Indian Journal of Economics and Development, Vol 5 (2), February 2017 ISSN (online): 2320-9836
ISSN (Print):2320-9828

On CO_2 emissions and major macroeconomic variables: A Var Model; Case of China, India, Pakistan and Sri Lanka

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Abstract

Objectives: This paper investigates the association between carbon dioxide emanations, energy utilization, real gross domestic product, trade, financial development and urbanisation in an econometric time series model.
Methods: The statistical specification is -Test of stationarity of data. Testing the existence of cointegrating relation. Finding an error correction model. Finally for robust results the study employs impulse response function and variance decomposition method .The impulse response function traces the responsiveness of the endogenous variables to shocks to each of the other exogenous variables over a certain period of timeThe software used is STATA (12).
Findings: Gross Domestic product and energy consumption continues to be the explanatory variables for carbon emissions in the Asian region. The coefficient of gross domestic product is a positve and statistically signficant for all countries ; so growth of income leads to environmental degradation proxied by carbon emissions. For India the bulk of the shock of the dependent variable is due to improvement in gross domestic product and trade openness. For Pakistan the bulk of the shock in the dependent variable is on account of gross domestic product, energy utilization. In the long run, the countries need to embrace more energy conservation policies no matter what the directional approach in the short run may be. The contribution of the current paper is to assess the short and long run equilibrium association of carbon emanations, economic expansion, energy use, urban development and trade for India, Sri Lanka, Pakistan and China under a Vector Error Correction Model.
Improvements: The study contributes in examining the dynamics of short run association among the variables; to explore the presence of long term equilibrium relation, to capture the linear dependencies among the variables under study and to test the responsiveness to shocks in the system.
Keywords: Time Series , Vector Error Correction Model, Impulse response function, India , South Asia.

1. Introduction

The correlation involving income and energy spending has been a prevalent expanse of analysis in the research of economic advancement, development and the issues for the global environment. Yet, an agreement in the inferences plan has not been founded concerning the type of association amongst the variables. Studies have established causality running from energy use to income. Again the literature ascertains the neutral stance of proposition of connectedness across energy depletion and economic advancement. Numerous empirical papers discuss on energy depletion and economic progress for the articulation of accurate energy strategies**.** The methodology has been that of utilisation of co integration and error correction techniques. The conclusions from such country studies have been mixed. Further ongoing studies have attempted to identify a number of factors apart from energy consumption which explain the variability in economic growth both in developed and developing nations. According to World Bank estimates Energy use per Purchasing Power Parity rates of Gross Domestic Product is 165.21(kg of oil equivalent)for East Asia Pacific region excluding the high income countries, in 2013;for East Asia Pacific Region as whole the figure is 149.39(kg of oil equivalent), in 2013. The relatively low income East Pacific regional countries is consuming more energy and so require policy guidelines to reduce energy intensification.The developing countries along with the process of rapid energy consumption , is also experiencing the phenomenon of rapid urbanisation. Urbanisation is a social and economic occurrence where economic activities transform from the rural agriculture to city/town based industries and services. Urbanisation affects the global pattern of energy use and environmental quality. Urban cities are expected to consume more than 50 percent of overall energy produce and generate carbon dioxide (CO_2) to about 60 percent which will increasingly lead to global warming.China, India and the ASEAN Region are responsible for the globe's almost half of CO_2 emissions. The countries which top the list as far as global CO_2 emission is

 ISSN (online): 2320-9836
ISSN (Print):2320-9828

concerned are the United States (15 percent), the European Union (10 percent) India (6.5 percent) and China (30 percent). They together account for 61% of total global emission [1].

Many research efforts have been put to assess the influence of large scale global warming upon the world economy. United Nations is positioning rigorous attempts to cut down the deleterious influence of global warming through international agreements. The Kyoto protocol was signed in 1997 in the Convention of the United Nations on Climate Change with the objective of reducing the greenhouse gases which causes rise in global temperature. However most countries are yet to fulfil their commitments. Thus energy consumption along with rapid urbanisation implies higher emissions of carbon dioxide. Energy policies should be properly designed to ensure balance in the ecology and energy consumption. Discussion on the range to which different countries have managed to control release of carbon dioxide in the air compared to economic growth puts valuable understandings to the future policy changes.

The empirical literature has abundantly discussed the relationship and linkages across gross domestic product, energy utilization urban expansion and CO_2 release in the atmosphere. Trade openness has also been used to study its impact on CO_2 emissions. In[2]for example decomposes the effect of trade on pollution, energy consumption and output. Recent literature opines that financial development and ease of doing business negatively impacts the environment [3]. Many studiesdiscuss in a multi variate framework the impact of energy utilization, financial progress, trade and urban expansion on CO_2emanations, these studies have diverse interpretations regarding whether trade, urbanisation and financial development influence the emanations of CO_2. The strength of the Environmental Kuznets Curve Hypothesis is also tested here. Against, the backdrop of the forgoing deliberations in this paper an effort has been made to investigate the association between carbon dioxide emanations, energy use, real gross domestic product, trade ,financial development and urbanisation in an econometric time series (VAR model) across the countries of India, Pakistan , Sri Lanka and China. Thus the study examines the behaviour of the variables across India and her neighbouring countries. India and China analysis are crucial because they are major contributors as far as CO_2 emission at the global level is concerned. Moreover it is notable that each of the four countries taken into consideration share different position in the ranking of Human Development Index. Thus it is important to study the causality across the variables for the countries which share different levels of human development. In addition substantial increase in carbon emissions is anticipated in the countries of South Asia on account of their rapid economic progress and upsurge in energy consumption and depletion. The dangers are of tall order as these countries argue that emissions controls have an impact on GDP growth. Against these reflections it becomes all the more vital to understand the relationships that exist among economic growth, other broad macroeconomic variables, energy use and carbon di oxide emanations in the newly industrializing neighbouring countries of India before an effective policy for energy utilization can be developed for this part of the region. The study utilises statistics from the World Development Indicators (for the period 1971-2013) to study the relationship of the variables namely carbon dioxide emission, energy consumption, real gross domestic product, trade and financial progress.

The remainder of the paper is planned as follows: Section 2 discusses the broad objectives, methodology and data sets utilized thereof. The broad results are summed up in Section 3. Finally, the paper is concluded in Section 4.

The literature on economic growth and its relation with environmental pollution particularly the discussion on emission of greenhouse gases is manifold. The literature on one strand discusses the interconnections between economic progress and environmental effluence centred on assessing the soundness of the proposition of the Environmental Kuznets Curve (EKC). As stated in the EKC proposition that as income increases emission increases until after sometime a certain threshold level of income is reached after which emissions of greenhouse gasses begin to decline. These studies are valuable because they model EKC hypothesis under time series dynamics. The notable contributions are the studies by [4-11]. In addition a number of studies use panel data to validate EKC hypothesis – [12] for 189 countriesfrom six different regions, namely Asia Pacific, Eastern Europe, North Africa, the Middle East and Americas, Sub-Saharan Africa, and Western Europe; [13]for MENA countries; [14] for European, East Asian,and Oceania countries. The broad results from such studies are contradictory and in many cases the EKC hypothesis is not validated. The second strand of literature concentrates on modelling time series changes in the economic expansion - energy utlization and effluent emanation link in the situation of the developing and developed areas. The Granger causality works on this part is enormous, [15-19] are major studies .These studies concluded on no causality relation between energy utilization and income generation. A bidirectional causality among the variables has been obtained in the studies of [20-22]. A unidirectional causality from output to energy consumption has been found in the studies -[23-27].The works of [28-36], found the course of causality from energy utlization to economic progress. The third element of discussion deliberates on issues on carbon dioxide emanations and its causality with broad macro variables in a multivariate framework, the variables include trade openness, Foreign Direct Investment, financial development , population growth. The important contributions include [37-41]. In [42]studied the causality nexus across environmental quality, energy consumption, Gross Domestic Product, energy consumption, openness and urbanisation for a panel data of sixty nine countries (1985-2005)- this study generated further research along similar line of thinking in the recent period. In [43] discusses the causal association among gas emissions, real output, energy consumption, trade, and urbanization for new European Union members over the period 1992–2010). In [44] studies the causality relation across carbon di oxide emissions, energy consumption, real output, trade openness, urbanisation and financial progress in United States of America during1960-2010. The results show bidirectional causality between CO_2 and GDP, $CO_2$and urbanisation and GDP and trade openness. The study concludes that development of energy efficient policies will lower CO_2 without sacrificing growth of real income.

The foregoing discussion summarily points out that there is a lack of clear consensus on the relationship of the variables under study in the literature. This is due to methodological differences, different time period chosen for the study, country heterogeneity in the context of pollution, different patterns of economic growth and stages of industrialization. Therefore country specific studies especially studying causality relation across pollution and macro-economic variables of countries in different stages of development is vital. The need for country specific studies is all the more important in the era of global financial crisis and policy issues on climate change agenda. This paper attempts to contribute to the existing literature by choosing four South Asian countries, at different levels of human development but all shares the tropical humid climate whereby there can be a common thrust on utilisation of energy intensive policies. Before proceeding with our study the subsequent deliberations discusses the country case studies already reported on carbon emanations , economic progress and other broad macroeconomic variables for the countries of Pakistan, Sri Lanka, India and China.

In [45]investigates the presence of longrun relationship among carbon dioxide emission, financial expansion, economic progress, energy utlization and population growth in Pakistan for the period 1974-2009. The major variables trying to explore the augmentation in carbon dioxide comprise economicprogress, financial development, population and energy consumption.The study concludes that policy prescription towards financial development will be helpful in lessening environmental degradation.The paper opines that there is a need to review policy issues on proper enforcement of environmental protection laws. Summarily, as far as the causality analysis across carbon di oxide emissions, economic growth, energy consumption ,trade openness, population and financial liberalization is concerned for the experience in Pakistan the research indicates mixed results. The studies differ in time period choice, in choice of methodology in time series econometric modelling and further the inclusion of the variables is also varied. However the research uniformly indicate the strong need for proper environmental laws to control emission of carbon dioxide. In [46]studies the long run Granger causality relationship , it determines that strategies to diminish carbon dioxide release in Sri Lanka for the period 1971-2006. The results indicate that there is unidirectional causality running from economic growth to carbon emissions and energy consumption. Sri Lanka will be at the cost of lower economic growth if no supplementary energy intensification utilization policies is addressed.In [47]studies the association across trade openness and carbon dioxide emissions in Sri Lanka for the period 1960-2006 using Autoregressive Distributed Lag (ARDL) bound test method. The paper concludes that there is no long run equilibrium relationship across trade openness and carbon di oxide emissions for Sri Lanka. However unlike other research the paper observes the existence of short run relationship between trade openness and carbon emissions. This conclusion could be owing to the choice of time period because trade liberalization policies in most south Asian countries have been announced over the period of the nineties. In [48] makes an important contribution to the growing debate on the analysis of macroeconomic variables and environmental pollution for Sri Lanka. Using Autoregressive Distributed Lag bound test model the paper studies the causality relation across energy utlization carbon dioxide emanations, gross domestic product, population and financial progress over the period 1971-2012. The Granger causality test manifests a one way causality running from carbon dioxide release to energy use and two way causality across industrialization and energy utilization. The contribution of this study to the existing literature is its task of predicting the subsequent energy use for Sri Lanka under a neural framework. Though the time series analysis on the causality of carbon dioxide emissions and major macro-economic variables for Sri Lanka are few , the policy direction from the research contribution is clear- supplementary policy thrust on energy use is essential otherwise growth rates will be hampered if only the stress is on to reduce emission of carbon dioxide.

As outlined in India’s 12th Five Year Plan (2012-2017), the Government of India has provisionally targetted 9% Gross Domestic Product (GDP) as growth target which will require energy supply to grow at 6.5% per year. The government is aware that a concomitant need of the economy is to reduce the emission intensity, the target is to reduce the same from 20-25% of GDP from 2005 levels by 2020. Given that India shares the common platform of pursuing economic growth and pursues a policy of pollution free environemnt, the research studies has chosen India in many panel data studies to identify the emission- energy- growth nexus. However cross country studies it is accepted provides only a broad understanding of the linkage of the variables [49] has addressed the impact of both economic expansion and financial progress on environmental deterioration using panel cointegration methods for the period 1980-2007, where China, Brazil, Russia and India are included.The study observes that in the long term CO2 emissions appear to be energy consumption elastic and Foreign Direct Investment is inelastic. The observations verifies the EKC hypothesis. In [50] using the same set of countries in the method of panel cointegration they conclude in order to reduce emissions and not affecting the growth potential of the economy, the need is to choose energy conservation policies for the concerned set of countries. In [51,52] studied the relation among carbon release and economic expansion in a multi variate dimension, the period of study is different. The papers determined that energy use influences economic expansion which in turn emits carbon di oxide. The studies conclude that clean energy technology policies would reduce carbon emissions in the longrun. In [53]studies the longrun equilibrium relation across carbon release, financial progress, economic expansion, energy use and trade expansion for India. The results indicate that there is longterm association between carbon release , financial progress, income, energy and trade. Keeping confirmity with the earlier studies this study stresses on the need to develop energy policies that would reduce emissions but not at the cost of growthj. In [54]verifies the earlier conclusions with respect to causality analysis across carbon emissions , energy use , economic growth, over the period 1971-2007. Accordng to [55], unlike the exisitng studies observes the dynamic relationship across coal consumption , trade openness and carbon emissions for India using ARDL modelling and bound test approach. India must enhance its energy associated research and development for the dissemination of cleaner technologies in the future. International cooperation and technology transmission from developed world would facilitate India to go along a low-carbon growth pathway. In the backdrop of climate change policy the case study of India has always been topical. India has experienced a remarkable rise in erergy consumption and carbon emissions in the recnt decades. The highest direct emissions is due to electricity followed by manufacturing ,steel and road transportation. So discussion on India in the current paper is necessary to study the recent behaviour[56]investigates the causality between China's financial development and carbon emissions. The paper concludes that financial development is a significant contributior to carbon emissions.China's FDI exerts least influence on the carbon emissions. This is because low carbon areas were chosen for FDI developemnt in China. Apart from this,there are studies [57,58] discuss the issues across carbon release, financial progress, economic expansion, energy use and trade expansion for India. The results indicate that there is longterm association between carbon release , financial progress, income, energy and trade. Keeping confirmity,the methodology used are econometric models like cointegration, errror correction model and Granger causality tersts. The general conclusion from the papers is financial developemnt boosts economic growth. In [59] discusses the financial development cauaslity on carbon emissions ande energy consumption across twenty two countries including China using panel data model. The study in conformity with the earlier literature conclude that financial developemnt signficantly influence energy consumption. In [60] explores a comparative analysis of India and China regarding the factors that influence carbon dioxide emissions . The paper utilises the bound testing approach to cointegration and ARDL methodology to obtain the relationships across economic growth, energy use ,trade and its impact on carbon emissions. The paper concludes that carbon dioxide emissions in China were influenced by economic growth, energy use and structural changes of the economy. Such causality was not established for India because India has a large informal sector with low energy consumption. So the suggestion is for these two major countries international agreement on climate change requires more intensive research. A large number of empirical research relating to the Chinese economy concentrate on studying the Environmental Kuznets Curve Hypothesis (EKC) and the emission of pollutants.

The foregoing country case study wise review of the current literature on the causality of carbon dioxide emanations, economic expansion energy use and other macroeconomic variables reflect diversifying ends on the trend of causal relations.

Such observations renew the scope of further research with respect to the four countries namely India, Pakistan, India Sri Lanka and China. The contribution of the current paper will be to assess the short and long run equilibrium association of carbon emanations, economic expansion, energy use, urban development and trade for each country under a Vector Error Correction Model. Suchcountry specific case studies of India and her neighbours against the backdrop of recent financial crisis is not available. The next section discusses the broad objectives, the data sets utilized and the methodology followed.

ISSN (online): 2320-9836
ISSN (Print):2320-9828

2. Objectives

The main objective of this study is to explore the causal relation among carbon dioxide emanations, economic progress rate, energy utlization, trade liberalization, urban expansion and financial maturation in the countries of India, Sri Lanka, Pakistan and China, using time series data for the period 1971-2013, (for China it analyzed over1977-2013). More specifically the study attempts to examine the dynamics of short run association among the variables; to explore the presence of long term equilibrium relation, to capture the linear dependencies among the variables under study and to test the responsiveness to shocks in the system.

2.1. Data and methodology

Data and Model Specification

The model to be estimated to test the causality for Co_2 emission in multi variate framework can be written as follows:

$$\log CO_{2it} = \beta_{1i}\log U_{it} + \beta_{2i}\log Y_{it} + \beta_{3i}\log E_{it} + \beta_{4i}\log T_{it} + \beta_{5i}\log FD_{it} + \epsilon_{it} \qquad \text{Eqn (1)}$$

where CO_2 is the carbon dioxide emanations measured in per capita in metric tonnes, U is the urban expansion denoted by urban population proportion to total population, Y is the real gross domestic product per capita,E is the energy used measured in kilograms of oil equivalent per capita, T is the trade liberalization indicated by total trade as a proportion of GDP, and FD is the financial maturation denoted by domestic credit disbursed to private sector category. The time series data are running from1971 to 2013, for China it is from 1977-2013 and is available from the site of World Bank-World Development Indicators[61]. All variables are transformed into their natural logarithmic forms. Generally, speaking it is expected that higher level of energy utilization should result in greater economic activity thereby increasing

CO_2 so the expected sign of β_{2i} and β_{3i} is expected to be positive in equation (1). However according EKC hypothesis the expected sign of β_{2i} will be negative after a certain threshold income is attained. The expected sign of β_{1i} is mixed depending on the intensity of urban expansion. Again the sign of β_{4i} will be positive for developing countries as they indulge in dirty industries trade with high pollution emission with trade liberalization. The expected sign of β_{5i} is mixed depending on the nature of financial stability and maturation.

The exercise of testing connectedness of per capita carbon dioxide emanationsin the concerned countries is performed in five steps: per capita real income, per capita energy utlization,trade liberalization, urban expansion, and financial maturation.

Econometric Specification

The study has employed the following econometric specification to test the association across the above mentioned variables.

- Test of stationarity of data, relevance of unit root test, Augmented Dickey- Fuller (ADF);
- Testing the existence of cointegrating relation across the variables, application of Johansen and JuseliusCointegration Tests;
- Finding an error correction model if cointegration is established;
- Finally for robust results the study employs impulse response function and variance decomposition method. The variance decomposition approach shows the magnitude of the predicted error variance for a series due to innovation from each of the independent variables over the time horizon beyond the selected period. The impulse response function traces the responsiveness of the endogenous variables to shocks to each of the other exogenous variables over a certain period of time.

On unit root tests

In the time series analysis the spurious regression problem was identified, the literature implies that using non-stationary time series progressively diverging from the long-run implies will generate biased standard errors which causes defective correlations in the regression analysis generating unbounded variance process. So, when a non-stationary I(d) process identifies any time series, the standard OLS regression form will usually yield a good fit and forecast statistically significant results across the variables, where none exists across them.

 ISSN (online): 2320-9836
ISSN (Print):2320-9828

The variable needs to be differenced (d) times to get a covariance- stationary process. Thus the individual time series properties of the variables need to be scrutinized. [62,63] provide one of the commonly used test methods which is popularly known as augmented Dickey Fuller (ADF) test of finding out whether the series under consideration is stationary or not. This can be formulated as:

$$\Delta X_t = \alpha + \beta t + (\rho - 1) X_{t-1} + \Sigma_{i=1}^k \theta \Delta X_{t-1} + \epsilon_t \qquad \text{Eqn (2)}$$

Here $\Delta$is the first difference operator, k= optimal number of lags , $\epsilon_t$is the disturbance term ,the white noise error, X is the concerned time series variable carbon dioxide emissions, gross domestic product and so on.

Where the null hypothesis is the presence of unit root $\rho=1$ and alternative is stationary hypothesis. For X_t to be stationary$\rho-1$ should be negative and statistically different from zero.

On cointegration tests

In [64] Indicated that even though time series may not be stationary at their level forms there may exist some linear combination of the variables that converge to a long-run relationship over time. Thus if the series are individually stationary but if a linear combination after their first differentiation is stationary then the series are cointegrated.

The error correction models obtained from a cointegration analysis enables us to obtain both the short and longrun dynamics of the variables. Contemporaneous co integration following [65]is developed in this study. This methodology constructs an error correction mechanism between the same integrated order variables, which enables that a stationary combination of the variables do not drift apart without bound even though all have been individually subject to a non-stationary I(d) process, thereby ruling out the possibility that the estimated relationships tend to be spurious.

Let z_t be a vector of non-stationary n endogenous variables and model this vector as unrestricted vector autoregression (VAR) involving upto k-lags of z_t

$$z_t = \Pi_t z_{t-2} + \cdots + \Pi_k z_{t-k} + \epsilon_t \qquad \text{Eqn (3)}$$

Where ϵ_t follows $N(0,\sigma^2)$) and z is $(nX1)$ and $\P_i$is an (nXn)matrix of parameters. Eqn (3) can be alternatively expressed in a Vector Error Correction (VEC) form as follows

$$\Delta z_t = \Gamma_1 \Delta z_{t-1} + \Gamma_2 \Delta z_{t-2} + \cdots + \Gamma_{k-1} \Delta z_{t-k+1} + \Pi_k z_{t-k} + \epsilon_t \qquad \text{Eqn (4)}$$

$$\text{where } \Gamma_i = -I + \Pi_1 + \cdots + \Pi_i \ (i=1,2,\cdots,k-1) \text{ and } \Pi = I - \Pi_1 - \Pi_2 - \cdots - \Pi_k. \qquad \text{Eqn (5)}$$

Equation (3) can be obtained by subtracting z_{t-1} from both sides of equation (2) and collecting terms on z_{t-1} and then adding $-(\Pi_1 - 1)$ z_{t-1} $+(\Pi_1 - 1)z_{t-1}$. Replicating this procedure and obtaining the terms would generate equation (4). This form of the system of variables generates the short and the long run adjustment to changes in z_t through the estimating Γ_i and Π.Here Π is written as $\Pi=\alpha\beta'$ where α is the speed of adjustment of the coefficient of the particular variables to the interruption phrase in the long runequilibrium relationship and can be inferred matrix of error correction terms,while β is a matrix of the long-run coefficients such that $\beta' z_{t-k}$, in equation (4) represents $(n-1)$ co integrating relations in the multivariate model, which confirms that z_t converge to their long-run steady state solutions. Next, the long run cointegrating relationships across the variables is estimated by using two likelihood test statistics denoted as maximum eigenvalue for the null hypothesis of r versus $r+1$ cointegrating relationships and trace statistics for the null hypothesis of r cointegrating relations against the alternative of n cointegratingrelations for $r=0,1 \cdots n-1$ where n is the number of endogenous variables.

On Vector Error Correction Framework

Short run and long run relation amongst the stated variables is acquired from the vector error correction model (VECM). It is a distinct case of restricted VAR (vector autoregression), it is utilized for the variables that are integrated of order one as well as have long run relationship. In [66,67]have shown that representation of VAR in the first difference form is not correct when there exists cointegration among the variables. Thus, VECM is the appropriate for such cointegrating systems. The major thrust of the VECM is to indicate the speed of adjustment from short run to the long run equilibrium state.

On Variance Decomposition Analysis and Impulse Response Functions

 ISSN (online): 2320-9836
ISSN (Print):2320-9828

Finally, the study has used variance decomposition analysis (VDA) and impulse response functions (IRFs) to assess to what extent shocks to certain macroeconomic variables are explained by other variables in the system. VDA measure the proportions of forecast error variance in a variable explained by innovations i.e. impulses in it and by other variables in the system. Let the sum of the influence of the j^{th}disturbance term ϵ_j on y_i from infinite past to current time point be :

$$y_{it} = \Sigma_{j=1}^k (c_{ij}^{(0)} \epsilon_{jt} + c_{ij}^{(1)} \epsilon_{j\,t-1} + c_{ij}^{(2)} \epsilon_{j\,t-2} + c_{ij}^{(3)} \epsilon_{j\,t-3} + \cdots \qquad \text{Eqn (6)}$$

Let us assume there is no autocorrelation . The relative variance contribution(RVC), which reflects the influence of the j^{th} variable on the i^{th} variable is:

$$RVC_{j>i} (\infty) = \frac{\Sigma_{q=0}^{\infty} (c_{ij}^{(q)}) \sigma_{jj}}{var(y_{it})} = \frac{\Sigma_{q=0}^{\infty} (c_{ij}^{(q)} \sigma_{jj})}{\Sigma_{j=1}^k (\Sigma_{q=0}^\infty (c_{ij}^{(q)})^2 \sigma_{jj} } \qquad \text{Eqn (7)}$$

Impulse response analysis traces out the responsiveness of the dependent variable in a vector autoregressive system to shocks to each of the other explanatory variables over a period of time. More specifically assume a VAR in the vector MA(∞) form as

$$y_t = \mu + \epsilon_t + \Phi_1 \epsilon_{t-1} + \Phi_2 \epsilon_{t-2} + \cdots,$$ where the matrix φ_s is interpreted as

$$\frac{\partial y_{t+s}}{\partial \epsilon^\prime} = \varphi_s \qquad \text{Eqn (8)}$$

So the element φ_s explains the consequences of one unit increase in the j^{th} variable's innovation at period (t) on i^{th} variable at time $(t+s)$, holding all other innovations constant.

To gauge the adequacy of the specification of the model diagnostic and stability tests are conducted. Diagnostic tests examine the model for serial correlation, functional form, non normality and heteroscedasticity.

3. Empirical results and discussion

Table 1presents the results of the unit root tests based on the Augmented Dickey-Fuller (ADF), statistics on the natural logarithms of the levels and the first differences of the variables. All tests are providing us with a coherent results on unit root tests. Sri Lanka. The Hence, the results of unit root tests reveal that carbon di oxide emanations, energy utlization, output , urban expansion, trade liberalization and financial maturation are integrated of order one, I(1), in India, China, Pakistan and whole set of the I(1) variables can only be regressed on each other if they are cointegrated. Thus, we proceed to testing the variables using the Johansencointegration approach.

Table 1. Unit Root Test results (ADF Tests)

UNIT ROOT TEST AT LEVEL				
Variables	India	China	Pakistan	Sri lanka
$\log CO_{2it}$	-2.890	-0.794	-1.198	-1.510
$\log Y$	-1.375	-1.944	-1.277	-0.248
$\log E$	-0.602	-0.136	-0.106	-2.251
$\log U$	-1.002	-0.988	-2.806	-3.345
$\log T$	-1.552	-1.820	-1.443	-1.162
$\log FD$	-1.277	-2.025	-1.354	-1.900
UNIT ROOT TEST AT FIRST DIFFERNCE				
$\Delta \log CO_2$	-5.840	-7.674	-6.884	-6.519
$\Delta \log Y$	-7.868	-5.567	-5.025	-6.113
$\Delta \log E$	-5.805	-4.531	-5.458	-5.935
$\Delta \log U$	-4.895	- 4.650	-4.765	-4.556
$\Delta \log T$	-5.477	-5.136	-8.180	-5.830
$\Delta \log FD$	-5.387	-5.554	-5.148	-6.052

Interpolated Dickey-Fuller

1% Critical Value	5% Critical Value	10% Critical Value (confidence interval)
-4.224	-3.532	-3.199

 ISSN (online): 2320-9836
ISSN (Print):2320-9828

Source : Author's Calculation. Note:$\Delta $denotes the first difference of the variable.
The null hypothesis states that the variable has a unit root.

Table 2 presents Johansen cointegration tests with capita carbon dioxide emanations,per capita real income, , per capita energy utlization, trade liberalization,urban expansion, and financial maturity in logarithim forms for the selected countries.The λ_{trace} and $ \lamda_{max} $ statistics are calculated as per Johansen methodology.The null hypothesis for the trace test is that there is at most r cointegrating vectors while the alternative is that there are more.For maximum eigenvalue test the null hypothesis is that there are exactly r cointegrating vectors while the alternate is there are exactly r+1. Since Johansen method is sensitive to lag length the optimal lag length in the var model was tested.As long as$ \lamda $ statistic is below the critical value we cannot reject the corresponding null hypothesis that there is no cointegration. The last column of Table 2 denotes the number of cointegrating equation. The results confirm the existence of cointegrating relation among the variables.

Table 2.Johansen cointegration tests

INDIA				
Cointegration rank test		$\lamda $Statistics	Critical Value	Cointegrating Rank
$\lamda_{trace} $Tests	$H_0 :r=0, H_A : r>0$	203.8772	94.15	0
	$ H_0 :r=1, H_A : r>1 $	126.0168	68.52	1
	$ H_0 :r=2, H_A : r>2 $	82.7564	47.21	2
	$ H_0 :r=3, H_A : r>3 $	44.5569	29.68	3
	$ H_0 :r=4, H_A : r>4 $	17.1542	15.41	4
	$ H_0 :r=5 H_A : r>5 $	**3.5690***	**3.76**	**5**
$ \lamda_{max} $tests	$ H_0 :r=0, H_A : r=1 $	77.8605	39.37	0
	:$H_0 :r=1 H_A : r=2 $	43.2603	33.46	1
	$ H_0 :r=2, H_A : r=3 $	38.1995	27.07	2
	$ H_0 :r=3, H_A : r=4 $	27.4027	20.97	3
	$ H_0 :r=4, H_A : r=5 $	13.5852*	14.07	4
	$ H_0 :r=5, H_A : r=6 $	**3.5690***	**3.76**	**5**
CHINA				
Cointegration rank test		$\lamda $Statistics	Critical Value	Cointegrating Rank
\lamda_{trace} $Tests	$H_0 :r=0, H_A : r>0 $	367.33	94.15	0
	$ H_0 :r=1, H_A : r>1 $	231.55	68.52	1
	$ H_0 :r=2, H_A : r>2 $	115.47	47.21	2
	$ H_0 :r=3, H_A : r>3 $	59.33	29.68	3
	$ H_0 :r=4, H_A : r>4 $	23.03	15.41	4
	$ H_0 :r=5 H_A : r>5 $	**3.32***	**3.76**	**5**
$ \lamda_{max} $tests	$ H_0 :r=0, H_A : r=1 $	135.7827	39.37	0
	: $H_0 :r=1 H_A : r=2 $	116.0813	33.46	1
	$ H_0 :r=2, H_A : r=3 $	56.1337	27.07	2
	$ H_0 :r=3, H_A : r=4 $	36.2972	20.97	3
	$ H_0 :r=4, H_A : r=5 $	13.38*	14.07	4
	$ H_0 :r=5, H_A : r=6 $	**3.32***	**3.76**	**5**
SRI LANKA				
Cointegration rank test		$\lamda $Statistics	Critical Value	Cointegrating Rank
$\lamda_{trace} $Tests	$H_0 :r=0, H_A : r>0 $	221.1584	94.15	0
	$ H_0 :r=1, H_A : r>1 $	138.8384	68.52	1
	$ H_0 :r=2, H_A : r>2 $	77.8149	47.21	2
	$ H_0 :r=3, H_A : r>3 $	42.8879	29.68	3
	$ H_0 :r=4, H_A : r>4 $	19.2175	15.41	4
	$ H_0 :r=5 H_A : r>5 $	**3.0726***	**3.76**	**5**
$ \lamda_{max} $tests	$ H_0 :r=0, H_A : r=1 $	82.3200	39.37	0
	: $H_0 :r=1 H_A : r=2 $	61.0235	33.46	1
	$ H_0 :r=2, H_A : r=3 $	34.9269	27.07	2
	$ H_0 :r=3, H_A : r=4 $	23.6705	20.97	3
	$ H_0 :r=4, H_A : r=5 $	16.1448	14.07	4
	$ H_0 :r=5, H_A : r=6 $	**3.0726***	**3.76**	**5**
PAKISTAN				
Cointegration rank test		$\lamda $Statistics	Critical Value	Cointegrating Rank

$\lamda_{trace} $Tests	$H_0 :r=0, H_A : r>0 $	221.93	94.15	0
	$ H_0 :r=1, H_A : r>1 $	156.7742	68.52	1
	$ H_0 :r=2, H_A : r>2 $	92.9501	47.21	2
	$ H_0 :r=3, H_A : r>3 $	53.2743	29.68	3
	$ H_0 :r=4, H_A : r>4 $	23.0934	15.41	4
	$ H_0 :r=5 H_A : r>5 $	**1.8346***	**3.76**	**5**
$ \lamda_{max} $tests	$ H_0 :r=0, H_A : r=1 $	65.15	39.37	0
	: $H_0 :r=1 H_A : r=2 $	63.82	33.46	1
	$ H_0 :r=2, H_A : r=3 $	39.67	27.07	2
	$ H_0 :r=3, H_A : r=4 $	30.18	20.97	3
	$ H_0 :r=4, H_A : r=5 $	21.25	14.07	4
	$ H_0 :r=5, H_A : r=6 $	**1.8346***	**3.76**	**5**

Source : Author's calculation. Note : * indicates the test statistics below the critical level at 5% level significance

Table 3. Vector Error Correction Estimates

Countries	The co integrating vector (CO_2 dependent variable) representing the long run relationship	On Long Run and Short Run relationship
China	$ \log $ CO_2$= $ 35.21^*+3.28 \log $Y_t-1.81\log $ E +2.07\log $ U_t- \log $FD_t $ *since the equation is written with sides changed the +ve sign is put	The error correction term (ECT) is negative and statistically significant, establishing the existence of long run relationship among the variables. In the short run gross domestic product and trade openness has significant influence. Gross Domestic Product and urbanisation is positively related to carbon emissions and the coeffcients are statistically significant in the long run.
The Diagnostic tests(China): The model is viable as far as serial correlation, normality and stability test is concerned : Lagrange Multiplier Test		
| lag | chi2 dfProb> chi2 |		
| 1 | 42.8625 36 0.1008 |		
| 2 | 49.7966 36 0. 2207		
H0: no autocorrelation at lag order		
Jarque-Bera test		
| chi2 dfProb greater than chi2		
All variables		
4..988 12 0.8883		
India	$\logCO_t $ = $46.21^*\log Y_t- 1.61$log E_t+1.51\log$U-t+1.91\logT_t-6.06\log FD_t *since the equation is is put written with sides changed the +ve sign	The error correction term (ECT) is negative and statistically significant, establishing the existence of long run relationship among the variables. In the short run energy consumption, urbanisation and trade openness has significant influence. Gross Domestic Product and trade openness and urbanisation is positively related to carbon emissions, the coefficients are statistically significant for Gross Domestic Product and trade openness in the long run.
The Diagnostic Test (India): The model is viable as far as serial correlation, normality and stability test is concerned :Lagrange Multiplier Test		
| lag | chi2 dfProb greater than chi2 |		
| 1 | 46.2397 36 0.11797 |		
| 2 | 41.4409 36 0.24534 |		
H0: no autocorrelation at lag order		
Jarque-Bera test		
chi2 dfProb greater than chi2		
All variables		
4.887 12 0.96165		
Sri Lanka	$\logCO_t $= $29.67^*\log Y_t+ $1.27\log E_t-$3.44\logU_t-$1.66\log T_t-$2.72\logFD _t$ sides changed the +ve sign is put	The error correction term (ECT) is negative and statistically significant, establishing the existence of long run relationship among the variables. In the short run gross domestic product and trade openness has significant influence.Energy consumption is positively related to carbon emissions is statistically significant in the longrun.
The Diagnostic Test (Sri Lanka) : Lagrange Multiplier Test		
| lag | chi2 dfProb> chi2 |		
| 1 | 62.5706 36 0.00394 |		
| 2 | 43.5525 36 0.18092 |		
H0: no autocorrelation at lag order		
Jarque-Bera test		
| chi2 dfProb greater than chi2		
All variables		
20.631 12 0.05605		
However for Y and FD probability is less than 5%, For rest of the variables the null hypothesis of normality assumption is valid. So the model is viable		
Pakistan	$\logCO_t $= $11.8^*\log Y_t- $2.37\log E_t-$5.44\logU_t+$0.98\log T_t+$0.50	The error correction term (ECT) is negative and statistically sig-

ISSN (online): 2320-9836
ISSN (Print):2320-9828

	\logFD _t$ *since the equation is written with sides changed the +ve sign is put	nificant, establishing the existence of long run relationship among the variables. In the short run gross domestic product and trade openness has significant influence. Gross Domestic Product, trade openness and financial development is positively related to carbon emissions and the coefficient are statistically significant in the long run.

The Diagnostic Test(Pakistan) : Lagrange Multiplier Test
	lag	chi2 dfProb greater than chi2
	1 43.6591 36 0.17803	
	2	32.8165 36 0.62080	
H0: no autocorrelation at lag order
Jarque-Bera test
chi2   dfProb greater than chi2
All variables
26.377 12   0.00949
The probability is less than 5% only for Y for the rest of the variables it is greater than 5%, so the normality assumption is valid for the model .

The results are of VECM is presented in Table 3. The results show that for all the concerned countries the error correction term is negative and statistically significant. So there is long term equilibrium relationship among the variables. The main purpose of VECM is to indicate the speed of adjustment from short run equilibrium to long run state. Causality in a cointegrated system can be established if and only if lagged error correction term is significant.The error correction term reflects long run and the short run dynamics. As the table 3. shows that the coefficient of gross domestic product is a positve and statistically signficant for all countries except Sri Lanka so growth of income leads to environmental degradation proxied by carbon emissions. Urbanisation is a signifiant variable for China because it is a developed country as against other countreis where the process of urbanisation is yet to mature. Trade openness is signifantly contributing to environemnt degradation for India and Pakistan because as per expectations trade openness in developing countries with less stringent environmental laws lead to trade in dirty industries.Sri Lanka has no causal connection between carbon dioxide emanations and trade openness.

Table 4. Impulse response Function On CO_2

Impulse response Function On CO_2, China					
Period	$\log$ Y $	$\log$ E $	$\log$ U $	$\log$ T $	$\log$ FD $
1	0	0	0	0	0
2	.24	1.07	0.74	-0.53	-0.52
Impulse response Function On CO_2, India					
Period	$\log$ Y $	$\log$ E $	$\log$ U $	$\log$ T $	$\log$ FD $
1	0	0	0	0	0
2	0.71	0.0023	-0.69	0.42	-0.34
Impulse response Function On CO_2, Pakistan					
Period	$\log$ Y $	$\log$ E $	$\log$ U $	$\log$ T $	$\log$ FD $
1	0	0	0	0	0
2	1.40	0.91	-0.11	0.322	0.39
Impulse response Function On CO_2, Sri Lanka					
Period	$\log$ Y $	$\log$ E $	$\log$ U $	$\log$ T $	$\log$ FD $
1	0	0	0	0	0
2	0.024	1.023	-0.47	-0.57	0.021

Source : Author's calculation

Financial development except for Pakistan has no contributions to carbon emissions , this could be due to the choice of the defintion on financial development. Table 4summarizes the results of the impulse response function in the short run for the countries under study. For the Chinese economy as per expectations most of the shock (impulse) on the dependent variable (CO_2) is due to innovation in energy consumption, followed by innovation in urbanization. Again for India the bulk of the shock of the dependent variable is due to improvement in gross domestic product and trade openness. For Pakistan the bulk of the shock in the dependent variable is on account of gross domestic product and energy utilization. For Sri Lanka, the impulse on the dependent variable is explained by innovation in energy consumption. So energy consumption is identified as the major impulse generating variable.

 ISSN (online): 2320-9836
ISSN (Print):2320-9828

The results of Variance Decomposition Analysis across CO_2, Gross Domestic Product, Energy Consumption, Trade Openness and Financial Development are presented in Table 5. For China, India, Sri Lanka and Pakistan over a 15 year time horizon. The observations with respect to country experience are reported below:

Country: China

The variation in carbon emanations in the short termis explained by its own shocks but subsequently it is explained by energy utilization, gross domestic product and urbanisation (around 49 percent in 15 period rest by CO_2 itself). Variations in GDP is explained by its own shocks then by shocks in urbanisation. Energy consumption is explained by its own shocks, carbon emissions. Urbanisation variation is explained by shocks in urbanisation and carbon emissions. Again trade openness fluctuations is explained by shocks in trade openness, urbanisation, gross domestic product.

Country: India

Variations in CO_2 emissions is explained by variaitons inits own shocks and subsequently by Gross Domestic Product considerably.Deviations in GDP is described by extensively by its own shocks.Shocks in energy utlization is expounded by carbon emnations, GDP and energy utlization by itself. Urbanisation shocks is explained by itself in the short period and subsequently by GDP.Trade openness in the short run is explained by its own shocks then by GDP in the long period. Financial Development is explained by its own shocks then by GDP in the long run.

Table 5. Variance decomposition Analysis

Country: China						
Variance Decomposition of $\log CO_2$						
Periods	$\log CO_2$	$\log Y$	$\log E$	$\log U$	$\log T$	$\log FD$
1	1	0.00	0.00	0.00	0.00	0.00
5	0.84	0.007	0.067	0.26	0.021	0.006
10	0.50	0.11	0.17	0.17	0.022	0.006
15	0.48	0.11	0.13	0.22	0.019	0.010
Variance Decomposition of $\log Y$						
Periods	$\log CO_2$	$\log Y$	$\log E$	$\log U$	$\log T$	$\log FD$
1	0.028	0.97	0.05	0	0.020	0.001
5	0.014	0.43	0.05	0.46	0.02	0.004
10	0.11	0.31	0.12	0.41	0.016	0.006
15	0.33	0.23	0.087	0.32	0.011	0.009
Variance Decomposition of $\log E$						
Periods	$\log CO_2$	$\log Y$	$\log E$	$\log U$	$\log T$	$\log FD$
1	0.61	0.023	0.34	0.006	0.01	0
5	0.82	0.021	0.12	0.12	0.01	0.009
10	0.47	0.09	0.24	0.15	0.01	0.006
15	0.44	0.11	0.19	0.22	0.01	0.009
Variance Decomposition of $\log U$						
Periods	$\log CO_2$	$\log Y$	$\log E$	$\log U$	$\log T$	$\log FD$
1	0.11	0.09	0	0.71	0.008	0
5	0.48	0.013	0.02	0.46	0.005	0
10	0.64	0.035	0.02	0.28	0.002	0.002
15	0.60	0.050	0.04	0.38	0.004	0.004
Variance Decomposition of $\log T$						
Periods	Log CO_2	$\log Y$	$\log E$	$\log U$	$\log T$	$\log FD$
1	0.089	0.27	0	0.30	0.43	0.06
5	0.033	0.48	0.12	0.23	0.12	0.01
10	0.31	0.22	0.13	0.24	0.06	0.01
15	0.25	0.19	0.13	0.35	0.04	0.01
Variance Decomposition of $\log FD$						
Periods	$\log CO_2$	$\log Y$	$\log E$	$\log U$	$\log T$	$\log FD$
1	0.59	0.26	0.07	0.001	0.023	0.12
5	0.15	0.31	0.20	0.28	0.009	0.03
10	0.18	0.23	0.17	0.36	0.04	0.01
15	0.22	0.24	0.16	0.31	0.03	0.01
Country: India						
Variance Decomposition of $\log CO_2$						
Periods	$\log CO_2$	$\log Y$	$\log E$	$\log U$	$\log T$	$\log FD$
1	1.00	0.0	0.0	0.0	0	0.0
5	0.40	0.27	0.08	0.003	0.18	0.03

10	0.19	0.54	0.07	0.006	0.12	0.05
15	0.15	0.55	0.06	0.025	0.13	0.06
Variance Decomposition of $\log Y$						
Periods	$\log CO_2$	$\log Y$	$\log E$	$\log U$	$\log T$	$\log FD$
1	0.05	0.94	0.07	0.001	0	0
5	0.13	0.74	0.07	0.004	0.02	0.01
10	0.09	0.81	0.04	0.004	0.01	0.01
15	0.10	0.81	0.04	0.006	0.01	0.01
Variance Decomposition of $\log E$						
Periods	$\log CO_2$	$\log Y$	$\log E$	$\log U$	$\log T$	$\log FD$
1	0.39	0.27	0.32	0.01	0	0.01
5	0.36	0.36	0.12	0.09	0.09	0.017
10	0.18	0.59	0.22	0.07	0.09	0.03
15	0.13	0.61	0.32	0.018	0.10	0.05
Variance Decomposition of $\log U$						
Periods	$\log CO_2$	$\log Y$	$\log E$	$\log U$	$\log T$	$\log FD$
1	0.04	0.005	0.02	0.92	0.083	0.019
5	0.12	0.28	0.02	0.35	0.09	0.15
10	0.046	0.64	0.007	0.20	0.09	0.11
15	0.057	0.77	0.01	0.24	0.03	0.05
Variance Decomposition of $\log T$						
Periods	$\log CO_2$	$\log Y$	$\log E$	$\log U$	$\log T$	$\log FD$
1	0.001	0.21	0.06	0.05	0.76	0.04
5	0.15	0.26	0.07	0.27	0.27	0.03
10	0.20	0.38	0.04	0.24	0.15	0.04
15	0.30	0.39	0.05	0.14	0.15	0.05
Variance Decomposition of $\log FD$						
Periods	$\log CO_2$	$\log Y$	$\log E$	$\log U$	$\log T$	$\log FD$
1	0.04	0.00	0.03	0.006	0.04	0.87
5	0.06	0.31	0.03	0.08	0.13	0.37
10	0.08	0.28	0.06	0.05	0.19	0.30
15	0.12	0.24	0.06	0.06	0.20	0.28
Country: Sri Lanka						
Variance Decomposition of $\log CO_2$						
Periods	$\log CO_2$	$\log Y$	$\log E$	$\log U$	$\log T$	$\log FD$
1	1.00	0.00	0.02	0.00	0.00	0.00
5	0.59	0.26	0.06	0.14	0.02	0.020
10	0.26	0.55	0.05	0.11	0.04	0.10
15	0.21	0.55	0.06	0.11	0.03	0.10
Variance Decomposition of $\log Y$						
Periods	$\log CO_2$	LogY	Log E	Log U	Log T	Log FD
1	0.002	0.99	0.04	0.003	0.004	0.01
5	0.02	0.77	0.20	0.011	0.01	0.003
10	0.04	0.65	0.26	0.008	0.01	0.003
15	0.05	0.47	0.38	0.03	0.04	0.006
Variance Decomposition of $\log E$						
Periods	$\log CO_2$	$\log Y$	$\log E$	$\log U$	$\log T$	$\log FD$
1	0.34	0.17	0.47	0.07	0.06	0.020
5	0.30	0.16	0.36	0.09	0.07	0.021
10	0.15	0.49	0.20	0.069	0.05	0.01
15	0.16	0.53	0.16	0.070	0.04	0.01
Variance Decomposition of $\log U$						
Periods	$\log CO_2$	$\log Y$	$\log E$	$\log U$	$\log T$	$\log FD$
1	0.05	0.03	0.03	0.88	0.04	0.00
5	0.02	0.03	0.02	0.87	0.03	0.012
10	0.03	0.07	0.01	0.82	0.03	0.011
15	0.03	0.10	0.04	0.76	0.03	0.011
Variance Decomposition of $\log T$						
Periods	$\log CO_2$	$\log Y$	$\log E$	$\log U$	$\log T$	$\log FD$
1	0.03	0.24	0.13	0.24	0.34	0.004
5	0.06	0.21	0.22	0.30	0.18	0.004
10	0.04	0.19	0.37	0.22	0.15	0.006
15	0.04	0.18	0.39	0.21	0.14	0.006
Variance Decomposition of $\log FD$						
Periods	$\log CO_2$	$\log Y$	$\log E$	$\log U$	$\log T$	$\log FD$
1	0.05	0.05	0.22	0.14	0.10	0.43

5	0.07	0.18	0.36	0.12	0.04	0.20
10	0.05	0.36	0.27	0.12	0.04	0.11
15	0.07	0.34	0.27	0.15	0.04	0.11
Country: Pakistan						
Variance Decomposition of $\log$ CO_2 $						
Periods	$\log$ CO_2 $	$\log$ Y $	$\log$ E $	$\log$ U $	$\log$ T $	$\log$ FD $
1	1.00	0.00	0.0	0.010	0	0.0
5	0.51	0.13	0.11	0.020	0.21	0.03
10	0.50	0.16	0.09	0.020	0.20	0.02
15	0.48	0.15	0.09	0.029	0.21	0.02
Variance Decomposition of $\log$ Y $						
Periods	$\log$ CO_2 $	$\log$ Y $	$\log$ E $	$\log$ U $	$\log$ T $	$\log$ FD $
1	0.14	0.85	0.023	0.03	0.018	0
5	0.16	0.51	0.017	0.03	0.26	0.048
10	0.27	0.37	0.05	0.06	0.20	0.03
15	0.40	0.24	0.048	0.06	0.22	0.04
Variance Decomposition of $\log$ E $						
Periods	$\log$ CO_2 $	$\log$ Y $	$\log$ E $	$\log$ U $	$\log$ T $	$\log$ FD $
1	0.43	0.017	0.54	0.001	0.003	0.016
5	0.20	0.14	0.34	0.004	0.15	0.12
10	0.50	0.09	0.13	0.03	0.18	0.05
15	0.44	0.12	0.18	0.04	0.17	0.04
Variance Decomposition of $\log$ U $						
Periods	$\log$ CO_2 $	$\log$ Y $	$\log$ E $	$\log$ U $	$\log$ T $	$\log$ FD $
1	0.05	0.011	0.013	0.91	0.06	0
5	0.04	0.02	0.007	0.51	0.43	0.005
10	0.25	0.008	0.006	0.28	0.42	0.005
15	0.38	0.005	0.086	0.12	0.38	0.008
Variance Decomposition of $\log$ T $						
Periods	$\log$ CO_2 $	$\log$ Y $	$\log$ E $	$\log$ U $	$\log$ T $	$\log$ FD $
1	0.07	0.003	0.001	0.001	0.91	0.017
5	0.068	0.22	0.033	0.07	0.57	0.018
10	0.12	0.19	0.08	0.08	0.47	0.03
15	0.28	0.15	0.10	0.05	0.37	0.10
Variance Decomposition of Log $\log FD $						
Periods	$\log$ CO_2 $	$\log$ Y $	$\log$ E $	$\log$ U $	$\log$ T $	$\log$ FD $
1	0.01	0.002	0.010	0.26	0.007	0.70
5	0.32	0.04	0.007	0.33	0.070	0.25
10	0.42	0.08	0.048	0.18	0.13	0.11
15	0.46	0.07	0.047	0.13	0.17	0.09

Source : Author's calculation

Country: Sri Lanka

Variations in carbon dioxide emissions is explained by shocks in itself and subsequently by Gross Domestic Product , significantly. Deviations in Gross Domestic product is explained in the short period by shocks in itself and subsequently by energy consumption .Energy consumption is explained by itself and subsequently by GDP to a major extent in the 15 period time horizon. Urbanisation is to large extent explained by variation in itself. Trade openness is explained by GDP, energy consumption and by itself over the time period under study. Financial maturation in the short term is explained by itself and energy consumption and then it is explained by shocks in GDP, urbanisation .

Country: Pakistan

The variation for CO_2 is expounded in the short termby CO_2 itself , subsequently by GDP and trade openness. Deviation in Gross Domestic Product is explained in the short term by itself and subsequently by CO_2 emissions and trade openness. Variations in energy consumption is explained by itself and shocks in carbon emissions subsequently. Urban expansion in the short term is explained by itself and then by carbon emissions significantly. Trade liberalization in the shortrun is explained by shocks in itself and the same is true for financial development

4. Conclusion

This paper fills the gap in the literature on studies regarding the connections across carbon dioxide emissions , economic growth and major macro variables for India and her major neighbours using a VAR model in a time series framework, adopting Cointegration Test,Impulse Response Function and Variance Decompostion Analysis. Gross Domestic product and energy consumption continues to be the signifant explanatory variables for carbon emissions

 ISSN (online): 2320-9836
ISSN (Print):2320-9828

in this Asian region. That trade openness will reduce carbom emissions has to be handled with caution beacuse it might lead to exapnsion of dirty industries in countries with less stringent environmental laws. The results indicate that in the long run the countries need to embrace more energy conservation policies no matter what the directional approach in the short run may be.Only implementing environmental and energy polices under a multilateral trade relations framework and using stricter environmetal neighbour polices can control carbon dioxied emissions. As the human development standards also occupy a more important concern promulgating polices for healthy living standards is a necessary condition in all the countries under study.

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The Publication fee is defrayed by Indian Society for Education and Environment (www.iseeadyar.org)

Cite this article as:

Sudeshna Ghosh. On CO_2 emissions and major macroeconomic variables: A Var Model; Case of China, India, Pakistan and Sri Lanka.*Indian Journal of Economics and Development*. Vol5(2), February 2017.