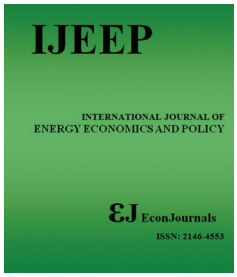

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How Globalization and Economic Growth Affect Energy Consumption: Panel Data Analysis in the Sample of Brazil, Russia, India, China Countries

Buhari Dogan[1]*, Osman Deger[2]*

[1]Department of Economics, Faculty of Economics and Administrative Sciences, Süleyman Demirel University, Turkey, [2]Department of Economics, Faculty of Economics and Administrative Sciences, Süleyman Demirel University, Turkey.
*Email: doganbuhari@gmail.com/osmandeger9@gmail.com

ABSTRACT

This study analyzes the causality and cointegration correlation between the series using total energy consumption, economic growth, and globalization data of Brazil, Russia, India, China (BRIC) countries in 2000-2012 period. Unit roots of the series were extracted in empirical part in order to make them stationary. Then, Pedroni and Kao cointegration and Granger causality analysis panel were used. As a result of the cointegration analysis, it was observed that the series were cointegrated in the long-term. On the other hand, causality analysis results suggested a unidirectional causality correlation from total energy consumption to economic growth, and another unidirectional causality correlation from globalization to economic growth. Lastly, no causality correlation between energy consumption and globalization was found.

Keywords: Globalization, Economic Growth, Energy Consumption, Brazil; Russia; India; China
JEL Classifications: F60, O10, O13

1. INTRODUCTION

Globalization is the integration of the national economy with the world economy, which means the integration of the world in a single market. According to KOF (index of globalization), globalization is process that removes national borders and integrates into economies, policies, and technologies (Samimi et al., 2012. p. 29). Additionally, globalization is a multi-faceted concept which is beyond indicators such as trade openness and capital mobility and has economic, social and political aspects (Potrafke, 2014. p. 510). Especially after World War 2 with the rapid transformation of international trade and financial circles to openness and integration, the impact of globalization began to attract attention in this procedure (Chang et al., 2011). 20 years ago, globalization was discussed quite rarely and at the same time at least 15% of the world population participated in global trade (Marber, 2004. p. 29). Because globalization has become a trend that is of higher significance in recent times with regards to the development of the world, whether or not globalization is useful regarding performance and the other aspects started to be discussed in many studies (Garrett, 2001; Milanovic, 2003; Lee and Chang, 2009; Shen et al., 2010). However, increasing income inequality with the economic crisis emerged in 2007 has resulted in questioning globalization (Potrafke, 2014. p. 509). Consequently, it is clearly known and proved by many scholars that the net effect of globalization is positive in a broader sense (Dreher, 2006. p. 1091).

The concept of globalization, which made the world into a single system, raises major impact on energy (Chang and Berdiev, 2011. p. 817). Today, world countries are connected to one another through oil, gas and coal resources. In a way, countries are in close relations by means of energy trade. In this sense, energy can be interpreted as a significant element of globalization (Kurtz and Fustes, 2014. p. 24). Moreover, world countries would require a certain level of energy before the 1890 industry revolution. Therefore, classical economics theories suggested that the actual inputs in production were land, labor, capital and entrepreneurship. The need for energy is increasing in recent times with the rise of globalization in economical and energy terms. Energy has become

a significant factor for international policies as well as being an actual input for production and consumption activities. It is lately seen that energy conversion, multinational energy cooperation, and opening energy markets are taking place in every part of the world leading to the globalization of the energy markets (Tansuchat and Khamkaew, 2011. p. 346).

Energy, which is an important input for industrialized and developing countries, is used as directly or indirectly input in the manufacturing of many goods and services (Tansuchat and Khamkaew, 2011. p. 356). Energy consumption demand has increased with the rapid population growth, technological development, and expansion of trade. Due to the fact that the world have to tend to act together about energy consumption in their economic trade and international commerce, it is becoming more significant to have comprehensive data on globalization and economic growth (Nasreen and Anwar, 2014. p. 82).

Firstly, the countries called as BRIC involving Brazil, Russia, India, and China which have mutual features of vast lands, high population and rapid economic development are among the fastest developing markets in the 2000s (O'Neill, 2001. p. 1-16). The land covered by these countries is more than 25% of the world and involves more than 40% of the world population. Some scholars claim that BRIC countries can replace G7 countries and have the world leadership in this sense (Frank and Frank, 2010. p. 46-54). According to Goldman Sachs, China will be the most powerful economy in the world in 2050. And India will have the third place, while Brazil taking the fourth and Russia settling to sixth place (Mercan and Göçer, 2013. p. 201).

The previous studies usually took with different aspects of globalization. It is clearly seen that especially academic studies focus on subcomponents of economic globalization. However, thanks to Dreher's (2006) study, different aspects of globalization could be analyzed empirically. Dreher (2006) defined globalization as the economic, social and political integration of each country with the other countries, and developed indices based on this description. Dreher (2006) developed three different indices regarding this topic including economic globalization index, index of social globalization, political globalization index, and overall globalization index[1]. With the index created by the Dreher, the effects of the different aspects of globalization on growth could be tested simultaneously. This index, which is called as KOF globalization index[2], provides the opportunity of testing and analyzing the effects of globalization separately and as a whole (Dreher, 2006. p. 1092). Scholars are able to have a systematic review of globalization with the contribution of KOF globalization index developed by Dreher. According to the KOF index, globalization components are presented in Table 1.

Indices related to the Table 1 are valued between 0 and 100. In this measure, 0 value represents that there is no globalization, while 100 value shows that globalization was fully completed.

1 See for detailed information: Dreher (2006. p. 1094); Dabour, (2000); Dreher et al. (2008); Rao et al. (2011).

2 The best index measuring all dimensions of globalization has been proposed as KOF (Samimi et al., 2012).

Table 1: Components of index of globalization

A. Data on economic integration
1. Actual flows
a. Trade (in percentage of GDP)
b. Foreign direct investment (in percentage of GDP)
c. Portfolio investment (in percentage of GDP)
d. Income payments to foreign nationals (in percentage of GDP)
2. Restrictions
a. Hidden import barriers
b. Mean tariff rate
c. Taxes on international trade (in percentage of current revenue)
d. Capital account restrictions
B. Data on political engagement
a. Embassies in country
b. Membership in international organizations
c. Participation in UN security council missions
C. Data on social globalization
1. Data on personal contact
a. Outgoing telephone traffic
b. Transfers (in percentage of GDP)
c. International tourism
d. Telephone average costs of call to USA
e. Foreign population (in percentage of total population)
2. Data on information flows
a. Telephone mainlines (per 1000 people)
b. Internet hosts (per capita)
c. Internet users (as a share of population)
d. Cable television (per 1000 people)
e. Daily newspapers (per 1000 people)
f. Radios (per 1000 people)
3. Data on cultural proximity
a. Number of McDonald's restaurants (per capita)

Resource: Dreher (2006. p. 1094). GDP: Gross domestic product

The purpose of this study is to analyze the correlation among economic growth, energy consumption and globalization (All KOF index) for BRIC countries through panel data analysis. In the second part of the study, literature reviews of empirical studies were presented as a Table 1. In the following section, the findings of the study were discussed identifying the data sets and methods used in the analysis. In the last part, an overall assessment is made.

2. LITERATURE REVIEW

Studies about energy consumption, globalization and economic growth conducted in literature are mainly related to the components of globalization (e.g. Sami, 2011; Sadorsky, 2012; Hossain, 2012; Shahbaz et al., 2013b). Most of these studies use the variables of export, import, trade liberalization and trade openness as an indicator of trade openness in the production function. On the other hand, studies carried out in recent years consider only subcomponents of globalization such as trade flow openness, capital mobility and economic integration. In this context, there are studies that use KOF globalization index (Shahbaz et al., 2014b; Chang and Berdiev, 2011; Shahbaz et al., 2015b; Shahbaz et al., 2015a). Table 2 shows the studies that research the relationships between globalization (subcomponents), energy and economic growth based on the classification of study, countries involved, methods, and study results.

Table 2: The summary of empirical and theoretic studies that research globalization (subcomponents), energy and economic growth

Study conducted by	Countries involved	Data set period	Method (s)	Study results
Cole (2006)	Selected 32 countries	1975-1995	Panel OLS	The study results suggested that trade liberalization promoted economic growth with the increasing energy demand. Moreover, trade liberalization has an impact on energy consumption and stimulates investors
Jena and Grote (2008)	India	1991-2013	Panel regression	Trade openness stimulates industrialization through comparative advantages of scale effects, composite effects and energy
Narayan and Smyth (2009)	Six countries in the Middle East (Iran, Israel, Kuwait, Oman, Saudi Arabia, Syria)	1974-2002	Panel VECM, Granger causality	The study results concluded that electricity consumption in the short term led to causality from economic growth to export. Additionally, it was found out that there was a neutral correlation between electricity consumption and export
Erkan et al. (2010)	Turkey	1970-2006	Granger causality	It was concluded that there was causality from energy consumption to export. In addition, impulse-response function also showed positive effects. In this sense, energy is a significant factor in terms of Turkey's economy
Lean and Smyth (2010)	Malaysia	1970-2008	ARDL, Granger causality	No correlation between energy consumption and export
Sadorsky (2011)	Eight countries in the Middle East (Bahrain, Iran, Jordan, Oman, Qatar, Saudi Arabia, Syria, UAE)	1980–2007	Panel VECM Granger causality	A correlation between the variables was found in the long term. According to study results, while there was causality from export to energy consumption, there was a reciprocal relationship between energy consumption and import. Similarly, reciprocal causality was found between GDP and energy consumption
Sultan (2011)	Mauritius	1970-2009	ARDL, VECM Granger causality	Causality from energy consumption to export was found
Chang and Berdiev (2011)	23 OECD countries	1975-2007	LSDVC	As a result of the analysis conducted based on KOF globalization index, it was found out that globalization and its subcomponents had significant effects on energy issues
Sadorsky (2012)	South America	1980-2007	Panel cointegration and panel causality	As a result of the study, it was found out that there was a significant long term relationship between output-energy-export and output-energy-import
Shahbaz et al. (2013a)	Pakistan	1972-2010	ARDL, VECM Granger causality	Causality from energy consumption to export was found
Dedeoğlu and Kaya (2013)	OECD countries	1980-2010	Panel cointegration Granger causality	In this study, which analyzes the correlation among export, import, economic growth and energy, variables are cointegrated. The other variables had a positive impact on energy consumption. Moreover, reciprocal causality between energy consumption and export and import was found
Nasreen and Anwar (2014)	15 Asian countries	1980-2011	Panel causality and Panel cointegration	The results suggest that growth and trade openness has a positive effect on energy consumption. Reciprocal causality between energy consumption and economic growth, and openness and energy consumption
Shahbaz et al. (2014a)	91 selected countries	1980-2010	Panel causality and Panel cointegration	Study results concluded that the variables were cointegrated and there was reciprocal causality between energy consumption and trade openness

(*Contd...*)

Table 2: (*Continued*)

Study conducted by	Countries involved	Data set period	Method (s)	Study results
Farhani et al. (2014)	Tunisia	1980-2010	ARDL, Toda–Yamamoto causality	Findings suggest that there was long term relationship between the variables. In addition, causality from trade openness to energy consumption was found
Sbia et al. (2014)	Bahrain	1975Q1-2011Q4	VECM Granger causality	According to findings, causality from trade openness to energy consumption was found. Foreign direct investment, trade openness and carbon emissions increased energy demand. It was also concluded that economic growth had a positive impact on energy consumption
Shahbaz et al. (2015a)	China	1970-2012	ARDL, VECM Granger causality	The study used KOF indices and resulted that globalization decreased carbon emissions in all indices
Can and Dogan (2016)	Turkey	1970-2012	Maki, Johansen cointegration	The empirical results show that there is a long run relationship between globalization and energy consumption

Resource: Developed by the research authors. OLS: Ordinary least squares, VECM: Vector error-correction model, ARDL: Autoregressive distributed lag, GDP: Gross domestic product, LSDVC: Least squares dummy variable corrected

3. EMPIRICAL ANALYSIS

3.1. Data and Method

This study used energy consumption (ENERGY), the annual growth (gross domestic product [GDP]) figures and globalization index (KOF) data related to BRIC countries in 2000-2012 period. GDP data of the countries was derived from Penn World Table (version 8.1), ENERGY data was taken from BP world energy statistics database, and globalization index was based on KOF (overall) index of globalization. GDP and ENERGY series were involved in the analysis by taking their logarithms.

3.2. Method

This study was conducted using panel data analysis. The relationship between total energy consumption and economic growth and globalization is analyzed by the following model:

$$ENERGY_{it}=\alpha_i+\beta_{1i}GDP_{it}+\beta_{2i}KOF_{it}+\varepsilon_i, \quad (1)$$

$i=1, 2, \ldots, N$; $t=1, 2, \ldots, T$,

In this equation, GDP_{it} shows economic growth in i country in t year, KOF_{it} represents globalization, and $ENERGY$ shows the total energy consumption. $i=1, 2, \ldots, N$ expresses horizontal unit size dimension, $t=1, 2, \ldots, T$ shows the time dimension, ε_i stands for error term, α shows unobservable group effects, and β stands for cointegration coefficient.

In order to analyze the relationships between the variables in this study, which was conducted using panel data analysis method, firstly unit root analysis and their stability was controlled. Then, panel cointegration test is used and then panel causality analysis is conducted to identify the direction of causality between the variables. Finally, the effects of the relationship between the series in the long-term is discussed.

3.3. Panel Stationary Test

Before conducting panel cointegration analysis, unit root tests for ENERGY, GDP, and KOF variable are done in order to control for the stationary of the series. First generation panel unit root test of Im, Peseran and Shin (IPS) (2003) was used in this study. IPS panel unit root test equation is expressed as below:

$$\Delta y_{it}=\alpha_i+v_i+\beta_i y_{it}+\sum_{j=1}^{k}\alpha_j\Delta y_{it-1}+\varepsilon_{it}, \quad (2)$$

In this equation, Δ expresses difference operator, y stands for the series investigated of stationary, α_i and v_i represent fixed effects and time effects. In the IPS unit root test.

Null hypothesis "for each i" (all horizontal sections).

H_0: $\beta_i=0$ unit root available.

Alternative hypothesis; "for some i's (at least one horizontal section).

H_1: $\beta_i<0$ no unit root.

While the acceptance of the null hypothesis states that it is not stationary for all horizontal sections, accepting alternative hypothesis means that one or more than one of horizontal sections in panel data analysis are stationary (Im et al., 2003. p. 60-62).

Table 3 shows IPS unit root test results. The analysis results of IPS stationary and stationary-trend models suggest that ENERGY, GDP and KOF series are not stationary in level values, and they became stationary after taking the differences of series.

3.4. Panel Cointegration Analysis

This study used panel cointegration test developed by Pedroni (1999, 2004) in order to analyze the cointegration status among energy consumption, growth, and globalization. Additionally, panel cointegration test which was developed through Dickey-Fuller (DF) and augmented Dickey-Fuller (ADF) tests by Kao (1999) was included in the study. According to Pedroni's approach, firstly regression model is predicted by ordinary least squares (OLS) model.

$$y_{it}=\alpha_i+\beta_{it}+\delta_i z_{it}+\varepsilon_{it} \quad (3)$$

Table 3: IPS panel unit root results

Variables	Level		First differences	
	Stationary		Stationary and trend	
	IPS statistics	P value	IPS statistics	P value
ENERGY	1.726	0.95	−1.424	0.07***
GDP	2.075	0.98	−2.278	0.01**
KOF	−0.152	0.43	−2.949	0.001*

*Shows that the series are stationary in 1% significance level, **shows that they are stationary in 5% significance level, and ***shows that they are stationary in 10% significance level. "Modified Schwarz Information Criterion" used in the selection of lag length. IPS: Im, Peseran and Shin

In this equation, *y* stands for dependent variable coefficient, *z* expresses explanatory variable coefficient, α_i represents stationary effects, and *t* expresses trend. In this equation, it is assumed that explanatory variables and the dependent variable are stationary in the first degree. Hypotheses of Pedroni approach may be expressed as follows (Pedroni, 2004. p. 599).

H_0: No cointegration for all cross-sections

H_1: There is cointegration for all cross-sections

In order to test the Pedroni's hypothesis, first four of the following tests show inside dimensions panel cointegration test and the last three tests show interdimensional panel cointegration test (Asteriou and Hall, 2007. p. 374-376). These tests are shown as follows:

1. Panel *v* statistic:

$$T^2N^{3/2}Z_{v\hat{}NT} = \frac{T^2N^{3/2}}{(\sum_{i=1}^{N}\sum_{i=1}^{T}\hat{L}_{\hat{}11i}^{-2}\hat{\mu}_{it}^{2})} \quad (4)$$

2. Panel ρ statistic:

$$T\sqrt{NZ_{\hat{\rho}NT}} = \frac{T\sqrt{N}(\sum_{i=1}^{N}\sum_{i=1}^{T}\hat{L}_{11i}^{-2}(\hat{u}_{it-1}^{-2}\Delta\hat{u}_{it}^{-2}-\hat{\lambda}_i}{\sum_{i}^{N}\sum_{i}^{T}\hat{L}_{\hat{}11i}^{-2}\hat{u}_{it}^{2}} \quad (5)$$

3. Panel *t* statistic:

$$Z_{tNT} \equiv \sqrt{\tilde{\sigma}_{NT}^{2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\hat{u}_{it-1}^{*2}}\left(\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}(\hat{u}_{i,t-1}\Delta\hat{u}_{i,t}-\hat{\lambda}_i)\right) \quad (6)$$

4. Panel *t* statistic (parametric):

$$Z_{tNT} = \sqrt{\tilde{\sigma}_{NT}^{*2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\hat{u}_{it-1}^{*2}}\left(\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}(\hat{u}_{it-1}^{*2}\Delta\hat{u}_{i,t}^{*2}-\hat{\lambda}_i)\right) \quad (7)$$

5. Group ρ statistic (parametric):

$$T\sqrt{N}\bar{Z}_{\hat{\rho}NT} = T\sqrt{N}\frac{\sum_{t=1}^{T}(\hat{u}_{it-1}^{2}\Delta\hat{u}_{it}^{2}-\hat{\lambda}_i)}{\sum_{t=1}^{N}(\sum_{t=1}^{T}\hat{u}_{it-1}^{2})} \quad (8)$$

6. Group *t* statistic (non-parametric):

$$\sqrt{N}\bar{Z}_{\hat{\rho}NT-1} = \sqrt{T}\sum_{i=1}^{N}\left(\sqrt{\hat{\sigma}_i^{2}\sum_{t=1}^{T}\hat{u}_{it-1}^{2}}\right)\sum_{t=1}^{T}(\hat{u}_{it-1}^{2}\Delta\hat{u}_{it}^{2}-\hat{\lambda}_i) \quad (9)$$

7. Group *t* statistic (parametric):

$$\sqrt{N}\bar{Z}_{tNT-1}^{*} = \sqrt{T}\sum_{i=1}^{N}\left(\sqrt{\hat{s}_i^{*2}\sum_{t=1}^{T}\hat{u}_{it-1}^{*2}}\right)\sum_{t=1}^{T}(\hat{u}_{it-1}^{*2}\Delta\hat{u}_{it}^{*2}) \quad (10)$$

The other panel cointegration test used in this study is Kao cointegration test. Kao (1999) uses DF and ADF test in his panel cointegration test (Baltagi and Kao, 2000. p. 13).

Kao co-integration model is expressed as follows (Asteriou and Hall, 2007. p. 372).

$$Y_{it}=\alpha_i+\beta X_{it}+u_{it} \quad (11)$$

H_0= No cointegration for all cross-sections

H_1= There is cointegration for all cross-sections

Having studied the long-term relationships among total energy consumption, economic growth and globalization, H_0 no cointegration hypothesis of Pedroni cointegration test was rejected. According to test results, the statistically significance levels are as follows: Panel PP-statistic 10%, Panel ADF statistic 1%, Group PP-statistic 5%, and Group ADF-statistic 5%. In a general review, it could be derived that there was cointegration relationship between the series based on both panel and group statistics of Pedroni cointegration test. On the other hand, H_0 no cointegration hypothesis of Kao cointegration test was rejected. According to Kao cointegration test, it was found out that there was cointegration relationship between the series in 5% significance level. Based on these results, economic growth and energy consumption are cointegrated in the long term and they are correlated in the long run (Tables 4 and 5).

3.5. Panel Causality Analysis

After the cointegtration analysis, Granger causality test was done to identify the direction of the relationship between the series. Basic causality test developed by Granger is shown below:

$$Y_t = \sum_{j=1}^{m} c_i X_{t-j} + \sum_{j=1}^{m} d_j Y_{t-j} + \eta_t \quad (12)$$

According to this model, if X variable is the reason of Y, changes occurring in Y are derived from the changes experienced in X. According to Granger causality analysis, variables must be stationary in advance (Granger, 1969. p. 431).

This study uses panel causality analysis developed by Holtz-Eakin et al. (1988). Holtz-Eakin et al. (1988) use the OLS method. Holtz-Eakin et al. (1988) model is shown below (Holtz-Eakin et al., 1988. p. 1373):

$$Y_{it} = \alpha_{0t}\sum_{l=1}^{m}\alpha_{lt}Y_{it-l} + \sum_{l=1}^{m}\delta_{lt}X_{it-l} + \psi_t f_i + u_{it} \quad (13)$$

f_i=Fixed effects

u_{it}=Error term

Y_{it} and u_{it}, which is error term, are correlated. The differentiated model is shown below:

$$Y_{it} - Y_{it-1} = a_t + \sum_{l=1}^{m}\alpha_t\left(Y_{it-1} - Y_{it-l-1}\right) + \sum_{l=1}^{m}\delta_1\left(X_{it-1} - X_{it-l-1}\right) + v_{it} \quad (14)$$

Table 4: Pedroni cointegration results

Alternative hypothesis: Common AR coefficients (cross-sections)				
Within-dimension	**Statistic**	**P**	**Weighted statistic**	**P**
Panel v-statistic	1.106	0.134	0.390	0.348
Panel rho-statistic	0.381	0.648	0.516	0.697
Panel PP-statistic	−1.014	0.155	−1.387	0.082***
Panel ADF-statistic	−2.973	0.001	−2.372	0.008*
Alternative hypothesis: Different AR coefficient (interdimensional)				
Between-dimension		**Statistic**		**P**
Group rho statistic		1.495		0.932
Group PP-statistic		−1.643		0.050**
Group ADF-statistic		−2.772		0.002*

Test results belong to stationary models. *shows 1%, **shows 5%, and ***shows 10% significance level. ADF: Augmented Dickey-Fuller

Table 5: Kao cointegration results

Statistic	t statistic	P
ADF	−2.157	0.01*
Residual variance	0.001	
HAC variance	0.002	

*Shows 5% significance level. Barlett–Kernel method was used in Kao cointegration test and the bandwidth was identified by Newey–West method. ADF: Augmented Dickey-Fuller

As can be seen in the equations, there is a correlation problem between dependent variable and error term. Therefore, panel causality test suggested by Holtz-Eakin et al. (1988) was conducted as two-stage OLS method (Ağayev, 2010. p. 173).

Hypothesis suggested based on causality analysis is as follows:

$H_0=\alpha_0=\alpha_1=pot\alpha_m=0$

If H_0 hypothesis is rejected, it can be revealed that there is causality relationship between the variables.

As a result of the analysis, while there was causality relationship from total energy consumption to economic growth, there was no causality relationship from economic growth to total energy consumption. Moreover, while there was causality relationship from globalization to economic growth, there was no causality relationship from economic growth to globalization. Lastly, analysis results suggested no causality relationship between energy consumption and globalization (Table 6).

3.6. Estimation of Cointegration Coefficient with Dynamic OLS (DOLS) Method

After identifying whether there is cointegration between the series, DOLS method developed by Pedroni (2000, 2001) was used to specify the coefficients and the direction of the relationship between the series. Estimation of the group mean panel of DOLS method, which was developed by Pedroni (2001), is shown in the following equations (quoted by Nazlıoğlu, 2010. p. 99):

$$y_{it} = \alpha_{it} + \beta x_{it} + \sum_{k=-K_i}^{K_i} \gamma_{ik} \Delta x_{it} + \mu_{it} \quad (15)$$

Table 6: Panel causality analysis

Direction of causality	F statistics	P
DENERGY→DGDP	5.093	0.02*
DGDP→ DENERGY	0.034	0.85
DKOF→ DENERGY	1.322	0.256
DENERGY→DKOF	1.927	0.172
DKOF→ DGD	5.837	0.02*
DGDP→ DKOF	0.037	0.84

*Shows 5% significance level

Table 7: Panel DOLS results

$ENERGY_{it}=\alpha_i+\beta_{1i}GDP_{it}+\beta_{2i}KOF_{it}+\varepsilon_i$			
Variable	**Coefficient**	**t-statistic**	**P**
GDP	0.81	4.13	0.002*
KOF	0.06	3.03	0.012**
R^2=0.99			
SSR=0.04			

DOLS: Dynamic ordinary least squares

In this model, which composes panel DOLS method, $-K_i$ and K_i show initial and lag numbers. This model assumes that there is no horizontal section dependence and therefore it is firstly necessary to test horizontal section dependence. For this, the following equation is used.

$$y_{it}=\alpha_i+\beta x_{it}+\mu_{it} \quad (16)$$

$$x_{it}=x_{it-1}+e_{it} \quad (17)$$

In the equation above, while y_{it} shows dependent variable, x_{it} represents independent variable, and a_i expresses fixed effects, it is presumed that there is not dependence between the sections.

The arithmetic mean of cointegration coefficients obtained through DOLS method was calculated and panel cointegration coefficients were calculated as shown below (quoted by Nazlıoğlu, 2010. p. 99):

$$\hat{\beta}_{GD}^{*} = N^{-1}\sum_{i=1}^{N}\beta_{D,i}^{*} \quad (18)$$

In the equation above, while $\hat{\beta}_{GD}^{*}$ shows the cointegration coefficient obtained by the presumed DOLS for each cross, t-statistics regarding the group mean panel DOLS's estimations are calculated as shown below (quoted by Nazlıoğlu, 2010. p. 99):

$$t_{\hat{\beta}_D^*} = N^{-1/2}\sum_{i=1}^{N} t_{\hat{\beta}_D^*} \quad (19)$$

Here, $t_{\hat{\beta}_D^*}$ shows t-statistic of cointegration coefficient obtained by presumed DOLS for each cross (quoted by Nazlıoğlu, 2010. p. 99).

According to panel DOLS test results, it can be concluded that the coefficients obtained by the analysis are statistically positive and meaningful. This means that an increase experienced in economic growth and globalization in the long term affects energy consumption positively. Considering the panel in a general sense, a 1% increase in economic growth increases energy consumption in 0.81%. Similarly, a 1% increase in globalization increases energy consumption in 0.06% (Table 7).

4. CONCLUSION

In this study, which was conducted using the data of the countries called as BRIC and had a quite rapid development rate in the turn of the century, energy consumption, economic growth, and globalization data were used. Energy sources in developing countries are primary source of input in the production of many goods. Increases occurring in the total energy consumption of the countries clearly reflect the structure of production and consumption in an economy, and these increases also mirror the changes occurring in economic growth. Additionally, there are many studies conducted in literature about the correlation between globalization, which shows how a country is placed in world markets and to what extent they are integrated and economic growth. This study analyzes the relationships among energy consumption, economic growth and globalization. The research sample is consisted of BRIC countries which started to grow rapidly and had a big impact on world economy. In the empirical analysis section, the stationary statuses of the series were controlled and they were made stationary by taking unit roots. Then, as a result of the co-integration analysis, it was concluded that there was cointegration between the series and these series are correlated in the long term. According to DOLS method which was conducted in order to find long-term coefficients, while a 1% increase in economic growth increases energy consumption in 0.81%, a 1% increase in globalization increases energy consumption in 0.06%. These results mainly suggest that the increases in economic growth and globalization in BRIC countries increase the total energy consumption. Based on the causality analysis results which supported the findings of many other studies, a unidirectional causality from energy consumption to economic growth was found, and a unidirectional causality from globalization to economic growth was identified. However, no causality correlation between energy consumption and globalization was found. Consequently, it was inferred in this study that the changes occurring in energy consumption in BRIC countries have an impact on economic growth. In addition, the concept of globalization is also effective on economic growth.

REFERENCES

Ağayev, S. (2010), Doğrudan Yabancı Sermaye Yatırımları Ve Ekonomik Büyüme İlişkisi: Geçiş Ekonomileri Örneğinde Panel Eşbütünleşme Ve Panel Nedensellik Analizleri. Gazi Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 12(1), 159-184.

Asteriou, D., Hall, S.G. (2007), Applied Econometrics: A Modern Approach. Revised Edition. New York: Palgrave Macmillan.

Baltagi, B.H., Kao, C. (2000), Nonstationary Panels, Cointegration in Panels and Dynamic Panels: A Survey, Center for Policy Research Working Papers 16, Center for Policy Research, Maxwell School, Syracuse University.

Can. M., ve Doğan, B. (2016), Küreselleşme ve Enerji Tüketimi İlişkisi: Türkiye Örnekleminde Eşbütünleşme Analizi. Maliye Dergisi, Sayı 170 (Ocak- Haziran), 59-70.

Chang, C., Lee, C., Hsieh, M. (2011), Globalization, real output and multiple structural breaks. Global Economic Review, 40(4), 421-444.

Chang, C.P., Berdiev, A.N. (2011), The political economy of energy regulation in OECD countries. Energy Economics, 33(5), 816-825.

Cole, M.A. (2006), Does trade liberalization increase energy use? Economics Letters, 92, 108-112.

Dabour, N. (2000), The role of foreign direct investment (FDI) in development and growth in OIC member countries. Journal of Economic Cooperation, 21(3), 27-55.

Dedeoğlu, D., Kaya, H. (2013), Energy use, exports, imports and GDP: New evidence from the OECD countries. Energy Policy, 57, 469-476.

Dreher, A. (2006), Does globalization affect growth? Evidence from a new index of globalization. Applied Economics, 38(10), 1091-1110.

Dreher, A., Gaston, N., Martens, P. (2008), Measuring Globalization - Gauging its Consequences. New York: Springer.

Erkan, C., Mucuk, M., Uysal, D. (2010), The impact of energy consumption on exports: The Turkish case. Asian Journal of Business Management, 2, 17-23.

Farhani, S., Shahbaz, M., Arouri, M., Teulon, F. (2014), The role of natural gas consumption and trade in Tunisia's output. Energy Policy, 66, 677-684.

Frank, W.P., Frank, E.C. (2010), International business challenge: Can the BRIC countries take world economic leadership away from the traditional leadership in the near future? International Journal of Arts and Sciences, 3(13), 46-54.

Garrett, G. (2001), Globalization and government spending around the world. Studies in Comparative International Development, 35(4), 3-29.

Granger, C.W.J. (1969), Investigating causal relations by econometric models and cross-spectral methods. Econometrica, 37(3), 424-438.

Holtz, E., Newey, W., Rosen, H.S. (1988), Estimating vector auto regressions with panel data. Econometrica, 56(6), 1371-1395.

Hossain, M.D.S. (2012), Multivariate granger causality between economic growth, electricity consumption, exports and remittances for the panel of three SAARC countries. Global Journal Management Business Research, 12, 41-54.

Im, K.S., Peseran, M.H., Shin, Y. (2003), Testing for unit roots in heterogeneous panels. Journal of Econometrics, 115, 53-74.

Jena, P.R., Grote, U. (2008), Growth-trade-environment nexus in India. Economics Bulletin, 17, 1-17.

Kao, C. (1999), Spurious regression and residual-based tests for cointegration in panel data. Journal of Econometrics, 90(1), 1-44.

Kurtz, D.V., Fustes, M. (2014), Globalization and energy: An anthropological perspective. Journal of Globalization Studies, 5(2), 19-38.

Lean, H.H., Smyth, R. (2010), On the dynamics of aggregate output, electricity consumption and exports in Malaysia: Evidence from multivariate granger causality tests. Applied Energy, 87, 1963-1971.

Lee, C.C., Chang, C.P. (2009), FDI, financial development, and economic growth: International evidence. Journal of Applied Economics, 12, 249-271.

Marber, P. (2004), Globalization and its contents. World Policy Journal, Winter, 5. Available from: http://www.bev.berkeley.edu/ipe/readings/Globalization%20defined%202005.pdf. [Last accessed on 2016 Feb 04].

Mercan, M., Göçer, I. (2013), The effect of financial development on economic growth in BRIC-T countries: Panel data analysis. Journal of Economic and Social Studies, 3(1), 199-216.

Milanovic, B. (2003), The two faces of globalization: Against globalization as we know it. World Development, 31(4), 667-683.

Narayan, P.K., Smyth, R. (2009), Multivariate granger causality between electricity consumption. exports and GDP: Evidence from a panel of Middle Eastern countries. Energy Policy, 37, 229-236.

Nasreen, S., Anwar, S. (2014), Casual relationship between trade openness, economic growth and energy consumption: A panel data, analysis of Asian countries. Energy Policy, 69, 82-91.

Nazlıoğlu, Ş. (2010), Makro İktisat Politikalarının Tarım Sektörü

Üzerindeki Etkileri: Gelişmiş ve Gelişmekte Olan Ülkeler için Bir Karşılaştırma. Yayınlanmamış Doktora Tezi. Erciyes Üniversitesi Sosyal Bilimler Enstitüsü.

O'Neill, J. (2001), Building Better Global Economic BRICs, Goldman Sachs. Global Economics, Paper No: 66. p1-16.

Pedroni, P. (1999), Critical values for cointegration tests in heterogeneous panels with multiple regressors. Oxford Bulletin of Economics and Statistics, 61(1), 653-670.

Pedroni, P. (2000), Fully modified OLS for heterogeneous cointegrated panels. Advances in Econometrics, 15, 93-132.

Pedroni, P. (2001), Purchasing power parity tests in cointegrated panels. Review of Economics and Statistics, 83(4), 727-731.

Pedroni, P. (2004), Panel cointegration: Asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. Economic Theory, 20, 597-625.

Potrafke, N. (2014), The evidence on globalisation. The World Economy, 38(39), 509-552.

Rao, B.B., Tamazian, A., Vadlamannati, K.C. (2011), Growth effects of a comprehensive measure of globalization with country-specific time series data. Applied Economics, 43, 551-568.

Sadorsky, P. (2011), Trade and energy consumption in the Middle East. Energy Economics, 33, 739-749.

Sadorsky, P. (2012), Energy consumption, output and trade in South America. Energy Economics, 34, 476-488.

Sami, J. (2011), Multivariate cointegration and causality between exports, electricity consuption and real income per Capita: Recent evidence from Japan. International Journal of Energy Economics and Policy, 1(3), 59-68.

Samimi, P., Lim, G.C., Buang, A.A. (2012), A critical review on synthetic globalization indexes. International Journal of Fundamental Psychology and Social Sciences, 2(1), 28-31.

Sbia, R., Shahbaz, M., Hamdi, H. (2014), A contribution of foreign direct investment, clean energy, trade openness, carbon emissions and economic growth to energy demand in UAE. Economic Modelling, 36, 191-197.

Shahbaz, M., Khan, S., Tahir, M.I. (2013a), The dynamic links between energy consumption, economic growth, financial development and trade in China: Fresh evidence from multivariate framework analysis. Energy Economics, 40, 8-21.

Shahbaz, M., Ozturk, I., Afza, T., Ali, A. (2013b), Revisiting the environmental Kuznets curve in a global economy. Renewable and Sustainable Energy Reviews, 25, 494-502.

Shahbaz, M., Khan, S., Ali, A., Bhattacharya, M. (2015a), The Impact of Globalization on CO2 Emission in China. Munich Personel RePEc Archive, No.64450.

Shahbaz, M., Bhattacharya, M., Ahmed, K. (2015b), Growth-globalisation-emission nexus: The role of population in Australia. Monash Business School Discussion Paper, No.23/15. p1-33.

Shahbaz, M., Nasreen, S., Ling, C.H., Sbia, R. (2014a), Causality between trade openness and energy consuption: What causes what in high, middle and low income countries. Energy Policy, 70, 126-143.

Shahbaz, M., Mallick, H., Mahalik, M.K., Loganathan, N. (2014b), Does Globalization Impede Environmental Quality in India? Comsats Working Paper Series, No. 2014-002. p1-31.

Shen, C.H., Lee, C.C., Lee, C.C. (2010), What makes international capital flows promote economic growth? An international cross-country analysis. Scottish Journal of Political Economy, 57(5), 515-546.

Sultan, R. (2011), An econometric study of aggregate output, energy and exports in Mauritius–implications for trade and climate policy. International Journal of Energy Economics and Policy, 2(4), 225-237.

Tansuchat, R., Khamkaew, T. (2011), The impact of energy consumption on economic performance in the era of globalization. In: The Scale of Globalization. Think Globally, Act Locally, Change Individually in the 21st Century. Ostrava: University of Ostrava. p346-358.