2.702)	0.246*** (2.533)	0.6388*** (10.49)
RGDP	-0.120 (-0.408)	0.7230*** (3.393)	0.506*** (2.246)	-0.1206*** (-1.023)
UP	0.882*** (6.6369)	0.4487* (1.734)	0.235 (0.969)	0.889*** (16.854)
LF	0.1545 (0.513)	-0.368 (-0.730)	-1.1599*** (-2.239)	0.1543 (1.047)
I	0.931*** (26.744)	0.0230 (0.415)	0.094 (1.4305)	0.931*** (67.924)
YS	0.1759 (1.4294)	0.2977*** (2.228)	0.351*** (2.735)	0.1750*** (3.604)
K	-0.067* (-0.058)	-0.0107 (-0.223)	-0.0373 (-0.7995)	-0.0067 (-0.198)
M	-0.121 (-1.040)	0.002 (0.047)	-0.005* (-0.116)	-0.1212*** (-2.643)
N	-4.9E-05*** (-5.677)	-5.35E-06 (-0.7823)	7.25E-07* (0.108)	-4.29E-05*** (-14.425)
E	0.001* (1.641)	-0.002 (-1.010)	-0.002** (-1.935)	0.001*** (4.679)
R-Squared	0.9185	0.988	0.9402	0.9132
No of Countries	12	12	12	12
No. of Observations	216	216	216	216
F-test		F= 101**(0.000)		
Hausman Test				H=11.047***(0.001)

Estimation: To choose FEM or REM the Hausman test can be used which has an asymptotic chi-square distribution which tests the hypothesis that FEM and REM estimators differ substantially against the null hypothesis FEM and REM estimators do not differ substantially.
The F-test has normal distribution N (0, 1) and tests the null hypothesis of insignificance as a whole of the estimated parameters, against the alternative hypothesis of significance as a whole of the estimated parameters.
***, **, and *denote significance at 1, 5 and 10 % level of significance, respectively. The figure in parentheses represents the t-statistic.
Source: Author's calculation

Table 2: Corresponding Intercept Value for CO_2

Countries Fixed Effect		Periods Fixed Effect		Random Effect	
Pakistan	-0.306 (0.891)	1995	4.7591** (0.031)	Pakistan	2.72E-08
Bangladesh	-0.938*** (0.001)	1996	4.6070** (0.032)	Bangladesh	-7.23E-07
China	2.775*** (0.000)	1997	4.6666** (0.032)	China	2.58E-07
India	2.194*** (0.000)	1998	4.8880** (0.025)	India	4.57E-08
Indonesia	0.3019*** (0.000)	1999	4.9033** (0.031)	Indonesia	2.84E-08
Iran	-0.1650 (0.454)	2000	4.8702** (0.033)	Iran	2.55E-07
Malaysia	-1.795*** (0.000)	2001	4.9551** (0.032)	Malaysia	-1.29E-07
Sri Lanka	-2.667*** (0.000)	2002	4.9468** (0.033)	Sri Lanka	-1.05E-07
Philippines	-1.030*** (0.000)	2003	4.8982** (0.022)	Philippines	-1.15E-07
Thailand	-0.4665 (0.572)	2004	4.858** (0.023)	Thailand	6.47E-07
Singapore	-3.843*** (0.000)	2005	4.7680** (0.0276)	Singapore	6.47E-08
Hong Kong	-4.4739*** (0.000)	2006	4.6488** (0.026)	Hong Kong	-2.55E-07
		2007	4.5044** (0.0345)		
		2008	4.4162** (0.023)		
		2009	4.2780** (0.029)		
		2010	4.0029** (0.031)		
		2011	4.1339** (0.028)		
		2012	4.090*** (0.002)		

***, **, and *denote significance at 1, 5 and 10 % level of significance, respectively. The figure in parentheses represents the p-values.
Source: Author's calculation

Table 3: Pooled and Panel data Models for Methane Gas Emissions

Independent Variables	Model 5	Model 6	Model 7	Model 8
	Pooled OLS	Countries Fixed Effects (CFE)	Periods Fixed Effect (PFE)	Random Effect (RE)
C	1.642 (1.548)	1.786 (1.039)	1.8603** (1.7100)	1.645*** (3.7199)
TO	-0.334*** (-2.38)	-0.1404 (-1.306)	-0.1833 (-1.551)	-0.3325*** (-5.7973)
GE	0.3039*** (2.684)	0.0512 (0.6864)	0.0703 (0.9740)	0.3039*** (6.520)
RGDP	-1.163*** (-5.345)	0.2636* (1.6150)	0.1107 (0.6457)	-1.163*** (-13.016)
UP	1.089*** (10.91)	0.7473*** (3.862)	0.6788*** (3.532)	1.080*** (26.783)
LF	1.131*** (5.123)	-0.1992 (-0.5060)	-0.5058 (-1.247)	1.1311*** (12.4748)
I	0.649*** (25.400)	-0.014 (-0.393)	-0.039 (-0.489)	0.6493*** (61.752)
YS	0.5451*** (6.036)	0.330*** (3.3032)	0.353*** (3.628)	0.5450*** (14.638)
K	0.0650 (0.7585)	-0.0376 (-0.8802)	-0.0582 (-1.323)	0.0650** (1.8452)
M	-0.0340 (-0.3564)	-0.0175 (-0.488)	-0.0219 (-0.684)	-0.0341 (-0.8698)
N	-3.48E-05*** (-6.2618)	-4.22E-06 (-0.8056)	-2.43E-06 (-0.4066)	-3.48E-05*** (-15.251)
E	0.0448 (0.9045)	4.85E-05 (0.1048)	-0.0289 (-0.6145)	0.0004*** (2.2014)
R-Squared	0.9684	0.9943	0.9010	0.9664
No of Countries	12	12	12	12
No of Observations	216	216	216	216
F-test		F= 91.6***(0.000)		
Hausman Test				H=9.678***(0.0023)

To choose FEM or REM the Hausman test should be used which has an asymptotic chi-square distribution and tests the hypothesis that FEM and REM estimators differ substantially against the null hypothesis FEM and REM estimators do not differ substantially.
The F-test has normal distribution N (0, 1) and tests the null hypothesis of insignificance as a whole of the estimated parameters, against the alternative hypothesis of significance as a whole of the estimated parameters.
***, **, and *denote significance at 1, 5 and 10 % level of significance, respectively. The figure in parentheses represents the t-statistic.
Source: Author's calculation

Table 4: Corresponding Intercept Value for Methane gas

Countries Fixed Effect		Periods Fixed Effect		Random Effect	
Pakistan	1.7861** (0.0229)	1995	1.8683** (0.064)	Pakistan	2.50E-08
Bangladesh	1.8428*** (0.0026)	1996	1.8042** (0.049)	Bangladesh	-4.85E-08
China	4.0087*** (0.000)	1997	1.7735** (0.048)	China	3.16E-08
India	3.488*** (0.00)	1998	1.9876** (0.046)	India	-1.24E-08
Indonesia	2.088** (0.013)	1999	1.9863** (0.03)	Indonesia	-3.15E-08
Iran	1.0356*** (0.000)	2000	2.0537** (0.048)	Iran	1.47E-08
Malaysia	0.1778*** (0.000)	2001	1.9853** (0.06)	Malaysia	2.11E-08
Sri Lanka	-0.0514*** (0.000)	2002	2.055** (0.045)	Sri Lanka	-1.63E-08
Philippines	1.0422*** (0.000)	2003	2.0336** (0.033)	Philippines	1.20E-10
Thailand	1.4108* (0.098)	2004	2.0463** (0.0417)	Thailand	5.34E-08
Singapore	-3.4098*** (0.000)	2005	2.0848** (0.0382)	Singapore	-2.18E-08
Hong Kong	-3.2234*** (0.000)	2006	2.0663** (0.037)	Hong Kong	-1.53E-08
		2007	1.954** (0.040)		
		2008	1.923** (0.040)		
		2009	1.8093** (0.043)		
		2010	1.855** (0.040)		
		2011	1.8898** (0.036)		
		2012	1.8604* (0.088)		

***, **, and *denote significance at 1, 5 and 10 % level of significance, respectively. The figure in parentheses represents the p-values.
Source: Author's calculation

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