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The Impact of Urbanization and Energy Consumption on CO_2 Emissions in South Asia

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ABSTRACT

This paper explores the relationship between urbanization, CO_2 emissions and energy consumption in South Asia for the period of 1983 to 2013, using Panel Co-integration and Granger causality approach. A long-run relationship exists between CO_2, energy consumption and urbanization. The empirics also indicate that energy consumption and economic growth are playing a significant role in degrading the environment while trade is improving its quality. Bidirectional causality exists between CO2 and energy, and between urbanization and CO_2 emissions both in the short run and long run.
Key Words: Carbon dioxide emissions, Urbanization, Energy, Co-integration

Introduction

Environmental problems got importance due to increase in the climate related problems. These problems are related to pollution and the deterioration of environmental quality. The intensive energy usage is increasing carbon dioxide (CO_2) emissions (see, for example, Bojanic, 2012). In Asia, the average annual growth rate of CO_2 emissions is 5.3 % (IEA, 2007).

Furthermore, the intensive use of energy is increasing the demand for fossil fuel which leads to depletion of natural resources, higher CO_2 emissions, and overall environmental degradation. So it is necessary to incorporate the environmental quality in the discussion of energy use.

Energy is an increasing factor of trade and is boosting economic growth rate. Energy is the backbone of production process because it transforms the raw material into goods, and production leads to international trade. Energy consumption is also closely linked with economic growth.

The migration from rural zones to urban areas is also problematic for developing countries. The rural area's population is linked with agriculture sector and they are moving towards urban areas and industrial sector as well. So, urbanization may cause the carbon dioxide emissions.

In the literature, trade has been found an increasing factor of economic growth. The origin of trade is driven on the basis of difference in resources among countries. By nature, some countries are labour abundant while some others are capital intensive. International trade, especially exports expedite economic growth, scale of production, quality of goods and employment opportunities.

An ample body of literature has investigated the importance of environmental quality. Many studies found adverse effect of economic growth and energy consumption on the environment (see, for example, Shahbaz et al., 2013). As far as financial development is concerned, it can have a positive as well as negative impact on CO_2 emissions. For instance, Ozturk and Acaravci (2013) determined that financial development increases CO_2 emissions while Shahbaz et al. (2013), and Jalil & Feridun (2011) found negative impact of financial development on pollution emissions.

Our objective is to explore the dynamic effect of energy, urbanization, trade and finance on CO_2 emissions for five South Asian economies for the time period of 1983 to 2013.

As the emerging economies exploit energy resources more rapidly due to relative inefficiency of utilization process, so per unit energy consumption is higher for them. Similarly, GDP per capita growth rate had been around 7.5% for these South Asian countries in 2007 before the global financial crisis (World Bank Report). Meanwhile per capita energy consumption for these economies is also showing an increasing trend for this region. So, in this study we focus South Asian region.

Literature Review

The increasing demand of energy has led to high demand for fossil fuel. The intensive use of fossil fuel causes many environmental problems such as CO_2 emissions, natural resource depletion among others. Lotfalipour et al. (2010) inferr unidirectional causality from GDP and gas consumption to carbon emission in Iran. Alam et al. (2012) also expose one-way causality from energy use to CO_2 emissions in short run and two-way causality in the long run. But some studies are against this argument, such as, Ozturk and Acaravci (2010) discovered that both per capita CO_2 emission and energy consumption did not cause real per capita GDP in Turkey.

Shahbaz et al. (2013) disclosed that financial development decreased CO_2 emissions while economic growth and energy consumption enhanced carbon dioxide emissions in Malaysia. Jalil and Feridun (2011) exposed that development in finance was found helpful to mitigate CO_2 emissions rather than increasing it, in China. According to Tamazian et al. (2009), development in finance reduced pollution in BRICS countries. Their results also showed that financial liberalization and openness reduced CO_2.

Tamazian and Rao (2010) also discovered that institutional and financial developments were important factors for better environment and for control of CO_2 emissions in twenty four transitional countries. They found that economic development improved the quality of environment. Their results also suggested that FDI reduced CO_2 emissions per capita while trade openness increased these.
Farhani et al. (2014) concluded that trade, real GDP and energy consumption affected pollution in the long run in Tunisia. Hossain, S. (2011) investigated one way causality holds from openness to carbon dioxide emissions in newly industrialized countries separately. The results also expose that energy consumption is increasing pollution (carbon dioxide). Kohler, M. (2013) also explored two way causation among energy consumption and CO_2 emission. The results also explain that an increasing trend of trade openness decreases the CO_2 emissions due to the technological innovations in South Africa.

Shahbaz and Lean (2012) inferred the relationship between energy consumption, urbanization and industrialization in Tunisia over the period of 1971 to 2008. Omri (2013) inferred that urbanization was increasing CO_2 emissions. Hossain, (2011) found that environmental quality was a normal good with respect to urbanization, trade and economic growth.

These results are giving suggestions for energy and environmental policy, and policies should be designed which may be helpful for reducing the intensive use of energy. The previous evidence explained that energy consumption increases with increased trade and economic growth. So the environmental policy needs to be designed in such a way that it will not affect economic growth and trade. A country can control and reduce the use of energy through technological innovations and making efficient use of energy. There is an inverse relationship between the use of energy and energy efficiency. The impact of urbanization should be incorporated to find out the causes of CO_2 emissions in South Asia.

Methodology and Empirical Models

Omri (2013) incorporated trade and urbanization in growth equation to assess the above discussed relationship. While Tamazian et al. (2009) emphasised the importance of financial development in shaping these relationships. Urbanization is an important determinant of environmental quality, and **Hossain**, (2011) expressed the dynamic link between urban population and CO_2 emissions. So we have incorporated these indicators in our model and we can write the functional form of CO_2 emissions in the following form:

$$C = f\ (Y, K, L, E, T, F, URB) \qquad (1)$$

Where

C = Carbon dioxide emissions;
Y = Economic growth;
K = Capital;
L = Labor;

E = Energy consumption;
T = Trade (exports plus imports);
F = Financial development;
URB = Urbanization;

For modeling framework, we used the simple function to investigate the relevant relationships. According to our functional form the general production function was established as follows:

$$C_{it} = \beta_0 Y_{it}^{\beta_{1t}} K_{it}^{\beta_{2t}} L_{it}^{\beta_{3t}} E_{it}^{\beta_{4t}} T_{it}^{\beta_{5t}} F_{it}^{\beta_{6t}} URB_{it}^{\beta_{7t}} \quad (2)$$

We took natural logarithms of equation (2) to linearize the nonlinear production function.

$$ln(C_{it}) = \beta_0 + \beta_1 ln(Y_{it}) + \beta_2 ln(K_{it}) + \beta_3 ln(L_{it}) + \beta_4 ln(E_{it}) + \beta_5 ln(T_{it}) + \beta_6 ln(F_{it}) + \beta_7 ln(URB_{it}) + \varepsilon_{it} \quad (3)$$

Where,

ln = Natural logarithm;
β_0 = Intercept
β_1 = elasticity of CO_2 emissions with respect to economic growth;
β_2 = elasticity of CO_2 emissions with respect to capital;
β_3 = elasticity of CO_2 emissions with respect to labor;
β_4 = elasticity of CO_2 emissions with respect to energy consumption
β_5 = elasticity of CO_2 emissions with respect to trade;
β_6 = elasticity of CO_2 emissions with respect to financial development;
β_7 = elasticity of CO_2 emissions with respect to urbanization;
t = 1, 2 . . . 31 years;
i = 1, 2…5 economies; and
ε = error terms.

We were interested to find out the long-run relationships of CO_2 emissions with their respective determinants. The relevant techniques, methods and estimation procedure for panel data are discussed in this section. The panel co-integration method was applied to examine the relationship. In co-integration analysis, we identified the underlying relationship in the long run, to determine whether short-run variation contributed to inaugurate this relationship in the long run.

We applied the co-integration approach after checking the integration order by unit root test, and the procedure is given in the following sections. Furthermore, we will discuss the panel granger causality test for direction of causality. At the end we will discuss the pool mean group estimates for the whole panel as well as separate parameters of each cross section.

Panel Unit Root Test

All variables should have the same order of integration for proceeding to co-integration. Mostly, two tests are used in the literature and considered better as compared to others. Here we applied the Levin, Lin & Chu (2002) and Im, Pesaran & Shin test.

Panel Co-Integration Test

Panel co-integration test was employed to find the long-run relationship of CO_2 emissions with the independent variables. There are different co-integration methods, discussed in the literature e.g. Engle and Granger (EG) approach (1987), ARDL approach and Pedroni co-integration approach (1999) etc. Here the properties of panel data hold; we can raise the sample size as well as degree of freedom. EG approach is very simple and is useful for understanding the procedure of co-integration. Pedroni (1999) has modified EG approach for panel data set.

The Pedroni Co-integration Tests

Pedroni (1999) developed some panel co-integration tests and incorporated heterogeneity. Pedroni allows multiple $(k = 1, 2, \ldots. K)$ regressors and the proposed equation is given below:

$$Y_{i,t} = \beta_i + \delta_t + \sum_{k=1}^{K} \gamma_{ki} X_{mi,t} + \mu_{i,t} \tag{4}$$

Firstly, equation (3) is estimated by ordinary least square method and $\hat{\varepsilon}_{it}$ (residuals) are used to estimate following equations:

$$\hat{\varepsilon}_{it} = \delta_i \hat{\varepsilon}_{it-1} + \zeta_{it} \tag{4.1}$$

In equation, (4.1) δ_i are the AR parameters and ζ_{it} are the error terms. The null hypotheses of (4.1) is given as:

$$H_O: \quad \delta_i = 1, \quad \text{where} \quad i = 1, 2, 3, 4. \ldots, n$$

There is no co-integration if the null is accepted, while co-integration relationship exists between cross sections of the panel if the null is not accepted.

He has developed seven different co-integration statistics for testing the null hypothesis in heterogeneous panel data framework. The test has two categories. The first is 'panel statistics' that does not allow heterogeneity across countries. The null of these tests is no co-integration against the alternative hypothesis of these tests that is given below:

$$H_O: \quad \rho_i = \rho < 1, \quad \text{for all } i \quad (i = 1, 2, 3, 4, \ldots \ldots, n)$$

The second is 'group mean statistics (between dimensions)' that allows heterogeneity across countries. The null of these tests is no co-integration against the alternative hypothesis of these tests that is given as below:

$$H_O: \quad \rho_i < 1, \quad \text{for all } i \quad (i = 1, 2, 3, \ldots \ldots, N)$$

The null for both 'within dimension' and 'between dimensions' is the same while the alternative hypotheses are different for both categories.

Panel Granger Causality Test

After finding the existence of cointegration, we examined the error correction model (ECM) by applying Engle Granger causality approach, to find the panel granger causal relationship. The panel VECM for equation (3) is given below and all variables were taken in the natural logarithm form:

"$\Delta C_{it} = c_{1i} + \sum_{j=1}^{p} \gamma_{11ij}\, \Delta C_{it-j} + \sum_{j=1}^{p} \gamma_{12ij}\, \Delta Y_{it-j} + \sum_{j=1}^{p} \gamma_{13ij}\, \Delta K_{it-j} + \sum_{j=1}^{p} \gamma_{14ij}\, \Delta L_{it-j} + \sum_{j=1}^{p} \gamma_{15ij}\, \Delta E_{it-j} + \sum_{j=1}^{p} \gamma_{16ij}\, \Delta T_{it-j} + \sum_{j=1}^{p} \gamma_{17ij}\, \Delta F_{it-j} + \sum_{j=1}^{p} \gamma_{18ij}\, \Delta URB_{it-j} + \gamma_{19i}\, \varepsilon_{it-1} + \zeta_{1it}$ (3.a)

$\Delta Y_{it} = c_{2i} + \sum_{j=1}^{p} \gamma_{21ij}\, \Delta C_{it-j} + \sum_{j=1}^{p} \gamma_{22ij}\, \Delta Y_{it-j} + \sum_{j=1}^{p} \gamma_{23ij}\, \Delta K_{it-j} + \sum_{j=1}^{p} \gamma_{24ij}\, \Delta L_{it-j} + \sum_{j=1}^{p} \gamma_{25ij}\, \Delta E_{it-j} + \sum_{j=1}^{p} \gamma_{26ij}\, \Delta T_{it-j} + \sum_{j=1}^{p} \gamma_{27ij}\, \Delta F_{it-j} + \sum_{j=1}^{p} \gamma_{28ij}\, \Delta URB_{it-j} + \gamma_{29i}\, \varepsilon_{it-1} + \zeta_{2it}$ (3.b)

$\Delta K_{it} = c_{3i} + \sum_{j=1}^{p} \gamma_{31ij}\, \Delta C_{it-j} + \sum_{j=1}^{p} \gamma_{32ij}\, \Delta Y_{it-j} + \sum_{j=1}^{p} \gamma_{33ij}\, \Delta K_{it-j} + \sum_{j=1}^{p} \gamma_{34ij}\, \Delta L_{it-j} + \sum_{j=1}^{p} \gamma_{35ij}\, \Delta E_{it-j} + \sum_{j=1}^{p} \gamma_{36ij}\, \Delta T_{it-j} + \sum_{j=1}^{p} \gamma_{37ij}\, \Delta F_{it-j} + \sum_{j=1}^{p} \gamma_{38ij}\, \Delta URB_{it-j} + \gamma_{39i}\, \varepsilon_{it-1} + \zeta_{3it}$ (3.c)

$\Delta L_{it} = c_{4i} + \sum_{j=1}^{p} \gamma_{41ij}\, \Delta C_{it-j} + \sum_{j=1}^{p} \gamma_{42ij}\, \Delta Y_{it-j} + \sum_{j=1}^{p} \gamma_{43ij}\, \Delta K_{it-j} + \sum_{j=1}^{p} \gamma_{44ij}\, \Delta L_{it-j} + \sum_{j=1}^{p} \gamma_{45ij}\, \Delta E_{it-j} + \sum_{j=1}^{p} \gamma_{46ij}\, \Delta T_{it-j} + \sum_{j=1}^{p} \gamma_{47ij}\, \Delta F_{it-j} + \sum_{j=1}^{p} \gamma_{48ij}\, \Delta URB_{it-j} + \gamma_{49i}\, \varepsilon_{it-1} + \zeta_{4it}$ (3.d)

$\Delta E_{it} = c_{5i} + \sum_{j=1}^{p} \gamma_{51ij}\, \Delta C_{it-j} + \sum_{j=1}^{p} \gamma_{52ij}\, \Delta Y_{it-j} + \sum_{j=1}^{p} \gamma_{53ij}\, \Delta K_{it-j} + \sum_{j=1}^{p} \gamma_{54ij}\, \Delta L_{it-j} + \sum_{j=1}^{p} \gamma_{55ij}\, \Delta E_{it-j} + \sum_{j=1}^{p} \gamma_{56ij}\, \Delta T_{it-j} + \sum_{j=1}^{p} \gamma_{57ij}\, \Delta F_{it-j} + \sum_{j=1}^{p} \gamma_{58ij}\, \Delta URB_{it-j} + \gamma_{59i}\, \varepsilon_{it-1} + \zeta_{5it}$ (3.e)

$\Delta T_{it} = c_{6i} + \sum_{j=1}^{p} \gamma_{61ij}\, \Delta C_{it-j} + \sum_{j=1}^{p} \gamma_{62ij}\, \Delta Y_{it-j} + \sum_{j=1}^{p} \gamma_{63ij}\, \Delta K_{it-j} + \sum_{j=1}^{p} \gamma_{64ij}\, \Delta L_{it-j} + \sum_{j=1}^{p} \gamma_{65ij}\, \Delta E_{it-j} + \sum_{j=1}^{p} \gamma_{66ij}\, \Delta T_{it-j} + \sum_{j=1}^{p} \gamma_{67ij}\, \Delta F_{it-j} + \sum_{j=1}^{p} \gamma_{68ij}\, \Delta URB_{it-j} + \gamma_{69i}\, \varepsilon_{it-1} + \zeta_{6it}$ (3.f)

$\Delta F_{it} = c_{7i} + \sum_{j=1}^{p} \gamma_{71ij}\, \Delta C_{it-j} + \sum_{j=1}^{p} \gamma_{72ij}\, \Delta Y_{it-j} + \sum_{j=1}^{p} \gamma_{73ij}\, \Delta K_{it-j} + \sum_{j=1}^{p} \gamma_{74ij}\, \Delta L_{it-j} + \sum_{j=1}^{p} \gamma_{75ij}\, \Delta E_{it-j} + \sum_{j=1}^{p} \gamma_{76ij}\, \Delta T_{it-j} + \sum_{j=1}^{p} \gamma_{77ij}\, \Delta F_{it-j} + \sum_{j=1}^{p} \gamma_{78ij}\, \Delta URB_{it-j} + \gamma_{79i}\, \varepsilon_{it-1} + \zeta_{7it}$ (3.g)

$$\Delta URB_{it} = c_{8i} + \sum_{j=1}^{p} \gamma_{81ij}\, \Delta C_{it-j} + \sum_{j=1}^{p} \gamma_{82ij}\, \Delta Y_{it-j} + \sum_{j=1}^{p} \gamma_{83ij}\, \Delta K_{it-j} + \sum_{j=1}^{p} \gamma_{84ij}\, \Delta L_{it-j} + \sum_{j=1}^{p} \gamma_{85ij}\, \Delta E_{it-j} + \sum_{j=1}^{p} \gamma_{86ij}\, \Delta T_{it-j} + \sum_{j=1}^{p} \gamma_{87ij}\, \Delta F_{it-j} + \sum_{j=1}^{p} \gamma_{88ij}\, \Delta URB_{it-j} + \gamma_{89i}\, \varepsilon_{it-1} + \zeta_{1it} \quad (3.h)$$

Here in the above equations Δ was used for the first difference, c was intercept, p represented the appropriate lag length, ζ for error terms. The coefficients of variables describe the short-run granger causality relationships between variables. The error correction terms interpret the adjustments of short-run deviation to long-run equilibrium.

Data

The data on per capita CO_2 emissions (metric tons), energy use (kg of oil equivalent per capita), trade (% of GDP), financial development (domestic credit to private sector as a share of GDP), gross capital formation (% of GDP), total labor force participation rate (% of total population of ages 15+), per capita GDP (constant 2005 US$) as a proxy for economic growth, and urban population (% of total) was used as urbanization for five South Asian countries: Bangladesh, India Nepal, Pakistan and Sri Lanka. The sample spanned from 1983 to 2013. The data were taken from World Development Indicators (WDI) 2015.

Ozturk and Acaravci (2013) and Lotfalipour et al. (2010) used per capita GDP as a proxy for economic growth. Gross capital formation as share of GDP was used for capital, as was also used by Shahbaz, et al. (2013). Financial development was measured by domestic credit to private sector as a share of GDP. Al-mulali and Lee (2013) have also used domestic credit as a proxy for financial development.

Empirical Findings

This section consists of relevant empirical results and discussion. In unit root test, the lag lengths were selected with respect to Schwartz information criterion (SIC) for unit root tests. The values of t-statistics with their corresponding probability values are displayed in Table 1.

The null hypothesis was non-stationarity, and the results indicated that null hypothesis for all variables except labor should be accepted. The null hypothesis for labor was rejected by Levin Lin test, while it was not rejected according to Pesaran and Fisher tests. In this case we followed the Pesaran and Fisher tests. All variables were not stationary and co-integration existed between them, so, they had a long term relation.

Table 1: Panel unit root test

Method	lnC		$\Delta(lnC)$		$lnURB$		$\Delta(lnURB)$	
	Statistic	Prob.*	Statistic	Prob.*	Statistic	Prob.*	Statistic	Prob.*
Null: Unit root								
Levin, Lin and Chu	-1.15	0.12	-5.48	0.00	-0.88	0.18	-2.37	0.00
ADF - Fisher Chi-square	4.27	0.93	52.12	0.00	4.65	0.91	13.67	0.18
Im, Pesaran and Shin W-stat	1.74	0.95	-5.82	0.00	2.09	0.98	-0.16	0.43
PP - Fisher Chi-square	3.34	0.97	100.29	0.00	44.68	0.00	36.08	0.00

Method	lnY		$\Delta(lnY)$		
	Statistic	Prob.*	Statistic	Prob.*	Sta
Null: Unit root					
Levin, Lin and Chu	6.14	1.00	-3.07	0.00	-3
ADF - Fisher Chi-square	0.58	1.00	38.56	0.00	18
Im, Pesaran and Shin W-stat	8.28	1.00	-3.99	0.00	-0
PP - Fisher Chi-square	0.99	0.99	64.79	0.00	10

Method	lnK		$\Delta(lnK)$		
	Statistic	Prob.*	Statistic	Prob.*	Sta
Null: Unit root					
Levin, Lin and Chu	0.44	0.67	-3.28	0.00	0.862
ADF - Fisher Chi-square	13.27	0.20	54.45	0.00	10
Im, Pesaran and Shin W-stat	-0.29	0.38	-6.13	0.00	1
PP - Fisher Chi-square	15.61	0.11	106.40	0.00	9

Method	lnE		$\Delta(lnE)$		
	Statistic	Prob.*	Statistic	Prob.*	Sta
Null: Unit root					
Levin, Lin and Chu	3.22	0.99	-4.66	0.00	1
ADF - Fisher Chi-square	1.69	0.99	44.51	0.00	4
Im, Pesaran and Shin W-stat	5.46	1.00	-4.88	0.00	1
PP - Fisher Chi-square	3.35	0.97	82.92	0.00	8

* The unit root tests were performed including intercept and user specification lag at 1.

Results of Panel Co-Integration Tests

We have discussed the stationarity condition of variables at level and their first difference form in the previous section. The next step is to find out the co-integrating relationships between variables and for this we applied the Pedroni co-integration method. Firstly, equations 3 and 4.1 were estimated using the Pedroni co-integration method. The results are displayed in Table 2, which suggest that our variables are significant.

The null (no co-integration) of equation 4.1 was rejected which means co-integration existed between variables across the countries. Table 3 carries the empirics of co-integration method.

Table 2: OLS Results of Basic and Residual Models

Variables	Dependent Variable lnC	Dependent Variable $\hat{\varepsilon}_{it}$
Constant	-6.228*	0.00409
Prob.	(0.013)	(0.719)
lnY	0.594*	
Prob.	(0.000)	
lnK	1.094*	
Prob.	(0.000)	
lnL	-1.275*	
Prob.	(0.002)	
lnE	0.505*	
Prob.	(0.000)	
lnT	-0.652*	
Prob.	(0.000)	
lnF	0.118	
Prob.	(1.73)	
$lnURB$	0.849*	
Prob.	(0.000)	
$\hat{\varepsilon}_{it-1}$		0.757*
Prob.		(0.000)

* Shows that variable is significant.

Table 3: Results of Pedroni Co-integration Test

Alternative hypothesis: Common AR Coefficients **(within-dimension)**				
Tests	Statistic	Prob.	Weighted Statistics	Prob.
Panel v-Statistic	-1.43	0.92	-2.14	0.98
Panel PP-Statistic	-4.58	**0.00**	-7.51	**0.00**
Panel rho-Statistic	-0.67	0.25	-0.09	0.46
Panel ADF-Statistic	-1.17	0.11	-3.17	**0.00**
Alternative hypothesis: individual AR coefficients **(between-dimension)**				
Tests	Statistic	Prob.		
Group PP-Statistic	-9.58	**0.00**		
Group rho-Statistic	0.44	0.67		
Group ADF-Statistic	-2.37	**0.01**		

Table 3 displays the results. The null hypothesis of "no co-integration" was rejected in all cases except Panel rho-Statistic, Panel v-Statistic and Group rho-Statistic. Therefore, a long run relationship existed among CO_2 emissions, urbanization, trade, energy, growth and financial development.

The co-integration results confirmed that in the long run the error was connected by the short-run dynamics. Furthermore, we wanted to check for error corrections and Granger causality after short and long run analysis by error correction mechanism.

Granger Causality Results for VECM

Table 4 shows the causality results for CO_2 emissions and it holds the t-statistics with their probability values. We have also displayed the results of coefficients of lagged error terms with their probability values which indicate the speed of adjustment or feedback effect after a shock to long-run equilibrium. The short-run causality relationship existed in case of significant coefficients of lagged difference independent variables while coefficients of lagged error terms indicated the long-run causality relationship.

In the short run, the results showed the bidirectional causal and significant relationship among carbon dioxide and energy use, and between CO_2 emissions and urbanization. Shahbaz et al. (2013) and Kohler (2013) also found the two-way causality between CO_2 and energy.

Table 4: Granger Causality Results

From	To							
	$\Delta(lnC)$	$\Delta(lnY)$	$\Delta(lnE)$	$\Delta(lnT)$	$\Delta(lnF)$	$\Delta(lnURB)$	$\Delta(lnK)$	$\Delta(lnL)$
Constant	-0.01	0.029*	0.001	-0.007	-0.035	0.0162*	-0.031*	0.002
Prob.	(0.69)	(0.00)	(0.87)	(0.67)	(0.32)	(0.00)	(0.01)	(0.95)
$\Delta(lnC)$		0.029	0.056*	0.143	-0.062	0.0410*	-0.085	0.001
Prob.		(0.18)	(0.05)	(0.13)	(0.75)	(0.01)	(0.21)	(0.92)
$\Delta(lnY)$	0.644		0.482*	-0.080	1.364	-0.196*	1.188*	-0.013
Prob.	(0.18)		(0.00)	(0.85)	(0.14)	(0.01)	(0.00)	(0.86)
$\Delta(lnE)$	0.686*	0.270*		0.370	0.111	-0.044	-0.238	-0.075
Prob.	(0.05)	(0.00)		(0.26)	(0.87)	(0.43)	(0.31)	(0.16)
$\Delta(lnT)$	0.171	-0.004	0.036		0.488*	0.017	0.250*	-0.008
Prob.	(0.13)	(0.85)	(0.26)		(0.02)	(0.34)	(0.00)	(0.64)
$\Delta(lnF)$	-0.017	0.017	0.002	0.112*		0.011	-0.043	-0.005
Prob.	(0.75)	(0.14)	(0.87)	(0.02)		(0.21)	(0.22)	(0.55)
$\Delta(lnURB)$	1.643*	-0.361*	-0.147	0.571	1.575		0.598	0.008
Prob.	(0.01)	(0.01)	(0.43)	(0.34)	(0.21)		(0.16)	(0.93)
$\Delta(lnK)$	-0.203	0.130*	-0.046	0.497*	-0.375	0.035		0.017
Prob.	(0.20)	(0.00)	(0.31)	(0.00)	(0.22)	(0.16)		(0.47)
$\Delta(lnL)$	0.066	-0.026	-0.271	-0.294	-0.790	0.008	0.323	
Prob.	(0.92)	(0.86)	(0.16)	(0.64)	(0.55)	(0.93)	(0.47)	
ε_{t-1}	-0.213*	0.015	0.006	-0.021	-0.0195	0.014*	-0.023	0.001
Prob.	(0.00)	(0.15)	(0.66)	(0.64)	(0.84)	(0.05)	(0.46)	(0.88)

$\boldsymbol{\varepsilon_{t-1}}$**:** lagged error term.

The feedback hypothesis existed between growth and urbanization, and between economic growth and energy consumption. Siddique and Majeed (2015) also found two-way causality between growth and energy use. **Hossain**, (2011) found unidirectional causality form urbanization to growth in the short run. The two-way causal relationship existed between trade and financial development. Al-mulali and Lee (2013) also discovered the feedback hypothesis between total trade and financial development.

The results showed that no causality existed between CO_2 emissions and financial development, between financial development and growth, and between energy and financial development. No causal relationship existed between trade and growth, and between trade and energy. Our findings are almost the same that of the earlier studies (see, for example, Ozturk and Acaravci, 2013).

In the long run, the coefficient of lagged error term of equation 3(a) was significant which showed the long-run causal relationship of urbanization, economic growth, energy consumption, trade and financial development with CO_2 emissions. It means that all the used indicators including urbanization enhanced the CO_2 emissions.

The coefficient of lagged error term of urbanization was also significant which showed the long-run causality running from CO_2 emissions, growth, energy use, trade and financial development to urbanization. In South Asia, without considering trade and financial development for controlling pollution is very dangerous because trade and financial development is very important for growth of an economy.

The coefficient of lagged error term of equation 3(a) was -0.213 and it was statistically significant, which showed that 21.3% of error adjusted towards long-run equilibrium in one year. The signs of coefficient of lagged error term of trade, capital and financial development were also negative, and their numerical values were -0.0216, -0.0238 and -0.0195, respectively. The adjustment of errors towards long-run equilibrium was 2.1% in case of trade, 2.3% in case of capital formation and 1.9% in case of financial development, respectively. However, the coefficients of these variables are insignificant at any level.

Conclusion and Policy Implications

Energy is an emerging and challenging issue of the world. In South Asia, countries have limited resources but they are not extracting them due to the heavy cost of exploration. Some of them have more resources of energy and enough capacity to control the energy crises but they are not playing an effective role in this field due to different reasons. For example, Pakistan is not politically strong enough to resolve this problem and also lacks government funding.

Some of the developing countries are not consuming energy in an efficient way. The inefficient use of energy causes environmental problems, such as, increasing level of pollution. Clean and friendly environment is a basic need of the society for a quality life of its citizens. Intellectuals and researchers are working on how we can fulfil the energy requirement and make efficient use of energy. They are also trying to explore the problems which inhibit the provision of clean and healthy environment.

The results show the long-run relationship between CO_2 emissions, urbanization, energy consumption, economic growth, trade and financial development. In the long run, feedback relationship exists between carbon dioxide emissions and urbanization.

The negative sign of significant lagged error coefficient (-0.213) of CO_2 emissions showed the long-run adjustment which was corrected by 21.3% each year. The negative sign of significant coefficient (-0.0149) showed the long-run adjustment in errors and 1.4% error was corrected in one year towards long-run equilibrium. The signs of coefficient of lagged error term of trade and financial development were also negative, and the coefficients were -0.0216 and -0.0195, respectively. The long-run adjustment in errors was corrected in a year by 2.1% in the case of trade and 1.9% in the case of financial development, while the coefficients of trade and financial development variables were insignificant.

Policy Implications

As the growth hypothesis is valid, an energy conservative policy will harm economic growth in South Asia as well as in emerging economies. The causality between CO_2 emissions and urbanization suggests that migration from rural to urban areas is increasing CO_2 emissions. Financial development improves the quality of environment and trade reduces the carbon dioxide emissions. We suggest environment friendly policies which are favourable for regional trade and economic growth. Moreover, the researchers should work on energy intensity and energy efficiency which might be helpful in reducing energy consumption and pollution.

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