THE IMPACT OF URBANIZATION ON ENVIRONMENTAL QUALITY INSIGHTS FROM CHINA AND EGYPT FROM 1992-2020

د. لميس محمد العربي

مدرس الاقتصاد بكلية الاقتصاد بالجامعة المصرية الصينية

Abstract

This paper evaluates empirically the impact of urbanization along with some other explanatory variables on environmental quality measured by carbon dioxide emissions for two countries namely China and Egypt Annual time series data over the period of 1992-2020 are used.

KEYWORDS: urbanization, environmental quality, carbon dioxide emissions

1.Introduction

Global warming is a considered a major threat to the world, the massive industrial revolution and increasing urbanization in recent years ran by huge consumption of fossil fuels and consequent quick increase in emissions of carbon dioxide (CO2) has led to severe global warming, The Intergovernmental Panel on Climate Change (IPCC) reported an increase of average surface temperature by 0.6 ◦C in the twentieth century recognized by greenhouse gases. (Anwar, et al, 2020)

The environmental degradation has reached worrying levels and has raised alarms about global warming and climate change issues. As a result, analyzing of the reasons for environmental degradation and its relationship with urbanization, fossil fuel usage and highly economic growth rates, has become increasingly vital, while many factors have been adduced for climate change, energy consumption is considered to have the most adverse impact on the environment. (Yazdi,2019)

However, this impact is more severe when accompanied by fast rates of increasing urbanization.

The rate of urbanization is fast-growing, with the percentage of the urban population doubling and expected to double between 2000 and 2030. Overall, the global urban population, which was 1.52 billion in 1970, is expected to reach 4.6 billion people by 2030 and a large part of this will be in Asian and African cities. Where those areas are expected to use energy and fossil fuels intensively. Urban areas account for more than 70% of CO2 emissions from burning fossil fuels. (UNITED NATION, 2018)

2. Literature Review

The impact of urbanization on environmental quality,Allam (2007) concluded that fast urbanization and bigger population growth have positive effects on environmental degradation, however,significantly negative impact on the economic development of Pakistan in the long run emission nexus within the STRIPAT framework, revealing the inverted U- shaped curve nexus between variables for a panel of 20 emerging countries

The impact of urbanization on environmental quality statistically, Poumanyvong and Kaneko (2010), used the STIRPAT method then inspected the influence of urbanization on CO2 emissions and energy usage among 99 nations during the data span of 1975-2005

Regarding the impact of urbanization & economic growth on environmental quality. Wang et al. (2013). concluded that Their results indicate that factors such as population, urbanization, GDP, industrialization, service sector results in an increase in CO2 emissions

Observing the energy use, economic growth, urbanization on environmental quailty The study of Arouri.(2014), tested the existence of EKC in Thailand during the period of 1971– 2010. The empirical results vindicate cointegration among economic growth, energy use, openness, urbanization, and energy pollutants and therefore, confirmed the existence of EKC for Thailand.

concerning the impact of urbanization & energy use on environmental quality Shahbaz et al (2017). Concluded urbanization can also be referred as migration of people from the agricultural area to non-agricultural area. Urbanization is said to have a positive effect on energy consumption & co2 emissions because of large housing rates, investment and industrialization.

Wang et al. (2018), on the other hand, employ study the relationship between urbanization, energy consumption, CO2 emission and economic growth in 170 countries in the period of 1980–2011. The authors confirm the co-integration between all these variables. In another study,

Concerning the impact of fossil fuels energy consumption, economic growth ,urbanization on environmental quality The results of Abouie-Mehrizi. (2012)study indicated that the intensity of energy consumption, GDP growth rate, urban population and population growth have significantly positive impact on CO2 emissions in Iran over the period 1973–2008.

Hossain (2012) inspected the causes of energy use, CO2 pollution, urbanization, and economic development in Japan between 1960 and 2009. The outcome revealed that the rise in energy consumption leads to a higher environmental population but urbanization, and economic expansion in the long term.

3. Data and Methodology

Annual data that covers the basic two countries of this paper, were collected from World Bank Development Indicators (WDI), Carbon Dioxide emissions (metric tons per capita),GDP Per capita constant (2015)US$, Fossil Fuel Energy consumption %, and urban population).time series from 1992 to 2020

The Countries were specifically chosen as China is ranked as the highest country having internal migration, and Egypt is witnessing a huge rural to urban migration and it is forecasted to be 62.4% at 2050 rapid increase in urbanization according to (United Nations)

1. Model Specification

This study tends to use the Autoregressive Distributed Lag (ARDL) on time series data from Egypt and China during the period (1992 – 2020), to study and measure the urbanization and its impacts on carbon dioxide emissions. The variables were selected based on the study of (Shahbaz et al, 2015). The econometric analysis involved regressing the carbon dioxide emissions (CO2) on urbanization (URB), and other significant variables, the following is unrestricted error correction model (UECM) form of the ARDL model, which includes both short and long-run dynamics:

$$CO2_t = \alpha_0 + \alpha_1 CO2_{t-1} + \alpha_2 URB_{t-1} + \alpha_3 FF_{t-1} + \alpha_4 GDP_{t-1} + \sum_{i=1}^{p} \gamma_i CO2_{t-i} + \sum_{i=0}^{q} \gamma_i URB_{t-i} + \sum_{i=0}^{r} \gamma_i FF_{t-i} + \sum_{i=0}^{s} \gamma_i GDP_{t-i} + \varepsilon_t$$

Where ε_t indicates the white-noise residual term, which has to be serially uncorrelated, and the model has to be stable. Where:

α_0 denotes the constant term.

α denotes the short-run coefficients, γ denotes the long-run coefficients

Dependent Variable

$CO2$ denotes carbon dioxide emissions

Independent Variables

URB denotes urbanization

FF denotes fossil fuel

GDP denotes gross domestic product

2. Data Source:

Variable	Definition	Source	Unit of measure	How to measure	Type of variable
Environmental degradation (CO2 Emission)	Environmental degradation is a process through which the natural environment is compromised in some way, reducing biological diversity and the general health of the environment. This process can be entirely natural in origin, or it can be accelerated or caused by human activities. Carbon dioxide emissions or CO2 emissions are emissions stemming from the burning of fossil fuels and the manufacture of cement; they include carbon dioxide produced during consumption of solid, liquid, and gas fuels as well as gas flaring.	world bank	co2 emissions (metric tons per capita)	Carbon emissions per capita are measured as the total amount of carbon dioxide emitted by the country as a consequence of all relevant human (production and consumption) activities, divided by the population of the country.	Dependent variable

Real GDP Per Capita	Real GDP per capita is a measurement of the total economic output of a country divided by the number of people and adjusted for inflation.	world bank	GDP per capita (constant 2015 US$)	GDP per capita is gross domestic product divided by midyear population.	independent Variable
Energy Use	The process of using energy, or the amount of energy that is used, energy used to perform an action, manufacture something or simply inhabit a building.	world bank	Fossil Fuel Energy Consumption %	By measuring the ratio of carbon isotopes in the samples the team collected, they were able to tell how much carbon was from fossil fuel	independent Variable
Urbanization	Urbanization refers to the population shift from rural to urban areas, the decrease in the proportion of people living in rural areas, and the ways in which societies adapt to this change. It is predominantly the process by which towns and cities are formed and become larger as more people begin living and working in central areas.	world bank	Urban population	It is calculated using World Bank population estimates and urban ratios from the United Nations World Urbanization Prospects.	independent Variable

3. Empirical results and analysis:

Results and analysis:

This part deals with the results of applying the estimation methodology to the relationship of the urbanization on environmental quality in Egypt and China, where the results of the application of the Augmented Dicky-Fuller test for the ADF will be presented first, to determine the degree of integration of the time series of the variables under study, and then determine the Long-term and short-term relationship between the variables, with determining the speed of adjustment to reach the equilibrium relationship by applying the co-integration test and also knowing the long-term relationship. The results will be reported into two parts, the first one will cover the results of the Egyptian case and the second part includes the findings of the Chinese case.

4. Model of the Egyptian Case

Before going to the estimation results, the descriptive statistics for the variables under study are reported in table (1). First, table (1) represents that the mean values of the CO2 is 2.064621. Looking at the min. and max. values of CO2 and the explanatory variables, the CO2 has the lowest value among the variables with 1.415000 while the URB has the largest value with 43781728. Regarding standard deviation values, most of them reflect little variance except for URB, which indicates that the study model is now more robust and stable, and inconsistencies and variability in the data returns are no longer a problem.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev	Min	Max
CO2	29	2.064621	0.404832	1.415000	2.592936
GDP	29	3002.551	614.9360	2073.940	4028.421
FF	29	96.05970	1.819789	93.38400	98.93087
URB	29	33565456	5598602.	25351103	43781728

Note: The Augmented Dickey Fuller test was applied to all the variables under study to test their stationarity using intercept. It is clear from Table 2 that, all the series under study become stationary after taking the first difference except the fossil fuel which is stationary at level.

Table 2: the results of the Augmented Dickey Fuller test

Variables	Level	1st difference	2st difference	The acceptance results
CO2	0.9141	0.0018***	0.0001***	I(1)
GDP	0.8955	0.0133**	0.0012***	I(1)
FF	0.0079***	0.0000***	0.0000***	I(0)
URB	1.0000	0.0454**	0.0572*	I(1)

Note: ***, ** and * denotes 1%, 5% and 10% significant level

Table 3 shows The maximum lag of (4) was used in each model as represented by the Akaike Information Criterion (AIC). The critical values are given under the number of variables, k = 3. The F-statistic (10.765) is greater than the corresponding lower and upper critical values in the table for k=4, and this makes the model significant at 1 percent level, thus, confirms the presence of the long run association among the variables.

Table 3: Results of bounds test for co-integration:

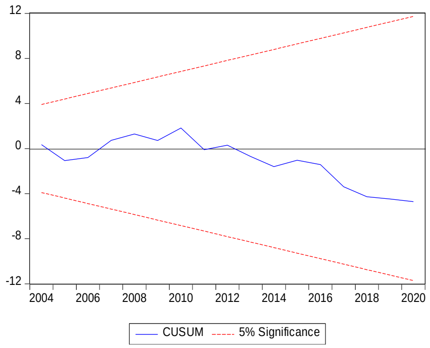
F-Statistics	10.7658***	
Maximum Lag	4	
Lag Order	(1,3,3,0)	
K	3	
Critical value	I(0)	I(1)
1%	2.37	3.2
5%	2.79	3.67
2.5%	3.15	4.08
10%	3.65	4.66

Table 4: Diagnostic Check:

Serial Corr.	Normality	Heteroscedasticity
1.41 (0.29)	0.32 (0.84)	0.58 (0.79)

The results from Table (4) validate that this model doesn't suffer from any diagnostic problem, and this indicates that the long-term estimation of this model is reliable. based on Figure (1) showing that the model is stable over time at a level of 5% significance, which confirms that the estimated parameters are stable throughout the study period.

Figure 1: the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of square of recursive residuals (CUSUMSQ)



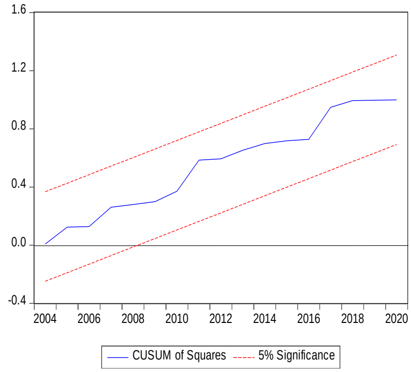


Table 5: long-Run Estimation

Variables	Coeff.
URB	1.96E-07***
FF	0.184098***
GDP	6.10E-07*
C	0.140153**

Note: *, ** and * denotes 1%, 5% and 10% significant level.**

In this section, we explore the results of the long-run and the short-run estimation as can be showed in Table 5 and 6. First for the long-run, the findings show that all variables have a significant positive impact at different levels of significance on the CO2 in Egypt. Increasing urbanization will result in more carbon emissions into the atmosphere (more air pollution) and hence lower environmental quality. Second, for the short-run we will just look at the short-term effects of URB. The results indicate the URB has a significant positive impact on CO2 in the short run. The negative and significant value of the error correction term confirmed the estimations of long run elasticity (ECT). The speed of adjustment for each model is represented by ECT, and a negative number indicates that the variables in the model will converge with time. This suggests that in the current year, approximately 70 percent of the disequilibria from the previous year's shock of those models converge back to the long term equilibrium. Next, the R-squared values show that almost 78 % of the independent variables are able to explain the corresponding dependent variables (CO2).

Table 6: Short Run Estimation Restricted Error Correction Model:

Variables	Coeff.
D(CO2(-1))	-0.301911
D(URB)	2.55E-07**
D(FF)	0.031077
D(FF(-1))	0.062700**
D(FF(-2))	0.076291***
D(FF(-3))	0.069611***
D(GDP)	-0.000333
D(GDP(-1))	0.000482
D(GDP(-2))	0.000890*
D(GDP(-3))	-0.001040***
C	0.182466**
ECT	-0.701911***
R-Sq	0.78
Adj.R-Sq	0.74

Note: *, ** and * denotes 1%, 5% and 10% significant level.**

5. Model of the Chinese case:

Before going to the estimation results, the descriptive statistics for the variables under study are summerized in table (1). First, table (1) shows that the mean values of the CO2 is 2.064621. Looking at the min. and max. values of CO2 and the explanatory variables, the CO2 has the lowest value among the variables with 1.415000

while the URB has the largest value with 43781728. Regarding standard deviation values, most of them reflect little variance except for URB, which indicates that the study model is now more robust and stable, and inconsistencies and variability in the data returns are no longer a problem.

Table 1: Descriptive Statistics

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Note: The Augmented Dickey Fuller test was applied to all the variables under study to test their stationarity using intercept and trend. Table 2 shows that all the series under study become stationary after taking the first difference.

Table 2: the results of the Augmented Dickey Fuller test

Variables	Level	1st difference	2nd difference	The acceptance results
CO2	0.2053	0.0373**	0.0000***	I(1)
GDP	0.8164	0.0000***	0.0000***	I(1)
FF	0.9525	0.0345**	0.0000***	I(1)
URB	0.9207	0.0000***	0.0000***	I(1)

Note: ***, ** and * denotes 1%, 5% and 10% significant level

Table 3 represents the result of the bounds test for checking the presence of co-integration between the variables of the study. The maximum lag of (4) was used in each model as represented by the Akaike Information Criterion (AIC). The critical values are given under the number of variables, k = 3. The F-statistic (5.809653) is greater than the corresponding the lower and the upper critical values, and this makes the model significant at 1 percent level, thus, confirms the presence of the long run association among the variables.

Table 3: Results of bounds test for co-integration:

F-Statistics	10.7658***	
Maximum Lag	4	
Lag Order	(4,4,4,4)	
K	3	
Critical value	I(0)	I(1)
1%	2.37	3.2
5%	2.79	3.67
2.5%	3.15	4.08
10%	3.65	4.66

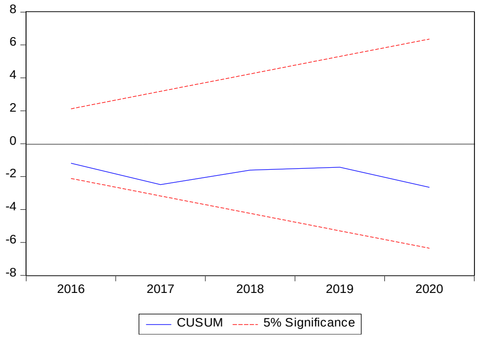
Note: *, ** and * denotes 1%, 5% and 10% significant level.**

Table 4: Diagnostic Check:

Serial Corr.	**Normality**	**Heteroscedasticity**
1.41 (0.29)	0.32 (0.84)	0.58 (0.79)

The results from Table (4) validate that this model doesn't suffer from any diagnostic problem, and this indicates that the long-term estimation of this model is reliable. The model represents no heteroscedasticity effects and no evidence of serial correlation in the residual terms.based on Figure (1) showing that the model is stable over time at a level of 5% significance, which confirms that the estimated parameters are stable throughout the study period.

Figure 1: the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of square of recursive residuals (CUSUMSQ)



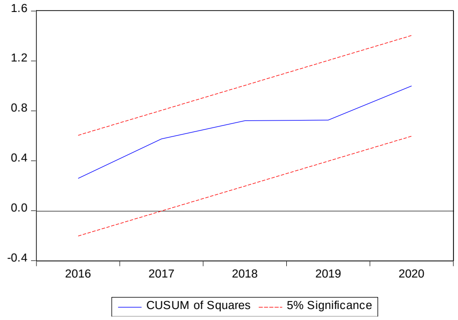


Table 5: long-Run Estimation

Variables	Coeff.
URB	1.47E-08***
FF	0.464238***
GDP	0.001147***
C	-31.09386***

Note: ***, ** and * denotes 1%, 5% and 10% significant level.

Table 6: Short Run Estimation Restricted Error Correction Model:

Variables	**Coeff.**
CO2(-1)	1.106913***
CO2(-2)	-0.251055
CO2(-3)	-0.748465**
CO2(-4)	-0.597845
URBANN	4.22E-08**
URBANN(-1)	1.41E-08**
URBANN(-2)	-2.92E-08
URBANN(-3)	-2.93E-08
URBANN(-4)	1.97E-08**
FF	0.096630
FF(-1)	-0.089410

Variables	**Coeff.**
FF(-2)	0.371192***
FF(-3)	0.113925
FF(-4)	0.199588**
GDP	-0.000896*
GDP(-1)	-0.000882
GDP(-2)	-0.000298
GDP(-3)	0.000560
GDP(-4)	0.003226***
C	-46.34391***
ECT	-0.791911***
R-Sq	0.99
Adj.R-Sq	0.99

Note: *, ** and * denotes 1%, 5% and 10% significant level.**

In this section, we explore the results of the long-run and the short-run estimation as can be showed in Table 5 and 6. First for the long-run, the results show that all variables have a significant positive impact at different levels of significance on the CO2 in China. Increasing urbanization will result in more carbon emissions into the atmosphere (more air pollution) and hence lower environmental quality. Second, for the short-run we will just look at the short-term effects of URB. The results indicate the URB has a significant positive impact on CO2 in the short run. The negative and significant value of the error correction term confirmed the estimations of long run elasticity (ECT). The speed of adjustment for each model is represented by ECT, and a negative number indicates that the variables in the model will converge with time. This suggests that in the current year, approximately 79 percent of the disequilibria from the previous year's shock of those models converge back to the long term equilibrium. Next, the R-squared values show that almost 99 % of the independent variables are able to explain the corresponding dependent variables (CO2).

Conclusion

In short, the main findings of the study show that there is a positive significant relationship between the urbanization and the CO2 emissions on the short and long run in Egypt and China during the period of the study from 1992 -2020, which illustrates that increasing urbanization will result in more CO2 emissions into the atmosphere (more air pollution) and hence lower environmental quality in both countries.

Measures taken by Egypt and China to reduce carbon emissions

Egypt:

Egypt has taken many measures to confront climate change and carbon emissions, as it is now dependent on establishing environment-friendly projects and relying on natural gas and electricity in many public transport systems, and it has also taken many measures aimed at reducing carbon emissions.

Reliance on clean energy to generate electricity, as it has become 20% of the energy percentage in Sarr, and the goal is to reach 42% in 2035

Also The beginning of establishing factories for electric cars and relying on natural gas as a fuel for cars instead of gasoline, which reduces carbon emissions,The beginning of Egypt in establishing factories to produce green hydrogen that are friendly to the environment, with an initial investment value of 4 billion dollars, It also criminalized the burning of rice straw and instead built factories for the manufacture of wood from rice straw to maximize the added value and reduce carbon emissions.

Encouraging Egypt to establish waste recycling plants Thus, Egypt was able to have the honor of hosting the climate summit this year, COP27.

China:

China aims to stop the rise in its carbon dioxide emissions by 2030 and achieve carbon neutrality by 2060.

China pledges to cancel energy-intensive climate-affecting projects that do not meet environmental standards

It also started a renewable energy project in the desert to produce 100 gigawatts, and it also entered the field of building green hydrogen stations and built a green hydrogen plant with a production capacity of 20 thousand tons in Koca City, Xinjiang Province

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