The Correlation Of Energy Utilization And Growth In Economy: A Case Study On Kazakhstan

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Abstract: This study observes an empirical correlation of energy utilization and economy increase in Kazakhstan using time fraction from 1993 to 2011. To specify, utilization of electricity and the electricity that is produced from oil and gas sources correlation had been observed as well. Co-integration method and Granger causality of Hsiao were applied in order to come up with unidirectional causes of economic growth on total energy consumption. The economic growth facilitates raise in gas energy production as well. For the energy conservation policy it suggests to remove energy saving policy from gas-energy sector to oil sector as we reject any causality correlation of increase in economy and production of oil and energy. Furthermore, policy makers should sustain technological innovations in electronic sectors, which will increase consumption of the electricity by the population and this will finally cause economic growth.

Index Terms: economic growth, energy consumption, Unit root test, Hsiao's Granger causality test.

1 INTRODUCTION

One of the most significant predicaments in the world is to find a way to decline the emission of greenhouse gas. On the other hand, until India and China, -the major representatives of the developing countries, assign themselves on improving the change in climate, other developed economies stumble at realizing actual accomplishments [35]. However, the significance of the involvement of such countries to the global warming accelerates while their economy development and energy resources' demand increases. As a matter-of-fact, diminishing the use of energy is an effective method to eliminate emissions [23]. The main difficulty that the majority of the developing countries meet up is the trade off among decreasing the consumption of energy or compromising an increase in economy. As we know consumption is part of GDP and when we cut energy consumption we decrease economic growth. Thus, it is very important to find causality relationships between these two indicators. The results of this research may help not only to energy policy makers but to whole nation and economic development as well. Among developing countries, the case of Kazakhstan is very remarkable as this country is one of the key producers in energy market. The reserves of energy in Kazakhstan are colossal. At the same time, the use of the energy and the growth in economy are increasing in a rapid pace too. By the year of 2012 utilization of energy and production in Kazakhstan were 88.11 bln. kW/h and 86.20 bln. kW/h, correspondingly. The energy consumption increased by 13% for one year, while growth in economy came out to be 5%. In the first half of the year of 2009 an economic recession has anguished the country; however, Kazakhstan has surpassed it straightforwardly. The reason of the recession was the dramatic fall of the prices for oil and gas when the GDP of the country came out to be only 1,2%. Despite all, in concordance with IMF (International Monetary Fund) Kazakhstan- one of the major oil and gas producers of the world is ranked as top ten fastest developing countries [54]. Regardless loads of studies and investigations on finding the link between energy utilization and growth in economy, conclusions of the causations came out to contradict. Yu and Choi [44] found in their paper indications of causality that energy influences GDP in Philippines, at the same time as it is controversy in Korea. Aqeel and his collaborator Butt [8] while researching Pakistani market had found out that development in economy brings increase of petroleum use, though there is no cause of development in economy on gas use and vice-versa. According to the study of Asafu-Adjaye [9] in India and Indonesia energy persuades income undirectionally in the course of Granger causality, whereas in Thailand and Philippines energy persuades income bidirectionally in the course of Granger causality. Other co-researchers such as Kraft along with Kraft [28] and Akarca along with Long [7] had evidenced causality between GNP and energy use in USA for the time fraction involving the years 1947-1974, but no indications of causality were discovered between GNP income alternate and energy utilization by following co-researchers: Akarca along with Long [7], Erol along with Yu [13], and Yu along with Hwang [45]. Pursuant to Hwong, et. al. [25] in Taiwan there is a bidirectional causality among increase in energy use and increase in GNP, whilst Cheng in pair with Lai [11] state that increase in economy commences use of energy and that use of energy commences employment without feedback in Taiwan. The main reasons of this kind of conflicting results are different approaches and different testing analysis. Nature of the time fractions of used variables was not accounted, because estimations were made using OLS's (ordinary least squares) simple log-linear model. Nevertheless, not long ago the non-stationarity of the majority of economic time series in levels form was proven [19]. Illustrate The following article is structured in next manner: a literature review is illustrated in 2nd part; data as well as methodology are represented in 3rd part; empirical results are given in the 4th section and finally the 5th section draws an attention to the conclusions made out from the research.

2 LITERATURE REVIEW

One of the notorious themes in the world of economy is the role of energy in the advancing development of economy. However, not few evidences were handed through economic theories stating that there is a correlation among energy use and economic development [26]. To highlight, Ferguson et al. [15] had indicated an immense relationship among consumption of electricity and altitude of advance in economy, which does not inevitably denote the causality. As a result, cause of energy maintenance policies on increase in economy is evaluated by empirically examining given two variables [23]. Given topic comprises of importance in a governmental level in the form of instrument for making efficient policies on economy and environment. In addition, it exhibits connection of environment with advancing development in economy [27]. Scenario of preceding researches on this topic may be laid down as following: (1.) increase in economy that affects use of energy, which is named after Granger (2) use of energy that

affects increase in economy, which is named after Granger (3) bi-directionally cause among use of energy and increase in economy and (4) nonexistence of any causalities. Of which, each situation draws different ways to energy policies to be applied on different situations (Table 1). Number of practical observations and experiments on correlation among use of energy and increase in domestic economy is narrow. Co-researchers Reynolds along with Kolodzieji [55] had examined a correlation among oil, gas and coal manufacture within CIS (Commonwealth Independent Countries), as well as Kazakhstan. Conclusion of the study revealed unidirectional causality of oil manufacture on GDP as well as unidirectional causality of GDP on gas and coal manufacture. Another pair of researchers Apergis with Payne [54] had investigated the same topic but as an alternative of manufacture used utilization criteria. Using panel error correction model they expose that in 11 CIS countries use of energy unidirectionally cause the increase of economy in short-run while in long-run the causality is bidirectional. Soon after, in a year of 2010 it was discovered that use of energy and real output convey a bidirectional causality [56]. They had observed Eurasian countries for any apparent correlations among use of energy and development of economy [56]. The resolution of this study was that renewable use of energy and development of economy cause each other bidirectionally in long and short run. Researchers had applied an error correction models in their study. The different results caused by various variables and sample sizes have been used. As a consequence, in order to prevent any controversies and different results new empirical indications like a co-integration technique along with Granger causality test are applied in this study.

3 DATA AND METHODOLOGY

It is well known that Granger [19] test1 is applied in order to test the causality among two variables. In condition that A variable considerably affects the estimation of B_{t+1} variable, a Granger causality appear between the variables. First of all, unit root tests and test for co-integration among variables are to be undergone, which are to be continued by causality and test for co-integration among variables. Granger [20] states that the validity of the test is proved when variables are not co-integrated. Furthermore, in order to attain accurate results lag length is to be precisely chosen. In case of understatement bias will come out, while in case of exaggeration calculations will be ineffective. In order to avoid alike to happen, systematic autoregressive process of Cheng Hsiao [57] is applied to select required To solve this problem we use Cheng Hsiao's [57] systematic autoregressive method which helps to select most favorable lag length for every variable in a given equation. Identified as mean square prediction error, it merges causality of Granger along with Final Prediction Error (FPE) of Akaike. Methodology used on this study scheduled by the steps followed. First, determination of the causality correlation of GDP with energy usage and GDP with different constituents of energy (oil, gas and electricity) usage is undergone using co-integration method and Granger causality tests using Hsiao's edition.

The basic model is

$$Y = F(x) \quad (1)$$

Here, GDP is represented by Y whilst use of energy is represented by X. The entire variables given in per capita: GDP is in per capita US dollars (in constant 2000) and others – in per capita KWH. The data were taken from 1992 to 2012. As source of the data we use the World Bank Development Indicators. Initially, method developed by Engle-Granger [20], ADF (augmented Dicky-Fuller) and (PP) Phillips-Perron tests are to be undertaken, i.e.

$$(DF)\Delta X_t = a + bX_{t-1} + \varepsilon_t \quad (2)$$

$$(ADF)\Delta X_t = a + bX_{t-1} + \sum_{i=1}^{\gamma} c\Delta X_{t-1} + \varepsilon_t \quad (3)$$

Here, X_t stands for GDP variables, sum of energy usage, usage of petroleum, usage of gas and usage of electricity; Δ stands for operator of difference; a, b, and c serve as parameters that will be calculated whereas γ is chosen in that way so that ε_t will be white noise. Assessments use the null hypothesis H_0, where: X_t does not represent I(0), and in case determined statistics DF and ADF will come out to be less than their own critical values on table of Fuller, this will mean that the null hypothesis H_0 must be redundant. Thus, series will come out to be stationary; integrated or order one i.e. I(1). On the basis of unit root along with co-integration tests, using the OLS system the following equation is drawn:

$$Y_t = a_0 + a_1 X_{ti} + Z_t \quad (4)$$

where Y is GDP, Xis the i components of energy consumption, Z is a residual. Given unit root test will be undertaken on residuals in order to check for the non-stationarity of null hypothesis:

$$(DF)\Delta Z_t = \alpha + \beta_0 Z_{t-1} + U_t \quad (5)$$

$$(ADF)\Delta Z_t = \alpha + \beta_0 Z_{t-1} + \sum_{i=1}^{k} \beta_1 \Delta Z_{t-1} + U_t \quad (6)$$

Null hypothesis will be rejected in case β will come out to be negative and estimated DF or ADF statistics will come out to be fewer than the critical value from the table of Fuller. That will reveal causality existence in the long run among given variables, which is found using the model of the error correlation. However, in case null hypothesis is discarded for non-stationarity as well as variables does not come out to be cointegrated too, in that case causality test by Granger is to be undertaken. The lag length selection procedure offered by Cheng Hsiao [57], Hwang et. al. [25] and Chang and Lai etc. [11] consists of two steps: Dependent variable lags once while autoregressive regressions on the dependent variables are applied. One more lag is placed on the dependent variable in every subsequent regression. The calculated M regressions a presented in the given outline:

$$d(Y_t) = \alpha + \sum_{i=1}^{m} \beta d_{t-1}(Y_{t-i}) + \varepsilon_{1t} \quad (7)$$

Here, 1 to m is represented by i value, size of the sample and process of the economy reflects the selection of the lag duration. As we know the selection of m should be as large as possibthe main sectors of the economy, we select maximum m as 10. Then we computed the FPE for each as follow:

$$FPE(m) = \frac{T+m+1}{T-m-1} ESS(m)/T \quad (8)$$

Here, size of the sample is represented by T; final prediction error is represented by FPE and sum of squared errors is represented by ESS. The lowest FPE is produced by lag length, which in its turn is represented by m^*. 2. Next, regressions are to be estimated by adding lags on other variables too, same as m^* was calculated. As a consequence ten regressions in the given form are to be estimated:

$$d(Y_T) = \alpha + \sum_{i=1}^{m^*} \beta d_{t-1}(Y_{t-i}) + \sum_{j=1}^{n} \gamma d(X_{t-j}) + \varepsilon_{2t} \quad (9)$$

Here, j starts from 1 to 10. After, FPE for each regression is to be inputted as follows:

$$FPE\,(m^*, n) = \frac{T+m^*+n+1}{T-m^*-n-1} ESS\,(m^*, n)/T \quad (10)$$

Optimal lag length for X and lag length with lowest FPE n^* are selected. After, FPE (m^*) is matched with FPE m^*n^* in order to check for causality. GDP (Y_t) is not Granger caused by energy (X_t) in the following condition: $FPE\,(m^*) < FPE\,(m^*\,n^*)$ and Y is caused by Granger in the following condition: $FPE\,(m^*) > F(m^*n^*)$ X_t. After undertaking estimations on GDP (Y_t) as the dependent variable, next alike estimation to be undertaken with energy (X_t) as the dependent variable. Finally, all the regressions are undertaken on each of the component of energy utilization with GDP in order to find out the causality between GDP and energy.

4 Results

In the foregoing part of this study correlations among per capita GDP, total energy usage, oil, gas, electricity and energy variables were examined. According to the formulas (2) and (3) we make a hypothesis to test for unit root existing:

$$H_0 = b\ (\text{unit root});\ H_1 \neq b \quad (11)$$

Unit root existence implies that null hypothesis cannot be declined, which is true if t^* comes out to be more than critical value. On the other hand, Unit root absence implies that null hypothesis is to be declined, which is true if t^* comes out to be lesser than critical value. Based on given above decision rule, table 2 illustrates the stationarity of all variables in level, i.e. I (1). The test was made by using Eviews 7.0 software. ADF along with DF tests were hold also for the residuals according to (5) and (6) formulas respectively. The Engle-Granger test was hold in Eviews 7.0 software as well as unit root test in residuals. Absolute values of all residuals are less than their critical value at 5 % level. Null hypothesis of no co-integration is admitted, because not any of the series came out to be co-integrated. Hence, the most suitable method for estimation is standard Granger test.

TABLE 2
UNIT ROOT TEST (STATIONARITY TEST RESULTS)

Variable	Level	
	DF	ADF
GDP	-2.86	-2.38
ENUSE	-1.91	-2.34
EL	-2.17	-2.39
OIL	-3.56**	-3.74**
GAS	-1.47	-3.91**

- GDP – Gross Domestic Product, per capita USD (in 2000 constant)
- ENUSE – Total energy use, per capita KWH
- EL – Electric power consumption, per capita KWH
- OIL – Electricity production from oil sources, per capita KWH
- GAS - Electricity production from natural gas sources, per capita KWH

** - Significant at 5 percent

TABLE 3
COINTEGRATION TEST (UNIT ROOT TEST IN RESIDUALS)

	Level	
	ADF	DF
GDP, ENUSE	-1.77	-1.65
GDP, EL	-1.38	-2.65
GDP, OIL	-3.46**	-2.92**
GDP, GAS	-2.45	-2.47

The absolute values of the calculated test statistics in the table are less than the critical values which indicates acceptance of the null hypothesis of No-Cointegration.

** - Significant at 5 percent

Table 4 shows Hsiao's type of Granger test for causality. Outcome is: increase in economy affects total use of energy, whereas use of energy does not affect GDP level. But, use of electricity affects GDP, whereas GDP affects assembly of electricity from natural gas resources. Absence of any causality among GDP and assembly of electricity from oil resources is to be highlighted. Heavy industry, buildings manufacture along with road and rail network construction sustains advancing growth in economy, which in their turn requires loads of energy use. Advance in these industries along with the advance in entire economy leads to more use of energy and electricity from gas resources. Beyond any questions electricity leads GDP to arouse economic development in Kazakhstan, even though correlation among GDP with electricity from oil resources.

TABLE 4
HSIAO'S GRANGER CAUSALITY TEST

Item	F(m*)		F(m*n*)	Causality result
GDP eq. (4)	17013.08	<	5.00e+08 (1)	ENUSE does not cause GDP
ENUSE eq. (5)	31680.37	>	4.93e-06 (4)	GDP causes ENUSE
GDP eq. (4)	17013.08	>	3.21e-06 (4)	EL causes GDP
El eq. (3)	32483.90	<	96041820 (3)	GDP does not cause EL
GDP eq. (4)	17013.08	<	41414096 (1)	OIL does not cause GDP
OIL eq. (1)	3388.660	<	41414096 (1)	GDP does not cause OIL
GDP eq. (4)	17013.08	<	60888477 (2)	GAS does not cause GDP
GAS eq. (0)	17150.30	>	3.21e-09 (4)	GDP causes GAS

5 Conclusion and Propositions for Policy

The aspire of this study was to determine directional correlations among use of energy and development in economy, to be in details matched variables are the national

GDP and various elements of energy utilization as use of energy, use of electricity, use of electricity from oil and gas resources. All the variables applied were given in per capita and population. Unit root tests along with co-integration tests as well as the causality test of Granger were undertaken in order to find the correlation. Version of Hsiao for Granger's causality was carried on, because Granger test itself is susceptible to lag lengths. According to the end results development in economy affects the overall use of energy. Moreover, effect of increase in GDP on increase in manufacture of gas and energy is determined, whereas effect of increase in economy on manufacture of oil and energy is determined to be absent. However, to highlight the use of energy affects the economy in whole. In accordance with the statistic data amount of manufacture in industry of the year 2009 came out to be 9121525 mln. tenge (Republic of Kazakhstan's national currency), which has arose in the year of 2012 to 16851775 mln. tenge that is 84 per cent and 28 per cent for each year, respectively. The sector of mining demonstrates the same condition. Consequently, as proved in this study, each and every of these heavy industries demand for masses of energy use, which in its turn rises the use of the energy in total. Results of this research also determine that loads of technological advances and novelties of this days and age rises the use of electricity, which bring economy to prosperity through supporting electronic products sector. The suggestions put forward relying on the results of this study is to implement a policy to increase energy in the case of electricity usage so that it leads to economic development, whereas policy on energy protection regarding use of oil and energy will not cause any unfavorable side-effects on development of economy of Kazakhstan. Consequently, it is essential for government to eliminate policy on energy protection from gas sector to oil sector. Moreover, technological advances and novelties in electronic sectors must be supported so that this will increase the use of electricity by populace in order to attain development in economy.

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