Sustainable Economic Growth and Energy Security in China: Implications on Regional Economic Order

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Abstract

Asian economies and China as major economic actors in terms of both regional and global economy are in the process of economic stagnation for now. Therefore, it is expected a sharp decrease in energy demand –that has continued since 1990s- of Asian economies which will be directly affected by export and investment flows.

In this context, first of all, the literature on the relation between economic growth and energy consumption of China and ASEAN countries and possible consequences of these relations are assessed within the context of the data. As a result of the panel data analysis for 1990-2015 period, although the relationship between energy consumption and growth in many developed countries is weakening, the relationship in ASEAN countries is still strong. Therefore, the decline in China's energy consumption may result in a narrowing of the region.

Keywords: China, ASEAN, Energy Consumption, Economic Growth, Panel Data Analysis.

1. Introduction

The developing Asian economies have reached the production level of the G7 countries by producing 30% of the total GDP globally produced in 2015 (GDP share of World total PPP).The most striking structural feature of Asian economies, which have reached high economic growth rates under the Chinese leadership, is their dependence on energy consumption, which requires high fossil use of these economies. Existing social and political instabilities of Asia which accounts for 59% of the world's population(UN, WPP,2015), 31.5% of global goods imports and 32% of global goods exports (WTO, 2015) require the sustained high economic growth rates and consequently the high energy consumption. In this context, the main problem for the Asian countries which makes up about 40% of global energy consumption(IEA, 2016) alone in 2014 according to the International Energy Agency's 2016 report, is to eliminate the social, economic and environmental concerns caused by rapid economic growth and thereby sustain economic growth.

The fact that Asian economies become dependent on China's economic growth is directly related to the process of economic growth in this region. In this context, Asia's prominent rise in global commodity and energy markets has basically occurred in two stages. The first phase of regional economic growth, which took place under the leadership of Japan between 1950 and 1970, completed its second phase with the rise of China in the 1990s (Wong, 2013, p.288).These developments, both of which led to Asia becoming one of the centers of global economic power, have resulted in different effects on the regional economic structure. Accordingly, the first wave under the Japanese pioneer resulted only in economic growth and regional interaction, while the second wave under the Chinese leadership resulted in economic and political dependence of the regional countries on China. This has led China to become an economically and politically active player in the Asia-Pacific region, affecting the development of regional countries (Wong, 2013, 288).Structural analyzes on the Asia-Pacific economies show that China is directly contributing to the development of many countries that are increasingly integrated into the Chinese market in Central and Southeast Asia economies as in many other regions (Coase and Wang, 2015, 332).

China, which is the first foreign trade partner in the economies of the regional countries, also directs the most direct foreign investment to these countries. With $ 187 billion in 2015, China, the third largest foreign investor after the United States and the EU, has directed 62% of its total outbound foreign direct investment to neighboring countries in Asia (OECD, 2016, Casanova et. Al. 2015,).[1]ASEAN is one of the regional actors that has the highest interaction with China in relation to regional countries. With more than 630 million inhabitants and 2015 GDP of US $ 2,431 million, the ASEAN has entered the top ten economies by setting the eighth rank in the global economic order after the US, EU, China, Japan, Germany, England and France (WB, 2016).The interaction between China and ASEAN has some basic variables that need to be analyzed compared to long-term economic forecasts. Accordingly, the critical development is expected to change regional and global balances; is the anticipation that Asian countries, especially China in the near future, will enter an economic contraction / stabilization period. The expected slowdown in the Chinese economy and the decline in energy demand resulting from the reduction of energy intensity are expected to directly affect Asia through export channels and investment flows and it is also predicted that the ongoing increase in energy demand which has continued since the 1990s will come to the end through the region (BP, 2015).Therefore, the question of how the economic contraction expected in China will affect the economic performance of the ASEAN countries and how this effect will be reflected in the global market is an important research question. For the very reason, the existence and direction of economic growth-energy consumption relation in China and ASEAN countries is examined by using Panel Data Analysis for the period of 1990-2015.

Table1. Academic Literature on China's Economic Growth - Energy Use

Authors	**Article**	**Year**
Jia-Hai Yuan	Energy Consumption and Economic Growth Evidence from China at both aggregated and disaggregated levels	2008
W. Yu, G. Ju'e, X. Youmin	Study on the Dynamic Relationship between Economic Growth and China Energy based on Cointegration Analysis and Impulse Response Functıon	2008
Y. Wang, Y. Wang, J. Zhou, X Zhu, G. Lu	Energy Consumption and Economic Growth in China: A multivariate causality test	2011
T. Yalta, H. Çakar	Energy Consumption and Economic Growth in China: A Reconciliation	2012
X. Yanqing	An Empirical Research on the Interactions of China's Energy Consumption, Pollution Emissions and Economic Growth	2012
Y. Liu	Energy Production and Regional Economic Growth in China: A more Comprehensive Analysis using a Panel Model	2013
M. Shahbaz	The Dynamic Links between Energy Consumption, Economic Growth, Financial Development and Trade in China	2013
J.G. Garcia	The Relationship between Economic Growth and Energy in China: Medium and Long-Term Challenges	2013
A. Jalil, M. Feridun	Energy-driven Economic Growth: Energy Consumption –Economic Growth nexus revisited for China	2014
Y. Sheng, XP Shi, DD Zhang	Economic Growth, regional disparities and energy demand in China	2014
R. J.R. Elliott, P. Sun, Q.Xu	Energy Distribution and Economic Growth: An Empirical test for China	2015
YB Zhao, SJ Wang	The Relationship between Urbanization, Economic Growth and Energy Consumption in China: an Econometric Perspective Analysis	2015
M. Zhang, Y. Song, B. Su, X. Sun	Decomposing the decoupling indicator between the economic growth and energy consumption in China	2015
H. Cui	China's Economic Growth and Energy Consumption	2016
H. Zhang	Exploring the impact of environmental regulation on economic growth, energy use and CO_2 emissions nexus in China	2016
G. H. Popescu, M. Comanescu, Z. Dınca	Economic Growth and Energy Utilization in China	2016

[1] OECD, FDI in Figures, October, 2016, http://www.oecd.org/daf/inv/investment-policy/FDI-in-Figures-October-2016.pdf, (e.t. 28.02.2017). Carlos Casanova, Alicia Garcia-Herrero and Le Xia, "Chinese Outbond Foreign Direct Investment", BBVA Research, Hong Kong, June 2015, https://www.bbvaresearch.com/wp-content/uploads/2015/07/15_17_Working-Paper_ODI.pdf (e.t. 25.07.2015). "Riding the Silk Road: China sees outbond investment boom, Outlook for China's outward foreign direct investment", March 2015.http://www.ey.com/Publication/vwLUAssets/ey-china-outbound-investment-report-en/$FILE/ey-china-outbound-investment-report-en.pdf , (e.t.28.02.2017).

As the recent period literature discussed above shows, the relationship between economic growth and energy use is addressed by various variables and econometric methods. Analyzes have shown that economic growth and the energy intensive industry encourage the use of high carbon levels of energy and that the social problems it poses are important risks for sustainable growth.

2. Determination of Economic Dependence and Interaction Level between China and ASEAN Countries

The South and East Asia region, which accounts for 54% of the world's population, produces 32% of world GDP according to the World Bank 2015 data's. China ranks third among the world countries with $ 116 billion in the order of investment for foreign countries in 2015.China ranks first in foreign trade of ASEAN countries and directs 70% of foreign direct investment abroad to Asian countries.

Table2. Human and Economic Dimensions of Regional Organizations (2015)

Regional Organization	Number of Member Countries	Population (thousand)-2015 Ratio to the total global population (%)	Total GDP (milion dollars)-2015	Total amount of imports (million dollars) and share in the global imports	Amount of exports (million dollars) and share in the global exports%	Foreign Direct Investment Flows[2] – 2014 (milyon dolar)
ASEAN*	10	632,305 %8,6	2,431,969	1,087,970 %6,5	1,181,889 %7,13	132,833 %10
ASEAN + China, Japan, South Korea	13	2,185,220 %29,7	18,799,544	3,861,033 %23,2	4,594,983 %27,7	273,322 %22,2

The table reveals that the 10-member ASEAN organization is an important organization within the global system with a population of over 630 million and GDP of $ 2,431 million. With GDP of $ 2,431 million realized in 2015, ASEAN entered the top ten economies after the US, the EU, China, Japan, Germany, Britain and France.[3] At the same time, achieving 6.5% of global imports and 7.13% of global exports, ASEAN brings together economies of very different levels and forms one of the most important economic regions in the global system (Nilcomborirak, 2015). However, the export and import figures reach over one-fourth of global exports and imports when trade with China, Japan and South Korea added on the figures.It is concluded that ASEAN is one of the dynamic centers of the global economic system which strengthens trade interaction between the countries of the region.

Table3. Shares of ASEAN's Foreign Trade Partners (%)[4]

	Share in ASEAN's exports	**Share in ASEAN's imports**	**Share in ASEAN's foreign trade**
ASEAN	25,9	21,9	23,9
China	11,3	19,4	15,2
Japan	9,6	11,4	10,5
US	10,9	7,6	9,4
EU-28	10,8	9,2	10,0
South Korea	3,9	7,0	5,4
Taiwan	2,8	5,6	4,2
Hong Kong	6,5	1,3	4,0
Australia	2,8	1,7	2,3
India	3,3	1,8	2,6
Share of Top 10 Countries	87,9	87,0	87,5
Others	12,1	13,0	12,5
Total	100,0	100,0	100,0

[2]UNCTAD, Foreign Direct Investment, http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=96740, (e.t. 24.10.2016).

[3] World Bank, GDP, http://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=CN-1W-US-EU-JP-FR-GB-DE, (e.t. 07.11.2016).

[4] http://asean.org/storage/2016/06/table20_as-of-30-Aug-2016-2.pdf, (e.t. 05.10.2016)

As it is seen in the table China, Japan and South Korea, which are regional countries in ASEAN foreign trade, have an important place while the level of interaction with global economic actors such as USA and EU is the foreground. The highlight of the table is that China's role in the export, import and foreign trade of ASEAN countries is undeniable. The growing bilateral trade between ASEAN and China is a direct result of efforts to increase China's interaction with its member countries.

The China-ASEAN Free Trade Area (CAFTA) and the ASEAN-China Free Trade Agreement (ACFTA), which envisage increasing bilateral trade between China and ASEAN, are among the most important of these efforts (Zhao and Zhang, 2016).The ACFTA, consisting of three separate agreements in total, was completed in 2005 with the entry into force of the contracts for the final goods and commodities trade, the 2007 for services trade and the 2010 agreements on mutual investments (Li et al., 2016).As a matter of fact, after this agreement, ACFTA became the third largest trade union after NAFTA and EU with 12% GDP in the global economy in 2010 (Li et al. 2016).It is a matter to be investigated whether the decline in energy intensity in ASEAN countries, and especially in the Chinese economy, is a change in the direction of the relationship between energy consumption and economic growth. For this reason, an analysis covering the ASEAN countries has been carried out because of the empirical evidence for the forward-looking estimates in the study. For this purpose, a model based on Panel Data Analysis was established to investigate the existence and direction of the relationship between energy consumption and economic growth. The relationship is being investigated with period 1990-2015 data for ASEAN countries.

3.Analyzes and Tests

In the context of accessibility to data, the data set includes China, Malaysia, Indonesia, Philippines, Thailand, Singapore and Vietnam.According to the new approach in the literature, energy consumption increases first in parallel with the development levels of countries, then it is beginning to decrease in the later stages of economic growth.In order to investigate whether ASEAN economies enter into this process, the square of the energy consumption as well as energy consumption is added variable representing non-linear relation.Panel data use generally provides parameter estimates with greater reliability and a greater degree of freedom. For this reason it increases efficiency in estimation while abolishing the problem of multicolinearity (Elhorst, 2003: 244). Linear panel data models can be classified as follows depending on whether the parameters are related to unit and / or time(Hsiao, 2003: 28).

1. Models in which both constant and slope parameters are constant in terms of units and time (classical model):

$$Y_{it} = \beta_0 + \sum_{k=1}^{K} \beta_k X_{kit} + u_{it} i = 1, \dots, N:\ t = 1, \dots, T \qquad (1)$$

2. Models in which the slope parameter is constant and constant parameter is variable according to the units (unit effect model):

$$Y_{it} = \beta_{0i} + \sum_{k=1}^{K} \beta_k X_{kit} + u_{it} i = 1, \dots, N:\ t = 1, \dots, T \qquad (2)$$

3. Models where the slope parameter is fixed and constant parameter is variable according to units and time (unit and time effect models):

$$Y_{it} = \beta_{0it} + \sum_{k=1}^{K} \beta_k X_{kit} + u_{it} i = 1, \dots, N:\ t = 1, \dots, T \qquad (3)$$

4. Models where all parameters are variable according to units, constant according to time:

$$Y_{it} = \beta_{0it} + \sum_{k=1}^{K} \beta_{ki} X_{kit} + u_{it} i = 1, \dots, N:\ t = 1, \dots, T \qquad (4)$$

5. Models in which all parameters are variable according to units and time:

$$Y_{it} = \beta_{0it} + \sum_{k=1}^{K} \beta_{kit} X_{kit} + u_{it} i = 1, \dots, N:\ t = 1, \dots, T \qquad (5)$$

In the above equations, Y_{it} means that the dependent variable value for i unit at t time; and X_{kit} shows k.explanatory variable for i unit at time t and u_t represents the error term.Furthermore, i sub index represents the units, while t represents the time dimension (Tatoğlu, 2005: 37-38).The general appearance of the panel data models together with the unobservable effects is expressed as follows.

$$Y_{it} = \alpha + X_{it}\beta + \mu_i + \lambda_t + u_{it}, \quad v_{it} = \mu_i + \lambda_t + u_{it} \qquad (6)$$

μ_i and λ_t represent unit and time effects that can not be observed respectively. Most of the panel data applications use the one-way model for error terms expressed in the form of $v_{it} = \mu_i + \lambda_t + u_{it}$, where μ_i is the unobserved specific individual effects and u_{it} is the stochastic error term.

The panel dataset, which includes both the cross section and the time dimension, is called a balanced panel with time series of equal length for each cross section; otherwise it is called an unbalanced panel. Since the dataset used in the study is suitable for balanced panel conditions, balanced panel is used in analysis.

$$growth_{it} = \alpha_0 + \alpha_1 ec_{it} + \alpha_2 ec_{it}^2 + v_{it} \qquad (7)$$

Growth variant, which is dependent variable in equation 7, reflects economic growth. Independent variable represented with **ec** expresses the primary energy consumption in terms of million tons of oil equivalent and **e**c^2 variable represents the square of energy consumption. The data were compiled from the World Bank's World Development Indicators.

Descriptive Statistics

For the model, descriptive statistics of the data set are given first, then unit root tests are performed and the empirical findings obtained from the model prediction are transferred. The stability of the series in the study was tested with the First and Second Generation Panel Unit Root Tests and the panel cointegration analysis was performed to series which was I (1). Afterwards, long and short term coefficients were estimated with error correction model.

Table4. Descriptive Statistics

	growth	**ec**	**ec^2**
Observation	182	182	182
Average	6.0703	280.2736	469196.7
Standard Deviation	3.7381	626.7389	1597408
Minimum	-13.1267	6.3	39.69
Maximum	15.2403	3014	9084196

According to descriptive statistics, the average value of the growth data set was 6,0703, while the lowest was recorded in 1998 at Indonesia and the highest in 2010 at Singapore. The average value of the energy consumption variable is equivalent to 280.2736 million tons of oil equivalent. The maximum value of this variable is found in China in 2015 and the lowest in Vietnam in 1990. The average value of the variable obtained by squaring energy consumption is equivalent to 469196,7.Maximum and minimum values are seen in the same unit and time with energy consumption variable.

Unit Root Test

If the model is estimated with non-stationary time series, the values of t, F and R^2 can give deviations, so the results do not reflect reality (Gujarati, 1999: 713). In this direction, the analysis series are started with the stationary test.The unit root test is based on a test of ρ = 0 in equation (8):

$$\Delta y_{it} = \beta_1 + \beta_{2t} + \rho y_{it-1} + u_{it} \qquad (8)$$

If ρ = 0 is reached, then y_t is considered to be unit root. Therefore, the result is that the time series is not static. In order to perform unit root tests of the series considered in the study, first generation unit root tests were applied. The Fisher ADF unit root test has been performed to represent these generation tests.

Table 5. Fisher ADF Unit Root Test

Variables	**Fisher ADF**		**Variables**	**Fisher ADF**	
	Constant(χ^2)	**Constant-Trend (χ^2)**		**Constant(χ^2)**	**Constant-Trend (χ^2)**
growth	26.8884[c]	22.8760	**Δgrowth**	51.3351[a]	30.1859[a]
lec	8.3717	16.9505	**Δlec**	30.0060[a]	21.8689[c]
lec^2	3.3255	19.5130	**Δlec^2**	34.0536[a]	21.3053[c]

According to the Fisher ADF panel unit root test results, the variables of ec and ec^2 are not stable at fixed and fixed-trend level. All the series become stationary when their first difference is taken, so all series are I (1). Unit root test was performed with Pesaran CADF test to represent Second Generation Unit Root Tests considering cross section dependency.The simple CADF regression is defined as follows:

$$\Delta Y_{it} = \alpha_i + \rho_i^* Y_{it-1} + d_0 \bar{Y}_{t-1} + d_1 \Delta \bar{Y}_t + \varepsilon_{it} \quad (9)$$

In equation $\bar{Y}_t$ is the average of all N observations by time t.After the CADF regression is estimated, the averages (t) of the t-statistics of the lagged variables ($CADF_i$) are obtained to obtain the CIPS statistic:

$$CIPS = \frac{1}{N}\sum_{i=1}^{N} CADF_i \quad (10)$$

According to the results, the growth variable is stationary at I(0) levels. However, when the ec and ec^2 variables are not stationary at the level, they become stable when their first difference is taken. One of the methods of stabilizing the series which are resulted in being non-stationary as a result of the test is to take the differences of the series. However, this method leads to the loss of important information for the long term relationship. The co-integration analysis is applied to solve this problem (Karagöl at., 2007: 75). Occurrence of co-integration between two variables indicates that the variables are in the same wavelength, so no need is left for making stabilization by taking the difference. In this case, the level values and regression of the variables becomes significant (Gujarati, 2009: 726).

Table 6. Pesaran CADF Panel Unit Root Test Results

Variables	**I(0)**		**I(1)**	
	Fixed	**Fixed-Trend**	**Fixed**	**Fixed-Trend**
growth	-2.581[b]	-3.054[b]	-6,962[a]	-5,342[a]
lec	-2,093	-2,371	-3,866[a]	-2,177[b]
lec^2	-2.178	-2,095	-3,307[a]	-1,826[b]

The analysis is based on the determination of the stability of the residues calculated from the regression between the variables;

$$Y_{it} = \beta_1 + \beta_2 X_{it} + u_{it} \quad (11)$$

If we determine that the linear combination of u_t is I(0) obtained from the regression model, then the result that the Y_{it} and X_{it} variables are co integrated is reached. In the study, Westerlund Panel Cointegration analysis is applied. The general equation of the Westerlund analysis is shown as follows;

$$\Delta y_{it} = \delta'_i d_t + \lambda'_i \lambda X_{it} + Y_i Y_{it-1} + \varphi_i X_{it-1} + e_{it} \quad (12)$$

The d_t in the equation is the deterministic elements vector. λ is the long term, Y_i and φ_i short period parameters. Westerlund (2007) presents 4 panel cointegration test statistics based on error correction model to test the presence of cointegration.

Table 7. Weterlund Cointegration Test Results

	Değer	**Z-Değeri**	**P Değeri**
Gt	-2.724	-3.390	0.000
Ga	-5.437	-0.187	0.574
Pt	-7.851	-4.043	0.000
Pa	-8.743	-3.371	0.000

According to the results of the cointegration test, statistics other than the Ga statistics show that there is a cointegration relationship between the variables. Long and short term relationships are predicted after the existence of a long-term relationship between variables. Methods such as the Panel Dynamic Ordinary Least Squares Method have been developed to estimate only long-term parameters. However, long term parameters as well as short term parameters can contain important information. For this reason, estimating the parameters of the short turn makes it possible to make economic interpretations more efficiently and correctly. After the analysis of the long-term relationship in the study, error correction model was used to estimate short-term parameters.

Pooled Average Group Estimator and Average Group Estimator predict both short and long term parameters together by constructing error correction model (Gujarati, 2009, 729). The panel ARDL model is used to establish the error correction model (Kabadayı, 2012, 78).The error correction model is shown in equation (13):

$$growth = \varphi growth_{it-1} + \beta_i' ec_{it} + \Upsilon_i' ec2_{it} + \sum_{j=1}^{p-1} \lambda_{ij}\ \Delta growth_{it-j} + \sum_{j=0}^{q-1} \delta_{ij}\ \Delta ec_{it-j} + \sum_{j=0}^{q-1} \mu_{ij}\ \Delta ec2_{it-j} + \varepsilon_{it} \quad (13)$$

$$\varphi_i = -\left(1 - \sum_{j=1}^{p} \lambda_{ij}\right),\ \beta_i = \sum_{j=0}^{q} \delta_{ij},\ \lambda_{ij}^* = -\sum_{m=j+1}^{p} \lambda_{im},\ \delta_{ij}^* = -\sum_{m=j+1}^{q} \delta_{im}$$

Φ denotes the error correction coefficient. This coefficient is expected to be negative and statistically significant. Firstly, the Hausman Test was conducted to select among the predictors for the long and short term estimation. According to the Hausman test results, $\chi^2 = 0.33$ (Prob:0.8470) long term parameters are homogenous, so the Pooled Average Group Estimator seems to be more reliable.

Table 8.Pooled Average Group Estimator Results

	Coefficient	Standard Deviation	Prob
Constant	0.92578	0.84576	0.274
lec	0.71795	1.8	0.690
lec^2	-0.04237	0.25377	0.867
Δlec	66.554	1.30	0.194
Δlec^2	-1.92015	6.9875	0.783
ECM	-0.8184	0.08635	0.0000

According to the results of error correction model (ECM), error correction coefficientis negative as expected and statistically significant. This result shows that there is a long term relationship between the variables and short term deviations of the series will come to the balance in the next period. Approximately 81% of the short-term imbalances will recover in the next period and converge to the long-run equilibrium.When the short-term relationships between the variables are examined, it is seen that the coefficients of the lec and lec^2 variables are positive and negative, respectively, as expected, but they are both statistically insignificant. For this reason, the square of energy consumption was removed from the model and the prediction was re-established.

Table 9. Revised Model: Pooled Average Group Estimator Results

	Coefficient	Standard Deviation	Prob
Constant	5.9351	0.91650	0.000
lec	1.04742	0.38258	0.006
Δlec	33.3273	9.056	0.000
ECM	-0.7545	0.0945	0.000

According to the results obtained, there is a meaningful and positive relationship between energy consumption and growth both in short term and long term. Error correction coefficient is negative and significant. 75% of the short-term imbalances will recover in the next period and converge to the long-run equilibrium. According to the results obtained, the strong and positive relationship between economic membership and energy consumption for ASEAN economies still continues. So a reduction in energy demand will also have a major impact on the growth rates of these countries. The level of development in the countries in question has been insufficient to weaken the relationship between energy consumption and economic growth.

4. Conclusion

Parallel to the change in China's economic growth, it is also necessary to follow a new strategy in the construction of energy consumption components. There is no significant change in the energy consumption components since the 1980s. Because expansion in the services sector will make it necessary. The high level of dependence between China and ASEAN countries due to trade and foreign direct investment makes it possible for China to have an economic recession and the potential to be affected by the fallen ASEAN countries in energy demand.The expected slowdown in the Chinese economy and the decline in energy demand resulting from the reduction of energy intensity are expected to directly affect Asia through export channels and investment flows and it is predicted that the ongoing increase in energy demand will continue in the region since the 1990s.(BP, Energy Outlook, 2035- February 2015).In developed countries, the increase in energy consumption is far from being a sign of economic growth, and it is possible to grow without increasing energy consumption.

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