This paper examines the relationship between FDI, technology and environment with an assessment of aggregated relationship, by technical composition and the mode of technology transferability through FDI. A panel data for 19 developing countries has been used to for 14 years of data. The empirical results have suggested that FDI is the significant variable in explaining the carbon emission in developing countries followed by energy consumption and technology transformation. Our findings suggest that to manage both energy consumption and FDI flows via investment in research and development (RDY) or energy efficiency demand to reduce CO2 emissions is not possible without stringent environmental regulations and without retaining the developing countries’ competitiveness.

Keywords: CO2 emissions; Foreign Direct Investment; Technological change; Energy consumption; Developing countries

JEL Classifications:

1. Introduction
With the rapid pace of development global warming has captured the attention of environmentalists, they are in constant search to find the
causes, possible strategies and consequences of climate change. In economic jargon, most of the economic activities will generate major greenhouse gas emission, like burning of fossil fuels, agricultural outcomes, industrial processes and deforestation are the main factors which lead towards climate change. The initial studies related to environment have roots of Environmental Kuznets curve (EKC). The main literature on EKC has concentrated on detection of inverted EKC between income and pollution. Panayotou (2003) presented his view that despite rising incomes through rapid development, the social and human welfare will be in halt without considering the risks of environmental implications.

Table No.1

<table>
<thead>
<tr>
<th>Effecting Variable</th>
<th>Form of Change</th>
<th>Primary Investment</th>
<th>Secondary Environmental Effect</th>
<th>Primary Motivation</th>
<th>Expected Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research and</td>
<td>Process Internalization</td>
<td>Reduced CO₂ Emissions</td>
<td>High consumption of energy</td>
<td>Environmental</td>
<td>-ve</td>
</tr>
<tr>
<td>development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High tech Exports</td>
<td>Input substitution</td>
<td>Increased CO₂</td>
<td>Increased mechanical intensive material</td>
<td>Economic</td>
<td>+ve</td>
</tr>
<tr>
<td>FDI</td>
<td>Endogenous</td>
<td>Reduced greenhouse gases emission</td>
<td>Increased technology transfer</td>
<td>Economic &amp; Environmental</td>
<td>+ve</td>
</tr>
<tr>
<td>Energy usage</td>
<td>Process</td>
<td>Reduced waste and CO₂</td>
<td>Research and development</td>
<td>Environmental</td>
<td>+ve</td>
</tr>
<tr>
<td>Combustible</td>
<td>Product change</td>
<td>Reduce energy consumption</td>
<td>Alternative production methods</td>
<td>Economic &amp; Environmental</td>
<td>+ve</td>
</tr>
<tr>
<td>Renewable resources</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fossil Fuel</td>
<td>Process</td>
<td>Reduction in CO₂</td>
<td>Reduce solid waste</td>
<td>Environmental</td>
<td>+ve</td>
</tr>
<tr>
<td>Consumption</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. Literature Review

To quantify the effect of trade on environmental quality or the effect of trade liberalization on the environment, environmental studies with technology are articulated. There are arguments in favor of FDI as a conduit for technology transfer. While focusing on trade liberalization FDI can open new horizon of development and labor turnovers as domestic employees move from foreign to domestic firms with technological change. Bretschger (2005) provided the evidence for the importance of endogenous technological change that change has the potential to compensate or complement for natural resource scarcity, poor input substitution, decreasing returns to capital and material balance restrictions, but it is limited by various restrictions or could hamper the progress such as fading returns to innovative investments and rising research costs.

The level of the utilization of natural resources, as measured by energy intensity and the level of environmental stress has measured by CO₂ emission. Sun and Kuntsi (2004), Loganathan and Subramaniam (2010) and Halicioglu (2008) has analyzed investigated the sustainability between energy consumption (kg of oil equivalent per capita) and economic performances (GDP) indicated that high price or cost of converting energy into GDP with FDI high energy intensity is prominent in developing countries and its impact is important for energy efficiency of newly industrializing countries can be improved via the transfer of energy saving technologies from developed countries.

Peterson (2008) explained the greenhouse gas (GHG) have risen primarily in developing countries to be in the pace of rapid industrialization, with developing international trade international and diffusion of advanced technologies have taken place and impacts on the energy infrastructure GHG emissions in developing countries has increased. Technology transfer to play a prominent role in GHG mitigation, governments and international donor agencies should aim
to improve the conditions for private technology transfer, remove market barriers and to set conditions to ensure effective technology transfer. Fu (2008) has investigated the impact of foreign direct investment (FDI) on the development of innovation capabilities at regional level in China; availability of the absorptive capacity depends on the strength of positive effect. The presence of innovative complementary assets in the host region these capabilities and technological diffusion would contribute towards economic development.

Pao and Tasi (2010) addresses the impact of economic growth, foreign direct investment and energy consumption on environmental degradation and find out that in long-run equilibrium, CO₂ emissions appear to be energy consumption elastic and FDI inelastic, and support the Environmental Kuznets Curve (EKC) hypothesis. Causality results show bi-directional causality towards FDI and emission and support the pollution haven hypothesis. Aguayo (2010) accessed the role of technical change in aggregation by relating it to economic growth and CO₂ emission in Mexico, with the example of a large, middle-income developing country, and shows that long periods of economic stagnation reinforce ‘carbon lock-in’ despite significant improvements in energy efficiency. If international technology transfer receives effective support, technological leap-fogging could allow developing countries to reach that level earlier on but with this the probability of GHG (Greenhouse gases) concentration and carbon emission in developing countries will reach at their highest points. Longjian (2010) called FDI as two-edged sword along with the great effect in host country’s economic development. Asici (2011) and Batinova (2011) cross-country analysis reveals that there is a positive relationship between income and pressure on nature. Growth impact is found stronger in middle and low income countries. As countries grow richer, so does their pressure on nature. His results reveal that 1% increase in income leads to a 4.6% increase in pressure on nature.
The relationship between income and pressure on nature remains highly significant and positive, and the effect is almost doubled. Dean (2009) focused their claim on that foreign investors from industrial countries are attracted to weak or soft environment regulations and laws in developing countries. They have discussed issue of inter-country and intra-country differences in environmental regulations which have turned poor countries into pollution havens. Blanco et al. (2011) have conducted panel Granger causality tests to study the relationship between sector specific FDI and CO₂ emissions, by using a sample of 18 Latin American countries for 1980-2007 period, they found causality running from FDI in polluting intensive industries (the dirty sector) to CO₂ emissions per capita. FDI has attracted in developing countries because of creation of capital stock and employment and the transfer of skills and technology that lead to greater productivity. The developing economies are becoming pollution havens because multinational corporations are locating industries in order to save environmental costs. Jayanthakumaran et al. (2012) focuses on the issue of destabilization of the Earth’s biosphere by comparing two major countries and growing economies, India and China, in terms of structural changes in growth, trade and energy use. CO₂ emissions from the burning of fossil fuels have significantly increased in the recent past.

3. Objective
This paper tries to empirically test the relationship between FDI and various aspects of the technological change with environment. We have hypothesized the existence of a relationship between FDI and environment and how other technical indicators have significant relationship with climate change?

Hₐ: Environmental degradation is determined by foreign direct investment in developing countries where energy consumption and technology transformation are considered explicitly.
4. Data and Methodology
To evaluate the correlation between FDI and technological transformation, a composite measure is necessary. The connotation of technological index is very extensive; it includes education, research and development expenditure, science and technological resources, innovative capabilities, innovational environment, high technology intensive exports and utilization of global knowledge. A practical problem faced by empirical studies to analyze the role of technological availabilities and measurement of availability of the different components of technology and their objectivity in an inter-country and intra country setting. There are various components which may include in technological prospects. However, a comprehensive indicator of technology availability is not available. Therefore, this paper first develops a composite index of the availability of different aspects of technical indicators using the principal component analysis. A technology Index (INTECX_{it}) is computed for a sample of 19 countries (i.e. i = 20) for 1999-2012 (t = 14).  \[ \text{Technological transformation} \] is proxied by Research & development expenditure (RDY), while other variables include Exports of high-technology (HT), Scientific research journals (SRJ) and Number of patents (P). These variables have been inspired from Mehmood & Azim (2014); Mehmood (2014); Mehmood & Azim (2013); Mehmood & Rehman (2015); Mehmood & Siddiqui (2013); Mehmood, Azim, & Anwar, (2013); Mehmood, Azim & Asghar (2013); Mehmood Azim, Raza, & Sohaib (2014); Mehmood, Muhammad & Mateen (2013); Mehmood, Rehman & Rizvi (2014); Mehmood, Rizvi & Rizvi (2014) and Mehmood, Shafique & Rafqat (2014). Source of data is World Development Indicators (WDI). The sample covers developing countries include Brazil, Chile, China, Colombia, Egypt, Georgia, India, Kazakhstan, Pakistan, Poland, Romania, Russia, Thailand, Tunisia, Turkey and Ukraine.
countries for which data on all the relevant variables is available. It is based on linear combinations of the data that maximize variance.

3.1 Principal Components Analysis
The research paper has conducted principle component analysis environmental degradation and technological progress is a multi-dimensional concept. For this purpose, certainly need summary indicators which may cover all of the dimensions of variable the most straightforward way of summarizing the indicators is PCA. There are several aspects of technological transformation which complement each other such as research and development, scientific journal, technical education and high technological exports etc. for comprehensive index of these variables; (PCA) becomes handy in constructing a single index that captures the variance or information contained in different variables.

3.2 PCA Model
PCA decomposes the data matrix X (m samples, n variables) as the sum of the outer product of vectors $s_i$ and $\theta_i$ plus a residual matrix $\epsilon$: (Penha and Hines, 2001)

$$X = s_1\theta_{1t} + s_2\theta_{2t} + \cdots + s_k\theta_{kt} + \epsilon$$

The vectors $\theta_i$ are orthonormal and the vectors $s_i$ are orthogonal, that is:

$$\theta_i^T\theta_j = 1, \text{ if } i = j \text{ and}$$

$$\theta_i^T\theta_j = 0, \text{ if } i \neq j; \text{ and}$$

$$s_i^T s_j = 0 \text{ if } i \neq j$$

Also note that $s_i$ is the linear combination of the original X data defined by the transformation.

Vector $\theta_i$:

$$X_{\theta_i} = s_i$$

The vectors $s_i$ are known as the principal component scores and contains information on how the samples are related to each other.
The $\theta_i$ vectors are the eigenvectors of the covariance of matrix $X$. They are known as the principal component loadings and contain information on how variables are related to each other. In fact, the PCA splits the data matrix $X$ in two parts: one describes the system variation (the process model $\theta_{kt}$) and the other captures the noise or un-modeled information (residual variance $\epsilon$).

### 3.3 Adequacy of the Data

It is obligatory to check the adequacy of data before applying principal component technique. Adequacy has been checked by following three criteria:

1. **Construction of Correlation Matrix**
2. **KMO Index**
3. **Bartlett’s Test of Sphericity.**

#### 3.3.1 Correlation Matrix

The correlation matrix exhibits the simple correlation among all the pairs of variables selected for the analysis. Principal analysis is said to be correctly applied if this matrix contains sufficient number of correlation coefficient values more than 0.30 (Hair, 2003; Kumar, 2010). From Table it is visible that variables are highly correlated. Hence, the data is deemed to be fit for the application of principal analysis. This redundancy in the measurements allows us to build a PCA model that will retain the most of information in a few principal components.

<table>
<thead>
<tr>
<th></th>
<th>RDY</th>
<th>$\ln(HT)$</th>
<th>$\ln(P)$</th>
<th>$\ln(SRJ)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDY</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\ln(HT)$</td>
<td>0.5523</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\ln(P)$</td>
<td>0.6402</td>
<td>0.7440</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>$\ln(SRJ)$</td>
<td>0.7311</td>
<td>0.7099</td>
<td>0.8400</td>
<td>1.0000</td>
</tr>
</tbody>
</table>
3.3.2 Kaiser-Mayer-Oklin (KMO) Index
The Kaiser-Meyer-Oklin measure of sampling adequacy is an index for comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients. Large values for the KMO measure indicate that a factor analysis of the variables is a good idea.

KMO statistic is a measure used by the present study to check the adequacy of data for principal component analysis. The high value of the KMO index is a symbol of adequacy. The value is considered high if it has value between 0.5 to 1. For the data used in the study, the KMO index comes out 0.80 which is reasonably fair to ensure the appropriateness of the component analysis, The Kaiser–Meyer–Olkin measure of sampling adequacy compares the correlations and the partial correlations between variables. If the partial correlations are relatively high compared to the correlations KMO measure will be small. So declare our KMO value, 0.80, which is meritorious.

<table>
<thead>
<tr>
<th>No.</th>
<th>Variable</th>
<th>KMO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RDY</td>
<td>0.8600</td>
</tr>
<tr>
<td>2</td>
<td>In(HT)</td>
<td>0.8805</td>
</tr>
<tr>
<td>3</td>
<td>ln(P)</td>
<td>0.7783</td>
</tr>
<tr>
<td>4</td>
<td>ln(SRJ)</td>
<td>0.7566</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>0.8088</td>
</tr>
</tbody>
</table>

3.3.3 Bartlett’s Test of Sphericity
Another indicator of the strength of the relationship among variables is Bartlett's test of sphericity. Bartlett’s test of sphericity is used to test the null hypothesis that the variables in the correlation matrix are
uncorrelated. The observed significance level is 0.000. It is small enough to reject the hypothesis. It is concluded that the strength of the relationship among variables is strong. It is a good idea to precede a Principal component analysis for the data. The value of Bartlett’s Test of Chi square for the present data is equal to 636.67 and found significant. The significant value indicates that the correlation coefficient matrix is not an identity matrix.

### Table No. 4
**Bartlett Test Calculations**

<table>
<thead>
<tr>
<th></th>
<th>Adj. LR $\chi^2$(6)</th>
<th>Prob &gt; $\chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adjusted LR</strong></td>
<td>636.67</td>
<td>0.000</td>
</tr>
</tbody>
</table>

#### 3.4 Principal Component Analysis
Mathematically putting:

$$ P_i = W_{i1}Z_1 + W_{i2}Z_2 + W_{i3}Z_3 + \cdots + W_{ik}Z_k $$

Thus

$$ P_i = w_{rdy_i} + w_{ht_i} + w_{srj_i} + w_{p_i} $$

Where $P_i = $ Estimate of $i^{th}$ principal component

$W_i = $ Weight or component score coefficient

$K = $ Number of variable

### Table No 5
**PCA Un-rotated Results**

<table>
<thead>
<tr>
<th>Principal Components</th>
<th>Eigen Values</th>
<th>% of Variance</th>
<th>Cumulative variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.116</td>
<td>77.9</td>
<td>77.9</td>
</tr>
<tr>
<td>2</td>
<td>0.465</td>
<td>11.6</td>
<td>89.5</td>
</tr>
<tr>
<td>3</td>
<td>0.272</td>
<td>6.8</td>
<td>96.3</td>
</tr>
<tr>
<td>4</td>
<td>0.145</td>
<td>3.6</td>
<td>100.0</td>
</tr>
<tr>
<td>Variables</td>
<td>PC1</td>
<td>PC2</td>
<td>PC3</td>
</tr>
<tr>
<td>RDY</td>
<td>0.4659</td>
<td>0.7724</td>
<td>0.3825</td>
</tr>
</tbody>
</table>
After ensuring the adequacy of data the various variables affecting FDI inflows were subjected to Principal Component Analysis (PCA). The number of factors retained is decided on the basis of Latent Root Criterion. Only the component having latent root or Eigen values greater than 1 have been considered significant and the components with latent roots less than 1 have been considered insignificant and so disregarded.

3.4.1 Graphical Criteria
A graphical method is the scree test first proposed by Cattell (1966) can be plotted the eigenvalues shown above in a simple line plot depicted in figure 1.
According to graphical criterion, we would still retain with 1 factor in our example.

3.4.2 Rotated Results
In the case where PCA does not yield interpretable Eigen images make it sometimes possible to select a specific rotation matrix R to get more informative results. Two step procedures that consists of; first by doing PCA and then determine the rotation matrix is called rotated PCA.
Table No. 6

<table>
<thead>
<tr>
<th>Principal Components</th>
<th>Total (eigenvalues)</th>
<th>% of Variance</th>
<th>Without Rotation</th>
<th>With Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDY</td>
<td>2.2148</td>
<td>55.37</td>
<td>0.4659</td>
<td>0.8123</td>
</tr>
<tr>
<td>ln(HT)</td>
<td>1.36735</td>
<td>34.18</td>
<td>0.7724</td>
<td>-0.5832</td>
</tr>
<tr>
<td>ln(P)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ln(SRJ)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Component Rotation Matrix

<table>
<thead>
<tr>
<th></th>
<th>Comp1</th>
<th>Comp2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comp1</td>
<td>0.8123</td>
<td>0.5832</td>
</tr>
<tr>
<td>Comp2</td>
<td>-0.5832</td>
<td>0.8123</td>
</tr>
</tbody>
</table>

Unrotated variables relationships have ambiguous interpretation because the factors may be correlated with many variables with varimax rotation method, rotation does not affect the Eigen values variance and percentage of total variance explained, it minimized the components with high loadings and lead to good interpretation of results.

3.5 Regression Analysis

The empirical analysis has used balanced panel data set of developing countries. In general, panel data (for firms, industries, or countries) are preferable to time series or cross section data, because it captures some of the heterogeneity at these different levels and allow looking at dynamic relationships. This analysis studies the link between technology, foreign direct investment and CO₂ emissions per-capita for 19 countries over 1996-2009. Apparently, CO₂ emissions difference across countries while differences in geographic characteristics lead towards a very dynamic process, for that purpose a researcher need a unique method to better capture these features. A number of methods and techniques have been proposed in the
literature to analyze a set of panel data such as Barker and Huang (2010) with the heterogeneous dynamic panels, Bond (2002) with autoregressive dynamics and explanatory variables, when variables are not strictly exogenous than generalized method of moment (GMM) is preferable Stock et al (2002).

The main objective of this research study is to examine whether the economic development and technological improvement along with energy consumption tend to increase the environmental damage or not. This allows to test if the degree of economic and technological development has a systematic relationship with the level of CO$_2$ emissions in a panel of developing countries. The study covers the period from 1996 to 2009. Model specification is:

$$
\text{co}_2(i,t-1) = \alpha_i + \beta_1 \ln(\text{fdi})_{i,t} + \beta_2 \text{rdy}_{i,t} + \beta_3 \text{gypc}_{i,t} + \beta_4 \text{leu}_{i,t} + \beta_5 \text{crt}_{i,t} + \beta_6 \ln(\text{ff})_{i,t} + \mu_{i,t} \ldots \ldots \ (1)
$$

This study examines the connection between technological transformations, FDI’s and influence of these variables on environmental degradation. In this paper, a crucial variable RDY an interaction term between FDI and endogenised technological impact is introduced to capture the environmental effect in developing countries which depends on levels of induced technological development. The subscripts $i$ and $t$ denote country and year respectively in equation (1), $\text{co}_2(i,t)$ denotes pollution emissions intensity measured as emission per unit. The variable RDY, $\text{rdy}_{i,t}$ denotes research and development expenditures. $\ln(\text{fdi})_{i,t}$ foreign direct investment flows. $\text{leu}_{i,t}$ defines the energy usage in country, $\text{gypc}_{i,t}$ growth is per capita, $\text{crt}_{i,t}$ denotes combustible renewable resources, $\text{ff}_{i,t}$ shows fossil fuels consumption (description and source of variables are given in Appendix 2); $\text{crt}_{i,t}$ the oil Combustible renewable and waste in country i at time t; $\text{ff}_{i,t}$ is the emission from fossil fuels both are control variables.
3.5.1 Empirical Model and Pre-Testing of Estimation Technique

We start the estimation with FE and confirmed that the Fisher test-statistics value is 28.8 which indicate that the specific individual effects are significant, however, the FE model does not free from the endogeneity bias and the potential correlation between regressors and specific individual models. 94.8% of the variance is due to differences across panels. As expected these results failed to justify estimates with their true signs and significance. To cope with these problems and obtain consistent parameter estimates, Arellano-Bond (AB) GMM technique has been used to estimate the model. The Arellano-Bond (1991) and Arellano-Bover (1995)/Blundell-Bond (1998) dynamic panel estimators are increasingly popular.

Instrumental Regression/2SLS has been used as identification checker for all types of identifications test but not as main estimation technique because it is in general biased, in finite samples the instruments are almost always at least slightly correlated with the endogenous components of the instrumented regressors. Results are given in appendix which validates the choice of estimation technique. For main estimation this research will focus on Arellano & Bond (1991) difference GMM estimator first proposed by Holtz-Eakin, Newey and Rosen (1988). The Arellano-Bond (1991) and Arellano-Bover (1995)/Blundell-Bond (1998) linear generalized method of moments (GMM) estimators modified by David Roodman. The classic Arellano-Bond (1991) used difference GMM estimator for dynamic panels. As the name suggests, Arellano and Bond originally proposed using the differencing transformation. When orthogonal deviations are used instead, estimator ought to be called deviations GMM. The estimators handle important modeling concerns fixed effects and endogeneity of regressors while avoiding dynamic panel bias, both estimators are designed for short, wide panels, and to fit linear models with one dynamic dependent variable, additional controls, and fixed effects (Roodman, 2009).
A dynamic equation of the form is:

\[ y_{i,t} = \delta y_{i,t-1} + \beta x_{i,t} + \varepsilon_{i,t} \]  

\( \text{................................. (a)} \)

Where \( y_{i,t} \) is dependent variables in country \( i \) for the period, the vector \( x_{i,t} \) contains a set of explanatory variables, \( \mu \) is an unobservable country-specific effect, \( \varepsilon \) is the error term, \( \delta \) is a coefficient and \( \beta \) is a column vector of coefficients. In order to get a consistent estimate of \( \delta \) and \( \beta \) first-difference transformation is used to eliminate country specific effect.

\[ y_{i,t} - y_{i,t-1} = \delta (y_{i,t-1} - y_{i,t-2}) + \beta (x_{i,t} - x_{i,t-2}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \]  

\( \text{................................. (b)} \)

Still endogeneity prevails in lagged dependent and error terms, to remove these bias instruments are required.

**4. Results and Interpretation**

Table 7 gives the estimation results. As shown in estimation results most of the estimated coefficients show good coherence among variables and the robust results are satisfactory. The overall fit of the model is good. Most of the coefficients show expected signs and high significance. The specification test of Sargan and Hansen J-statistic proves the orthogonality conditions of the instruments used for the lagged endogenous variables on equation level and the efficiency of the instrumentation used for the whole system. Adding the lagged dependent variables to the right side of the equation removes the first-order serial correlation problem successfully. The tiny inter-equation residual covariance shows the high efficiency of the GMM estimator. The diagnostic tests at the bottom of Table 7 suggest that the performance of estimator is good. The F test rejects the hypothesis that all the coefficients are zero. Hansen tests with robust analysis do not reject the hypothesis that the instruments are not correlated with the residual. This makes instruments valid. Results detect first order autocorrelation which is expected by set up of difference GMM
estimators. However, it does not contain second order autocorrelation as it makes it invalid to use the second lag of the dependent variables as instruments. The AR (2) test results indicate no second order autocorrelation in the residuals.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>( co_{2(i,t-1)} )</td>
<td>0.467</td>
<td>0.073</td>
<td>6.39***</td>
</tr>
<tr>
<td>( rdy_{i,t} )</td>
<td>-0.049</td>
<td>0.229</td>
<td>-0.22</td>
</tr>
<tr>
<td>( gypc_{i,t} )</td>
<td>0.018</td>
<td>0.006</td>
<td>2.86***</td>
</tr>
<tr>
<td>( ln(fdi_{i,t}) )</td>
<td>0.052</td>
<td>0.022</td>
<td>2.28**</td>
</tr>
<tr>
<td>( leui_{i,t} )</td>
<td>2.366</td>
<td>0.392</td>
<td>6.02***</td>
</tr>
<tr>
<td>( ctit )</td>
<td>0.017</td>
<td>0.016</td>
<td>1.05</td>
</tr>
<tr>
<td>( lff_{i,t} )</td>
<td>1.828</td>
<td>0.861</td>
<td>2.12**</td>
</tr>
</tbody>
</table>

AR(1)° 0.042
AR(2)° 0.615

Sargan test of overid. restrictions (a) 0.895
Difference-in-Sargan tests of exogeneity of instrument subsets (b)

Sargan test excluding group 0.789
Difference (null H = exogenous) 0.887
F-test 41.20 *
Time Dummies Yes

Notes: *, ** at 1% and 5% level of significance respectively

(*) Stands for the p-values associated with the test of absence of autocorrelation of second order. The result shows that there is no such autocorrelation in the data; thereby, validating the use of lagged variables of a minimum of two periods as instruments in the system-GMM model.

(a) Sargan/Hansen statistics can also be used to test the validity of subsets of instruments under the null of joint validity of the full instrument set.

(b) The difference in the two reported Sargan/Hansen test statistics is itself asymptotically with chi square, with degrees of freedom equal to the number of suspect instruments. As the moment conditions are set up under the assumption
of no serial correlation across disturbances, the differenced residuals should be correlated of order one, but not of order two. This is supported by the Arellano-Bond tests reported at the bottom of table above.

In table 7, results of RDY did not show any significance and fail to find out the relevance in developing countries context. RDY coefficient shows that still a small portion of GDP has been expending on these research activates so it has not any mentionable significance and impact. Overall estimates in the table showed that as growth rates are going high carbon dioxide also have significant and positive response because of nonconformity of Kyoto protocol, Currently, the Kyoto agreement includes the Clean Development Mechanism (CDM), which allows polluters in industrialized countries with emission constraints to receive credit for financing those projects that reduce emissions in developing countries, which do not face emission constraints under the Kyoto Protocol. It also confirmed the Pollution Haven Hypothesis, which claims that the aforementioned technology transfer results in a dirty technology flow. The most polluting firms in developed countries would move to developing countries. To control endogeneity for FDI as endogenous variable by using the time dummies results have controlled the time effect on variables. Their findings clearly indicate that FDI is an important source of technological transfer. Results of an econometric model indicated that changes in the quantity of energy usage, fossil fuels consumption and the productivity of energy leads to resource degradation and technical change. High consumption of energy in firms has increased the resource degradation. Results proposed that technical change could improve the efficiency of energy use. Soytas, Sari and Ewing (2007) found energy does cause on carbon emission furthermore policies considering the composition of energy use and technological changes may also be applied to mitigate environmental pressure. Renewable resources are highly recommended by
environmental organization that developing countries should find energy alternatives to fossil fuels. This study also attributed that inefficient use of renewable energy associated with the relatively high capital costs and subsequent disposition of radioactive waste. Control variables oil consumption and usage of fossil fuels are positively increasing the carbon dioxide in the environment. Burning of coals and other materials has strong relevance in environmental degradation.

6. Discussion
Overall pace of economic development does not dramatically alter the future annual or cumulative flow of CO$_2$ emissions there are many other emerging issues which are inevitable. This content of development is determined by the economic institutions within which human activities are conducted. Sustainability of nature and ecological system will promote greater efficiency and growth for poor countries. To achieve optimal production and to maintain a sustainable scale of economic activity capital-deepening, technological intensive FDI and inward-looking pattern of development are lynchpin. One-step difference GMM model found that there are positive relationships running from pollutant emission to economic development and from pollutant emission and energy consumption. Findings suggested that other energy resources should have considerable interest in terms of designing appropriate energy policies and development strategy. Though the economic and population growth is most rapid in the lower-income nation but economic growth is not a panacea for environmental quality; indeed, it is not even the main issue. What matters is the content of growth and composition of inputs, including environmental resources and outputs including waste products.

References


