

Dynamics of Urbanization and Carbon-Energy Model for Low Middle Income Economies of South Asia

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Abstract

In developing economies of the world, the release of greenhouse gases has become the biggest challenge. Various research scholars have explored that Carbon dioxide is the main element which highly contributes to the degradation of the environment. This research study has explored the causal link between urban population, use of energy and release of carbon dioxide in low middle-income economies of SA. The stationarity test depicted that the variables are stationary at the first difference. The “co-integration” analysis of the study shows that there is a long period association between the rising in urban population, energy use and release of carbon dioxide and the short period association between energy use and release of carbon dioxide. The VECM model explains that there is two-way linkage among the use of energy and release of carbon dioxide and rising urban population in the long period. But in a short period, two-way linkage occurs between the use of energy and release of carbon dioxide. In these economies, the rising urban population is driving the use of energy and rising energy use is resulting in negative effects on the environment. Thus, the government needs to make efforts to introduce planned rising urban population in these economies.

Keywords: Carbon dioxide release, urban population, Energy use, Co integration Test, VECM

JEL Classification: C23, O1, Q43, Q56

1. Introduction

Rapidly changing environment and rising release of greenhouse gases have become a challenge for almost all developing countries of the world. From among all greenhouse gases, carbon dioxide is one among them. The statistics of ADB reports (2018) revealed that in Asian countries the release of carbon dioxide is rising at the fastest rate. Moreover, the report has also mentioned that the top three carbon dioxide emitting economies are in Asia and the release of this gas in these countries is continuously rising. With the changing scenario of the rising urban population in these countries, the rate of CO₂ release is also changing.

After the second war, a wide gap has been observed in the rate of the rising urban population in these developing economies. In developed countries such as Europe, North America and Oceania, the level of rising urban population is too high. Partial of the population of these countries are living in cities. Asia and Africa are the two regions of the world with the least rising urban population. But the rate of rising urban population is rising in these regions at the fastest pace. It has been observed that from the past three decades the urban population in Asian cities has increased by 1 million. According to the expectation of the United Nation, this

population will be increased by 1.1 billion in the next three decades. By 2040, more than half of the population of Asian cities would be urban.

Various researchers in their studies have proved that this increase in rising urban population, energy use by this rising population and effects on the environment are related to each other. “Martinez-Zarzoso (2008), Halicioglu (2009), Acaravci and Ozturk (2010), Saboori and Sulaiman (2012), Sadorsky (2014), and Kasman and Duman (2015) rising urban population and use of energy are the main components of environment dilapidation”. Sadorsky (2014) mentioned that a rising urban population has also affected the growth of the economy in the developing economies with the increased use of energy and rising environment degradation (Sadorsky, 2014). The study aims at exploring the linkage between rising urban population, use of energy and carbon release in selected economies of SA.

2. Literature Review

Most of the researchers in their studies have proved that demand for energy is continuously rising because of the rising level of the urban population. This rise in urban population and rising use of energy arouses issues of environmental degradation. Various research studies have explored the link between rising urban population, rising use of energy in the economies and its effect on the environment and have identified one-way and the two-way link between these variables in different regions of the world and different countries.

Al-Mulali (2011) stated that there is a one-way linkage between environment and carbon release in MENA countries for the period of 1980-2009. Hossain (2011) in his study for newly industrialized countries for the period 1971-2007 mentioned that there is one-way linkage from the environment to carbon release and one-way linkage from carbon release to the environment. Hossain (2012), using ARDL bound testing for the period of 1960- 2009 for the economy of Japan mentioned that there is a two-way linkage between use of energy and carbon release and there is one-way linkage from rising urban population to carbon release.

Saboori & Sulaiman (2013) in his research for Malaysia for the period of 1970-2009 mentioned that there is one-way linkage from the environment to carbon release, one-way linkage from rising urban population to environment and there is one-way linkage from rising urban population to environment. Shahbaz et al (2017), in his study for the period of 1975-2011 for UAE using ARDL bound test and VECM approach mentioned that there is a bidirectional link between energy use and carbon release and there is a bidirectional link between rising urban population and carbon release.

Kasman and Duman (2018) in their study of new EU members mentioned that there is a bidirectional link between energy use and carbon release. There is a one-way link between rising urban population and carbon dioxide release and there is a one-way link between rising urban population and energy use.

3. Methodology

This research study has used panel data of four SA Countries (Bangladesh, Bhutan, India and Pakistan) from 1990 to 2018. The data for this study has been fetched from the WB database, World Urbanization Prospectus and International Energy Agency. The research study is based on the carbon release model and energy model. These models have been described below

$$C_{it} = \alpha + \beta_1 E_{it} + \beta_2 U_{it} + \varepsilon_{it} \dots \dots \dots (1)$$

$$E_{it} = \alpha + \beta_3 U_{it} + \beta_4 C + \varepsilon_{it} \dots \dots \dots (2)$$

In the above-given models, C refers to carbon dioxide release; E stands for use of energy; U stands for the rate of the rising urban population. In this model, α and β s are the intercepts and slope of coefficients respectively. A term used to represent time is t and ε_{it} is the error term.

Table 1. Descriptive statistics

	C_E	E_C	URB
Mean	1.963	531.121	41.321
Median	0.312	429.352	39.321
Std. dev.	2.121	53.848	13.254
Min.	0.029	221.526	10.268
Max	11.258	3041.25	86.352
Skewness	2.2584	2.6254	0.7514
Kurtosis	13.251	11.325	4.1252
Correlation Matrix			
	C_E	E_C	URB
C_E	1.000		
E_C	0.843	1.000	
URB	0.425	0.563	1.000

Source: calculated using E-views

According to the above-given data, the variables urban population, use of energy and release of carbon dioxide are correlated with each other. Thus, econometric approaches can be used for further analyses. The research study has used a stationarity test, “co-integration” tests and VECM model for bringing into light some new facts related to the rising urban population, energy use and environment in SA countries.

For checking the stationarity of the variables, the research study has used PURT, which is considered more powerful as compared to individual root test. The main tests used in this study for checking the stationarity of the variables are LLC and IPS test. LLC checks the existence of the conjoint entity source between the variables and IPS test individual “unit root”. In LLC, an alternative hypothesis refers to there is no “unit root” between the variables. In IPS, null hypothesis

means there is “unit root” in the variables. The results of “unit root tests”, co-integration and causality test are described in the below-given tables.

4. Results

Table 2. Unit Root Test

	D(0)	D(1)
LLC		
C_E	-1.429	-18.239***
E_C	-0.813	-16.859***
URB	-1.019	-5.639***
IPS		
C_E	-1.239	-19.396***
E_C	-1.211	-16.301**
URB	-1.154	-5.936***

Notes: *** specifies significance level at 1%, ** specifies significance level at 5%.

The above table presents the results of “unit root” tests LLC and IPS. The results of the tests describe the non-stationarity of variables at the level. But at D1, these variables are stationary. According to these results, there is the integration of variables in order 1. It shows that “co-integration” analysis can be used to check the “co-integration” among the variables. Pedroni “co-integration” test best describes the “co-integration” link among the variables.

Table 3. Pedroni “co-integration” Test

Test statistics	Carbon dioxide model	Energy use model
“H1: common AR coefficients. (within-dimension (Panel Statistics))”		
V	−0.921	-0.231
Rho	--2.032***	-3.698***
PP	−9.0214***	-3.587***
ADF	−12.963***	-3.256***
“H1: individual AR coefficients. (between-dimension (Group statistics))”		
Rho	--1.432*	0.536
PP	--5.936***	-2.125
ADF	-6.3214***	-2.014**

Notes: *** specifies significance level at 1%, ** specifies significance level at 5%.

The results of the test show that there is a long period association between urban populations, use of energy and their effect on the environment through carbon release. Kao & Pedroni both have used the same approach for testing “co-integration” among the variables. But Kao (1999) has described this integration through DF and ADF tests. The null hypothesis of these tests shows no integration among the variables.

Table 4. Kao’s “co-integration” Test

Test statistics	Carbon dioxide model	Energy use model
ADF	1.329*	-1.593**

Notes: *** specifies significance level at 1%, ** specifies significance level at 5%.

According to Kao's test, the significant value of ADF shows that there is a “co-integration” link among the variables urban population, use of energy and their effect on the environment through carbon release.

Although, Pedroni and Kao “co-integration” tests explain that there is a long period association between the variables but these tests do not explain the path of a causal link. But the presence of “co-integration” explains that granger linkage test can be used to check that path of linkage for these variables. VECM approach can best explain the linkage between these variables. This VECM can be explained through the following equation.

$$\begin{bmatrix} \Delta CO_{2it} \\ \Delta ENERGY_{it} \\ \Delta URBAN_{it} \end{bmatrix} = \begin{bmatrix} C_1 \\ C_2 \\ C_3 \end{bmatrix} + \sum_{k=1}^p \begin{bmatrix} \beta_{11k} & \beta_{12k} & \beta_{13k} \\ \beta_{21k} & \beta_{22k} & \beta_{23k} \\ \beta_{31k} & \beta_{32k} & \beta_{33k} \end{bmatrix} \begin{bmatrix} \Delta CO_{2it-k} \\ \Delta ENERGY_{it-k} \\ \Delta URBAN_{it-k} \end{bmatrix} + \begin{bmatrix} \gamma_1 \\ \gamma_2 \\ \gamma_3 \end{bmatrix} ECT_{it-1} + \begin{bmatrix} \varepsilon_{1it} \\ \varepsilon_{2it} \\ \varepsilon_{3it} \end{bmatrix}$$

In the above equation, C , β and γ are estimated parameters. Δ presents that the first differenced variables have been used in this equation. Error correction term of the equation ECT_{it-1} shows long period equilibrium association.

Table 5. Panel Granger Casualty Test

Dependent variables	ΔC_E	ΔE_C	ΔURB	$ECT (-1)$
ΔC_E	-	-2.436**	0.514	-3.968***
ΔE_C	-11.298***	-	0.496	-6.125***
ΔURB	0.371	-0.003	-	-6.625***

Notes: *** specifies significance level at 1%, ** specifies significance level at 5%.

The above table presents the results of Vector error correction model. According to the above-given results, there is two-way linkage among the use of energy and release of carbon dioxide and rising urban population in the long period. But in a short period, two-way linkage occurs between the use of energy and release of carbon dioxide.

5. Discussion

The research analysis has proved that rising urban population in SAn economies highly impact the use of energy by people of these countries and the energy use pattern of people of these countries high impact the environment of these economies. People in these low and low middle-income economies of SA, prefer to use cheap sources of fuel to fulfil their needs of energy. These cheap sources of energy emit a large amount of carbon dioxide. India, Pakistan, Bangladesh and Bhutan all are low middle-income economies of SA. Rising urban population in these economies is rising at a fast rate due to the high rate of rural to urban migration. It is expected that in the coming three decades more than half of the population of these economies will be urban. But with the rising urban population, level of economic development of these economies is not in line. Lack of houses and proper infrastructure development is leading to slum formation in these economies. People in these economies prefer to use cheap sources of energy without caring about the environment. Thus, these economies are highly contributing to carbon release. The long period association between rising urban population, use of energy and release of carbon dioxide shows that these economies are at risk of high release of carbon release in the coming years. People in these economies are not aware of the use of clean energy. They are not being provided with the infrastructural facilities. Thus they are forced to use the easily available and cheap sources of energy to fulfil the needs of their family members.

6. Conclusion

The research study explored the drivers of Co2 release in the SA countries in the long period. Using the panel data set from 1990-2018, the study identified the long period association between rising urban population, use of energy in these economies and effects on the environment. Through VECM analysis, the study has explored the causal link between rising use of energy and degrading environment and rising population and rising use of energy. In SAn countries, the Rising urban population is driving the use of energy and rising energy use is resulting in negative effects on the

environment. The results of the research study prove that rising urban population and use of energy are the main elements of environmental quality in these economies. Thus, the government needs to make efforts to introduce planned rising urban population in these economies. Environment quality can only be improved by controlling the level of rising urban population and by changing the use of energy in the economies. The governments need to make efforts to increase the share of clean energy in total use of energy in these economies.

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