Effect of Population density and urbanization on Energy Consumption and Environmental Degradation in Selected Populous Countries

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Introduction

- According to the World Population Prospects 2017, the world population will hit a staggering 9.8 billion by 2050.
- China (with currently 1.4 billion) and India (with currently 1.3 billion) will remain the two most populous countries, and
- Nigeria will overtake the United States to become the third-most populous country in the world.
- In next seven years, (around 2024), India is expected to surpass the population of China

- In next 13 years (2030) the world population is projected to increase by one billion people, making 8.6 billion people.
- It will be 9.8 billion in 2050,
- and 11.2 billion in 2100.
- In other words, 83 million people is being added to the world's population every year.

Introduction cont…..

Urbanization (URB) is an essential part of economic growth.

URB improved living standard, promote economic growth, but it also increases Energy utilization (Al-Mulali et al., 2012).

Developed country’s history showed that economic growth is a procedure of industrialization and Urbanization (Li and Lin, 2015).

URB is a crucial element to stimulate economic development in cities. It stimulated innovation in science and technology and in a system of law and government (Baqui, 2009).

Introduction cont…..

- In 1950, only 30 percent of the world's population lived in urban land,
- but increased by 50 percent in 2007 and projected to increase approximately 60% in 2030 (Baqui, 2009).

- High urban density influences the patterns of resource use and global ecological worth. In the relation of ecological pressure, with the utilization of energy and CO2 emission, these incredible challenges modeled by fast URB. (Zhang and Lin., 2012).
- The quickly growing URB has many harmful consequences on the atmosphere. Such as air contamination, industrial pollution, water, toxic waste, carbon emission and solid waste (Li and Rao, 2009).

Introduction ***cont.....***

- Nowadays, the problem is not only overpopulation, but
- also the ***abnormal disparity in its distribution***.
- On the one hand, great challenges of overpopulation are mostly in developing countries

Objectives

- To investigate the relationship between Population density, urbanization and Energy consumption.
- To estimate the impact of Population density, urbanization and Energy consumption on Environmental Degradation.
- To suggest policy implications and recommendations.

Review of Literature

	Studies	Findings
1	Ang 2007; Zhang and Cheng 2009; Halicioglu 2009; Begum et al. 2015; Kasman and Duman 2015	+ relationship between economic growth and energy consumption
2	Ozturk and Acaravci 2010; Kaika and Zervas, 2013, Liddle 2015 ;Narayan et al. 2015; Al-Mulali et al. 2015, Nasreen et al., 2017	+relationship between economic growth and environmental pollutions, and EKC found
3(a)	Alam *et al*., (2007), Poumanyvong and Kaneko (2010), Zarzoso and Maruotti (2011), Sadrosky (2013), Shafiei and Salim (2014)	Urbanization and population growth/density, showed positive impact on Co2 in low and middle income countries but negative in high income
3(b)	Sharma (2011), 69 countries (low, middle and high income Li and Lin (2015)	Urbanization decreased ED in low and middle and high income countries urbanization increase ED but decrease EC in low income countries. In middle and high income countries urbanization has an insignificant effect on EC and CO_2 emissions.
3(c)	Dai and Liu (2012) , in 29 china provinces Wang *et al*., (2016)	+ relationship b/w Urbanization and EC + relationship b/w Urbanization and environmental pollution + relationship b/w EC and environmental pollution

Data

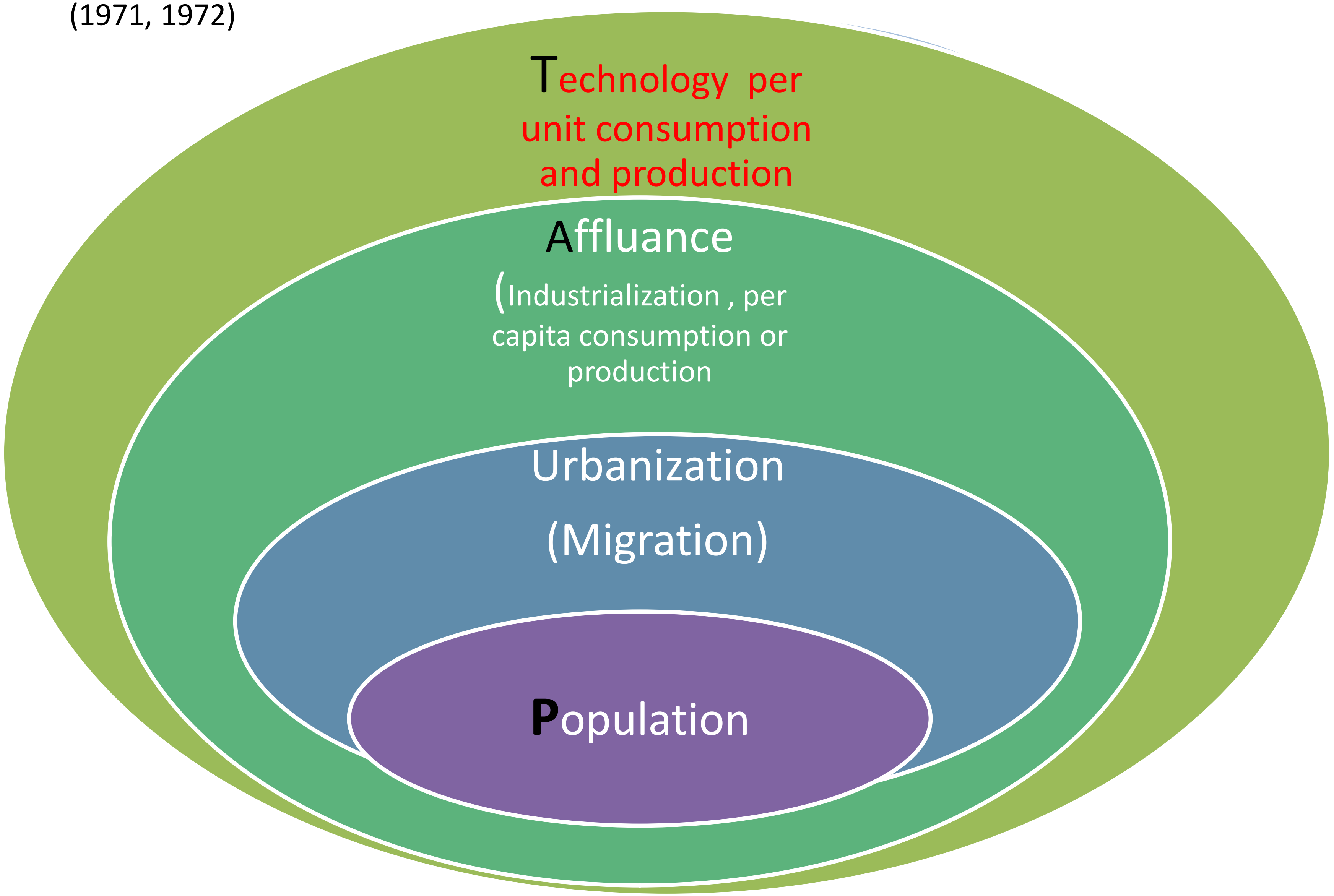
This study uses a panel data set of 10 top populous countries over the period of 1997-2014

Rank	Country	Population	Population Density	CO_2 /capita	Population Prospects2050	
1	China	1,376,048,940	143	7.6	1,348,056,330	10,457,971,944
2	India	1,311,050,530	399	1.6	1,705,332,540	2,097,680,848
3	United States	325,843,650	33	16.4	392,664,130	5,343,835,860
4	Indonesia	257,563,820	135	1.9	322,237,410	489,371,258
5	Brazil	207,847,530	25	2.5	238,270,380	519.618,825
6	Pakistan	188,924,870	238	0.8	309,639,860	151139896
7	Nigeria	182,201,960	197	0.6	398,507,700	109321176
8	Bangladesh	160,995,640	1118	0.4	202,209,050	64398256
9	Russia	143,456,920	8.4	12.5	128,599,240	1793211500
10	Japan	126,573,480	335	9.8	107,411,390	1,240,420,104

Variables

- Energy consumption (EC, in kg of oil equivalent per capita),
- Population density (PD, per square. Km of land area divided by GDP),
- Environmental degradation (ED, CO2 emission metric ton per capita),
- Urbanization (URB, percentage of the urban population in the total population),
- AGR, (share of agriculture in GDP as percentage
- IND (share of industries in GDP as percentage
- SV (share of services in GDP as percentage
- Real GDP per capita (GDP, in constant current US$) taken from World Development Indicators.

IPAT model by Ehrlich and Holdren (1971, 1972)



Model specification

STIRPAT by Dietz and Rosa (1997).

The final model after disintegration of the variables are given below:

$$I_i = \alpha PD_i^{\beta_1} AGR_i^{\beta_2} IND_i^{\beta_3} SV_i^{\beta_4} URB_i^{\beta_5} EC_i^{\beta_6} e_i$$

Where PD, AGR, IND, SV, URB and EC denote population density, agriculture sector, industrial sector, the services sector, urbanization and energy consumption, i indicate country

Model 3

Model s

$$\ln EC_{it} = \beta_0 + \beta_{it} PD_{it} + \beta_{2it} AGR_{it} + \beta_{3it} IND_{it} + \beta_{it} SV_{it} + \beta_{5it} \ln URB_{it} + \mu_{it}$$

$$ED_{it} = \beta_0 + \beta_{it} PD_{it} + \beta_{2it} AGR_{it} + \beta_{3it} IND_{it} + \beta_{it} SV_{it} + \beta_{5it} \ln URB_{it} + \beta_{6it} \ln EC_{it} + \mu_{it}$$

$$ED_{it} = \beta_0 + \beta_{it} PD_{it} + \beta_{2it} GDP + \beta_{3it} GDP_{it}^2 + \beta_{4it} \ln URB \beta_{it} + \beta_{5it} \ln EC + \mu_{it}$$

Panel Data Methodology

Panel Unit Root Tests

- Im, Pesaran and Shin (IPS) Test
- Levine, Lin and Chu (LLC) Test

Panel Co integration Test

- The Pedroni test (1997, 1999, 2000)

Panel Co integration Regression

- Panel FMOLS Test

Unit root test results

Table-1: IPS and LLC Panel Unit Root Test Results in Selected Populous Countries (1997-2014)

Variables	IPS Unit Root Test		LLC Unit Root	Test
	At level	At 1st Difference	At level	At 1st Difference
$lnEC_{it}$	-1.065	-5.089*	-1.146	-5.931*
PD_{it}	-0.511	-6.044*	-2.400	-7.677*
$lnURB_{it}$	-0.226	-6.341*	-0.354	-32.674*
AGR_{it}	-1.006	-6.862*	-0.655	-8.013*
IND_{it}	-0.354	-6.341*	-1.098	-7.189*
SV_{it}	-0.631	-5.735*	-0.285	-8.024*
ED_{it}	-0.747	-8.019*	-2.260	-10.516*
GDP_{it}	1.058	-4.683*	-1.155	-5.573*
GDP_{2it}	-0.853	-5.200*	-2.800	-7.909*

Table 2: Pedroni Panel Co integration Test Results in model 1
(Variables: *lnEC, PD, lnURB, AGR, IND, SV*)

Models	Measurements	P-value	Measurements	P-value
	Intercept		Intercept &Trend	
Panel υ-measurement	-1.225	0.889	0.557	0.289
Panel σ- measurement	1.393	0.918	0.390	0.652
Panel ρρ- measurement	-0.275	0.001	-2.635*	0.004
Panel adf- measurement	-2.195	0.004	-2.391*	0.008
Group σ- measurement	1.916	0.973	0.759	0.776
Group ρρ- measurement	-0.046	0.002	-2.715*	0.003
Group adf- measurement	-2.356	0.009	-2.439*	0.007

Table 3: Pedroni Panel Co integration Test Results of model 2 in Selected Populous Countries (1997-2014)

(Variables: *ED*, *lnEC*, *PD*, *lnURB*, *AGR*, *IND,SV*)

Models	Measurement	P-value	Measurement	P-value
	Intercept		Intercept &Trend	
Panel υ-measurement	0.055	0.478	0.088	0.464
Panel σ- measurement	-0.090	0.463	0.324	0.627
Panel ρρ- measurement	-3.680*	0.000	-2.755*	0.002
Panel adf- measurement	-3.521*	0.000	-2.519*	0.005
Group σ- measurement	0.279	0.610	0.690	0.755
Group ρρ- measurement	-4.142*	0.000	-2.849*	0.002
Group adf-measurement	-3.951*	0.000	-2.583*	0.004

Table 4: Pedroni Panel Cointegration Test Results of model 3 in Selected Populous Countries (1997-2014)

(Variables: *ED, PD, GDP, GDP2 lnURB, lnEC)*

Models	Measurement	P-value	Measurement	P-value
	Intercept		Intercept &Trend	
Panel υ-measurement	-1.641	0.949	-2.129	0.983
Panel σ- measurement	3.112	0.999	3.857	0.999
Panel ρρ- measurement	-0.366*	0.000	-1.474*	0.007
Panel adf-measurement	-2.020*	0.002	-3.246*	0.000
Group σ- measurement	3.382	0.999	4.362	1.000
Group ρρ-measurement	-6.534*	0.000	-10.082*	0.000
Groupadf-measurement	-4.860*	0.000	-6.836*	0.000

Panel FMOLS test results

Table-5: FMOLS Test Results of Model 1 in Selected Populous Countries (1997-2014)
(Dependent Variable: lnEC)

Variables	PD	lnURB	AGR	IND	SV
Coefficient	0.117*	0.522*	-0.050*	0.086*	0.038*
P-value	0.0000	0.0000	0.0007	0.0000	0.0000

Table-6: FMOLS Test Results of Model 1 in Selected Populous Countries (1997-2014) (Dependent Variable: ED

Variables	PD	AGR	IND	SV	lnURB	lnEC
Coefficient	0.182*	0.132*	0.036*	0.047*	0.806*	0.998
P-value	0.001	0.0000	0.0007	0.0000	0.0000	0.0004

Table-7: FMOLS Test Results of Model 1 in Selected Populous Countries (1997-2014) (Dependent Variable: ED

Model 3					
	PD_{it}	$lnURB_{it}$	$lnEC_{it}$	GDP_{it}	GDP_{2it}
FMOLS	0.178* (0.000)	0.210* (0.000)	0.450* (0.000)	0.126* (0.000)	-0.128* (0.001)

Conclusion

The results showed that both population density and urbanization have damaging impact on environmental quality and a major source of energy consumption. Further, the results provide evidence supporting the Environmental Kuznets curve (EKC) hypothesis in sample countries.

Policy Recommendations

- Boost their renewable energy consumption and implementation of energy saving projects.
- It should provide the encouraging friendly environment for urban development.
- Enhancing public transportation framework.
- Improving the energy efficiency of building and expanding the share of renewable energy sources in energy supplies.


Thank You!
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