Araştırma Makalesi / Research Article

ECONOMETRIC ANALYSIS OF CONVERGENCE IN CARBON EMISSION PER CAPITA FOR MENA COUNTRIES[1]

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MENA ÜLKELERİ İÇİN KİŞİ BAŞINA KARBON EMİSYONU YAKINSAMASININ EKONOMETRİK ANALİZİ

Abstract

In this study, it is mainly aimed to investigate whether carbon emission rates tend to converge for MENA countries. In this context, the convergence of carbon emissions per capita in MENA countries is examined for the period 1965-2014. In the study in which panel data econometric methods are applied, it is primarily investigated whether there are cross-sectional dependence on the variables. After the determination of cross-sectional dependency, the stationarity of the series are examined by CADF unit root test. According to the test results, it is concluded that the carbon emission rates series in MENA countries are stationary at I(1). The results of the study indicate that the carbon emission per capita in MENA countries tends to converge and they are in a similar industrialization process

Keywords: Carbon Emission, Convergence, MENA Countries, Panel Unit Root Test.

Öz

Bu çalışmada temel olarak MENA ülkelerinde karbon emisyon oranlarının yakınsama eğilimi içinde olup olmadığının araştırılması amaçlanmaktadır. Bu kapsamda çalışmada MENA ülkelerinde kişi başına karbon emisyonunun yakınsaması 1965-2014 dönemi için incelenmektedir. Panel veri ekonometrik yöntemlerinin uygulandığı çalışmada öncelikle değişkenlerde yatay kesit bağımlılığının olup olmadığı araştırılıştır. Yatay kesit bağımlılığının tespit

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edilmesiyle birlikte serilerin durağanlığı CADF birim kök testi ile incelenmiştir. Test sonuçlarına göre MENA ülkelerinde karbon emisyon oranlarına ait serilerin 1.farkında durağan olduğu sonucuna ulaşılmıştır. Çalışmanın sonuçları MENA ülkelerinde kişi başına karbon emisyonlarının yakınsama trendinde olduğunu ve bu nedenle ülkelerin yakın bir sanayileşme süreci içerisinde olduklarını işaret etmektedir.

Anahtar Kelimeler: Karbon Emisyonu, Yakınsama, MENA Ülkeleri, Panel Birim Kök Testi.

1. Introduction

With the industrial revolution, the countries' entering into a rapid production process has increased the need for energy resources. Increasing energy needs are also met from non-renewable sources (such as oil, natural gas, coal) and significant greenhouse gas emission occurs from these sources to the environment. In this context, as all the world economies grow, carbon emission rates increase and climate changes may occur depending on the density of various gases in the atmosphere. In order to prevent these, countries need not only economic growth, but also determine policies to transfer environmental resources to future generations. This is only possible with the sustainable development model. Sustainable Development is a development model that aims to ensure continuous economic development in line with the protection of human health and natural balance, and to leave physical, social and natural environmental areas to future generations depending on the rational management of natural resources. (Altunbaş, 2003: 103).

With the Brundtland Report, which emerged in 1987 as a result of the deterioration of environmental areas, the concept of sustainable development started to come to the fore. In this report, it is aimed to meet the needs of today's generation without making any concessions to meet the needs of future generations. Therefore, with this report, both the phenomenon of development and conservation of natural resources are considered together and put forward in a way that balances each other (United Nations, 1987). In addition, in the report prepared in 1991, Caring for the Earth, it is emphasized that by taking the human to the center, it is necessary to improve the human conditions and protect the nature, as well as to ensure the continuity of the products in nature (IUCN, UNEP and WWF, 1991).

When other environmental meetings are examined, firstly, it can be said that at the United Nations Humanitarian Environment Conference held in Stockholm in 1972, it was decided to establish a mechanism to examine environmental problems and a mechanism was created in 1988 to solve

environmental problems on international scale. In this context, it is seen that environmental problems are tried to be solved internationally (Karakaya and Sofuoğlu, 2015:4).

However, despite all the measures taken, it is seen that there is a significant increase in carbon emission in the World. On the other hand, carbon emissions are considered to converge over time, and this hypothesis has been tested in many studies. The aim of the study is to determine whether MENA countries are in convergence process depending on the greenhouse gas emissions generated. For this purpose, firstly, previous empirical studies related to the this subject for different country groups are presented. Then, for 17 MENA (Middle East and North Africa) countries, the validity of the convergence hypothesis is tested by analyzing per capita carbon emission data for the period 1965-2014 using panel data analysis methods. Although there are many studies on the convergence of carbon emissions in the literature, studies on MENA countries are very limited. This study is specific in terms of filling this gap in the literature.

2. Empirical Literature

Strazicich and List (2003) examine the convergence of carbon emission for 21 industrial countries for the period 1967-2000 and as a result of analysis, it is determined that stochastic carbon emission convergence was achieved. While Aldy (2006) can not find any evidence of carbon emission convergence in his study covering 88 countries for 1960-2000, he concluded that convergence for carbon emission is valid for 23 OECD countries. Ezcurra (2007) investigate the spatial distribution of carbon emission per capita in 83 countries for the years 1960-1999 and state that carbon emission per capita decreased among countries as a result of the study. Chang and Lee (2008) investigate the convergence of carbon emissions for the 21 OECD countries for the period of 1960-2000 using the Lagrange multiplier unit root test and reveale that these countries converged stochastically to each other. Barassi et al. (2008) analyze the carbon emission per capita for OECD countries for the period of 1950-2002 by using unit root tests on the assumption that cross-sectional dependence. As a result of the study, they reveal that carbon emissions per capita in these countries did not converge. Lee et al. (2008) state in their study for the period of 1960-2000 for 21 OECD countries that carbon emission per capita is relatively stationary and countries are stochastically converged. Lee and Chang (2008) evaluate whether the carbon emission per capita contains unit root in 21 OECD countries for the 1960-2000 period using with the SURADF test. They conclude that carbon emissions

per capita in the countries subject to the study comparatively have a unit root in both at I(0) and at I(1). According to these results, they find that OECD countries did not converge.

Romero-Ávila (2008) examine stochastic and deterministic carbon emission convergence for the period of 1960-2002 for 23 countries. As a result of the study, it is obtained strong evidence that the carbon emissions of countries converge, both stochastic and deterministic. Westerlund and Basher (2008) examine the convergence of carbon emissions for 28 developing and developed countries for the 1870-2002 period. According to study it is revealed that there was convergence during the period. Another study on carbon emission convergence was done by Panopoulou and Pantelidis (2009). In the study covering the years of 1960-2003 for 128 countries, it is emphasized that there are two groups of convergence and one of them is countries with higher carbon emission per capita and the other is countries with lower carbon emission per capita. And they also state that there is a transition between existing groups.

On the other hand, Lee and Chang (2009) reveal in their study that carbon emissions converged stochastically for OECD countries between 1950-2002. Jobert et al. (2010) evaluate the convergence of carbon emissions in 22 European countries for the period of 1971-2006 with a Bayesian approach, and in the study, it is revealed that there was a definite convergence in the related period. Camarero et al. (2011) evaluate 22 OECD countries for the years 1870-2006 using nonlinear methods. According to the study, there is a strong divergence between these countries. Çil Yavuz ve Yılancı (2013) examine the convergence of CO_2 emissions per capita of the G7 countries in a nonlinear panel analysis framework for the period of 1960–2005. According to study the carbon emissions per capita were conditionally converging in the first regime.

In another study, Tiwari and Mishra (2017) evaluate the carbon emission convergence for 18 Asian countries during to 1972 -2010 period. In the study, it is observed that carbon emissions per capita converged relatively in most Asian countries. Churchill et al. (2018) examined 44 developed and developing countries for the early 20th century. It is stated in the study that there was a conditional convergence in the related period and that the convergence of carbon emission per capita was more pronounced after the Second World War than before the Second World War. Solarin (2019) add carbon emission per person as well as carbon footprint and ecological footprint per person in his study. According to the results of the study, while conditional convergence regarding carbon emission per capita in 12 countries is valid, in 15 countries, conditional per capita

carbon footprint convergence and in 13 countries, conditional per capita ecological footprint convergence is valid.

On the other hand, it is seen that there are very few studies on MENA countires in the related literature recently. Magazzino's (2019) study is one of these studies. Magazzino (2019) aims to investigate the stationarity and convergence of CO2 emissions series in MENA countries in his study. Results of the study show that relative per capita CO_2 emissions in the 19 MENA countries are a mixture of I(0) and I(1) processes. Finally, the author find that there is a weak evidence to support the stationarity of CO_2 emissions in his study.

3. Method and Findings

In this study, it is evaluated the industrialization processes of the countries within the framework of the convergence hypothesis based on the carbon emission variable. For this purpose, the validity of the convergence hypothesis is examine by analyzing the per capita carbon emission data for the period of 1965-2014 for 17 selected MENA countries[2]. This period was chosen due to the difficulties in accessing the data of the countries studied. In this context, in this study, it is investigated whether carbon emissions tend to converge or not by analyzing the per capita carbon emission data obtained from the World Bank database for selected countries using the panel unit root test.

When determining the panel unit root test to be applied in the analysis, firstly, the existence of cross-sectional dependence in panel data should be investigated. If there is cross-sectional dependence in panel data, performing the analyzes without considering this situation affect the results. For this reason, the existence of cross-sectional dependence should be investigated before the panel unit root test to be applied. For this purpose, some tests, which are frequently used in the literature, are used in the study. The test results are given in Table 1.

Table 1: Cross-Sectional Dependence Tests Results

Test	stat.	prob.
Breusch-Pagan LM	2295.344	**0.0000**
Pesaran scaled LM	129.8987	**0.0000**
Bias-corrected scaled LM	129.7252	**0.0000**
Pesaran CD	29.51636	**0.0000**

[2]Algeria, Bahrain, Egypt, Iran,Iraq, Israel, Jordan ,Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, UAE and Yemen.

The null hypothesis for all tests states that there is no cross-sectional dependence. H_1 hypothesis represent the existence of cross-sectional dependence in panel data. When the results are examined, as the common result of all tests, the null hypothesis stated "no cross sectional dependence" is rejected and the existence of cross sectional dependence is determined in panel. Therefore, a second generation panel unit root test, which also takes into account cross-sectional dependence, give more accurate results. In this context, Pesaran (2007) panel unit root test is used to investigate the stationary of the series of carbon emission. Pesaran (2007) test is a second generation test and takes into account the cross-sectional dependence in panel data

Pesaran (2007) CADF (cross-sectionally augmented DF) panel unit root test is a unit root test that can be used in both T > N and N > T. After determining the CADF test statistics for each units forming the panel in the CADF test, CIPS (cross-sectionally augmented IPS) test statistics are calculated for the entire panel by taking the arithmetic average of the tests. The CIPS statistics calculated state whether the panel is stationary as a whole. CADF test statistics values are calculated as follows (Pesaran, 2007):

$$t_i\,(N,T) = \frac{\Delta\, y_i' \overline{M_w} y_{i,-1}}{\widehat{\sigma_i}(y_{i,-1}' \overline{M_w}\, y_{i,-1})^{1/2}}$$

Then, CIPS statistics are calculated as follows:

$$\text{CIPS} = N^{-1} \sum_{i=1}^{N} CADF_i$$

For the carbon emission variable, CIPS statistical values calculated to determine whether the panel is stationary as a whole and table critical values are included in Table 2.

Table 2: Pesaran (2007) CADF Test Results

	Constant						
	t-bar	**cv 10**	**cv 5**	**cv 1**	**z[t-bar]**	**p-value**	**Lag***
carbon	-1.657	-2.110	-2.200	-2.360	0.495	**0.690**	4
	Constant & Trend						
	t-bar	**cv 10**	**cv 5**	**cv 1**	**z[t-bar]**	**p-value**	**Lag***
	-2.258	-2.630	-2.710	-2.850	0.383	**0.649**	4
	Constant						
	t-bar	**cv 10**	**cv 5**	**cv 1**	**z[t-bar]**	**p-value**	**Lag***
	-2.920	-2.110	-2.200	-2.360	-5.043	**0.000**	4
d.carbon	**Constant & Trend**						
	t-bar	**cv 10**	**cv 5**	**cv 1**	**z[t-bar]**	**p-value**	**Lag***
	-3.062	-2.630	-2.710	-2.850	-3.385	**0.000**	4

* The appropriate lag length is determined according to the SIC.

According to Pesaran (2007) test results, the series of per capita carbon emission is stationary at I(1) for both the constant model and the constant and trend model. These results show that per capita carbon emissions tend to converge in selected MENA countries. In other words, we can say that these countries are in the similar industrialization process.

4. Conclusion

The convergence hypothesis, one of the important implications of neoclassical economics, suggests that relatively low-income countries will reach a higher growth rate and, over time, will converge to high-income countries. However, the validity of the hypothesis has been discussed among economists for many years and whether it is valid or not has been tested in many studies.

When the related literature is investigated, it is understood that many studies have sought answers to the question of whether the convergence hypothesis is valid. In studies, it is seen that convergence hypothesis is tested on many variables. Carbon emission is one of these variables and has been the subject of many studies. In the study, it is determined whether countries are in a similar industrialization process in the context of convergence hypothesis by analyzing the carbon emission data per capita obtained from the World Bank database with the help of panel data econometric methods. For this purpose, the validity of the convergence hypothesis is tested by analyzing the per capita carbon emission data for the selected 17 MENA countries for the period of 1965-2014 using the panel unit root test.

In the study, first of all, whether there is cross-sectional dependence in panel data is examined and the existence of cross sectional dependence is determined. Afterwards, the stationary of the series is investigated with the help of Pesaran (2007) panel unit root test. According to the unit root test results, it is understood that the series is stationary at I(1) in both constant model and constant and trend model. Ultimately, this results show that the per capita carbon emissions tend to converge for the selected 17 MENA countries and they are in a similar industrialization process. On the other hand, it is important to know whether the carbon emission is stationary or not for a sustainable environmental policy and the effectiveness of environmental policies. Carbon emission is a factor affecting the environment, quality of life and human health. Therefore, it is very important to keep it under control and to develop policies according to the level of carbon emission. When environmental policies are implemented in the light of this information, more permanent results

can be obtained. The results of the study also provide important clues to policy makers at this point.

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