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Industrialization, Electricity Consumption and Co_2 Emissions in Iran

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ABSTRACT: This paper investigates the short term and long term relation between Co_2 emissions, electricity consumption and industrialization in case of Iran over the period 1980-2011. To estimate this relationship The Granger Causality Test, Johansen cointegration test and Vector Error Correction Model are applied.
Granger Causality analysis indicates that in short-run there is a bilateral causal relationship between Co_2 emissions and electricity consumption, and a bilateral causal relationship between Co_2 emissions and industry value added. But Granger Causality analysis didn't show any causal relationship between the industry value added and electricity consumption variables. The effects of the electricity consumption and industrialization on Co_2 emissions is positive in long-term.

KEYWORDS: Industrialization, Electricity Consumption, Co2 Emissions, Iran.

INTRODUCTION

The industrialization is the result of consumer and capital goods production, and speed up investment trend to provide services and goods production. The developed countries experiences shows the necessity of industrialization for countries economic growth (Emami and Adibpour, 2011) (1).

Increasing manufacturing energy consumption and the level of energy consumption in the process of industrialization have an upward trend at the beginning and after reaching a certain level of development will have downward trend.

Such decreasing in energy consumption is due to substitution of energy with other inputs, technology improvement, changes in composition of higher quality energy sources (such as electricity) instead of lower quality ones and changes in production of goods (consumption goods to low consumption goods) (Hemmati, 2005) (2).

Among switch energies, electricity has the most consumption diversity. Electricity consumption caused industrial growth and development trough reduction of expenses in the industry investment; this issue caused power plants to become one of the most important aspects of economic development.

On the other hand the power plants fuels in their conversion process to energy emit pollutants such as carbon dioxide into the surrounding environment and impose a noticeable damage to agriculture, the environment and human health.

The purpose of the present paper is to study of the relationship between industrialization process, electricity consumption and carbon dioxide emissions in Iran. Thus, the remainder of this paper is structured as follows: background: explains literature review, the research methodology: the econometric specification and estimation methodology is outlined and discuss how various hypotheses are tested, results: provides a discussion of our empirical results and conclusion: will discusses major findings and concludes the paper.

BACKGROUND

Ghanbari and Khaksar Astaneh (2011) (3), have studied the relationship between electricity consumption, pollutant emission, and gross national production with a focus on high and low income countries. The results show a cointegration relationship between electricity consumption, pollution and gross national production. Also according to their results in long-run cannot considered the relationship between electricity consumption and gross national and this relationship difference, negative within the examined countries.

Mehrara et al (2011) (4), has been studied the relationship between economic growth and increasing electricity consumption in some of the selected Petroleum Exporting Countries using the Single-Equation model and Panel Data Model. The results show that the direction of causality between economic growth and increasing electricity consumption is bilateral in the long-run. But the direction in short-run is from increasing of electricity consumption to economic growth. Also the results show the selected Petroleum Exporting Countries are dependent to electricity energy. Thus, policies to reduce electricity demand by increasing electricity prices have adverse effect on the economy growth in these countries both in the short-run and long-run.

Golizade and Barati (2011) (5), discussed factors influencing household energy and electricity consumption with a focus on energy productivity. Studying the effects of four effective variables: household income, energy efficiency, switch energy and population growth show that income has the greatest effect on the household energy consumption growth. Then population growth and energy efficiency are two affecting factors which increase household energy consumption. Switch fuels and changes in the pattern of households' consumption, totally have a low but positive effect on increasing of energy consumption in the household sector.

Heydari et al (2011) (6), have examined the relationship between electricity consumption, electricity price and economic growth in Iran. Results from the Supply-Side Model, indicates negative unidirectional relationship running from economic growth to electricity consumption in long-term. Short-term results shows a positive bilateral relationship between electricity consumption and economic growth. The results from the demand-side model indicates that there is no relationship between the electricity consumption, its price and economic growth in long-run. Therefore, the increase in electricity consumption is not necessarily a reason of economic growth in countries.

Al-mulali et al (2014) (7), have studied the effect of electricity consumption from renewable and nonrenewable resources on economic growth in the 18 countries of Latin America. The results show that the electricity consumption of renewable electricity resources compare with nonrenewable resources have greater impact on economic growth.

Sadorsky (2012) (8), has studied the impact of information and communication technology (ICT) on electricity consumption in emerging economies. The results show that there is a significant positive relationship between electricity consumption and ICT; ICT is measured when is used to connect to the Internet, mobile phones or private PCs.

Ozturk & Acaravci (2011) (9), have studied the relationship between electricity consumption and economic growth of 11 countries in the Middle East and North Africa in short-run and long-run. Their research results show that there is long-run relationship between electricity consumption and economic growth.

Wolde-rufael (2014) (10), has examined the Granger causality between electricity consumption and economic growth for 15 transition economies. The results show the unidirectional causality run from the power consumption toward economic growth in Belarus and Bulgaria, and from economic growth toward electricity consumption in Czech Republic, Latvia, Lithuania and Russia. The bidirectional causality exists only in Ukraine; while in Albania, Macedonia, Moldova, Poland, Romania, Slovakia and Slovenia there is no causal relationship between electricity consumption and economic growth.

Hamdi (2014) (11), has studied the relationship between electricity consumption, foreign direct investment, and capital and economic growth in Bahrain. The results show that the electricity consumption, foreign direct investment and capital increase economic growth. Granger causality analysis shows the feedback effect between electricity consumption and economic growth, foreign direct investment and electricity consumption. Shahbaz et al (2014) (12) have examined the relationship between industrialization, electricity consumption and CO_2 emissions in Bangladesh and found that financial development increases pollution. Electricity consumption causes production of greenhouse gases. Trade openness has a positive impact on pollutant by energy. Also, the causality analysis shows that the electricity consumption is the reason of pollution, industrial growth and financial development.

RESEARCH METHODOLOGY

In order to achieve the objectives of the research and as Shahbaz et al (2014) used in their studies, the following model is used to estimate the relationship between variables.

$LCO_t = \alpha_0 + \alpha_1 LELC_t + LI_t + LOPEN_t + U_t$

Where: LCOt is emissions in million tons, LELCt is the total electricity consumption in kilowatt per hours, LIt is the industry value added and LOPENt is the degree of trade openness all variables. Are used in log form.

RESULTS

In this study, the Vector Auto Regression Model (VAR) is applied to analyses variables; VAR model is the most appropriate model to analyze the analytical pattern in a study. This model determines the long-run relationship between the variables and is able to explain the short-run relationship between variables. However VAR model relation is in line with short-run and long-run relationship between the variables. To use auto regressive vector model, it is needed to identify the variables and to evaluate if there is stationary or non-stationary. One of the most common tests used to test variables stationary is Augmented Dickey Fuller Unit Root Test (ADF). Based on the ADF test results shown in Tables 1 and 2, the null hypothesis that prove the existence of unit root is not rejected and all variables instead of electricity consumption that is stationary at level, will be stationary at the level of 95% first difference.

Table 1. ADF test results of the pattern variables stationary test

		Mackinon critical values		
Series Name	**ADF**	1%	5%	10%
LCO	1.21	-3.69	-2.98	-2.63
LI	0.84	-3.66	-2.96	-2.61
LELC	-3.08	-3.66	-2.96	-2.61
LOPEN	-2.25	-3.66	-2.96	-2.61

Table 2. ADF test results of pattern variables stationary test for the first difference

		Mackinon critical values		
Series Name	**ADF**	1%	5%	10%
LCO	-2.99	-3.71	-2.98	-2.62
LI	-4.97	-3.67	-2.96	-2.62
LELC	-3.36	-3.66	-2.96	-2.61
LOPEN	-5.75	-3.67	-2.98	-2.62

After reviewing the stationary of the variables, the optimal lag model should be determined. To determine the optimal lag model there are different criteria including: Akaike criteria, Hannan Quinn, Maximum Likelihood and Schwartz. In here Schwartz value is used to determine the optimal lag. Based on this criterion, the optimal lag length is one.

Johansen Cointegration test

After determining the optimal lag model, the long-term relationship between the model variables should be tested. In fact Cointegration test solves lack of non-stationary data problem on the series. In this study Johansen-Juselius cointegration test is used. EigenValue and trace-Value are examined in different condition of presence or absence of the constant or trend.

LCO = 0.17 LELC + 0.82 LI _ 0.46 LOPEI

Model (2) shows that the effect of electricity consumption on Co_2 emissions in long-term is positive, the impact of industrialization on CO_2 emissions is positive and the effect of trade openness degree on CO_2 emissions is negative.

Granger Causality Test and the short-run variables relationship

Granger causality test for CO_2 emissions and electricity consumption variables shows that there is a bilateral causal relationship between electricity consumption and CO_2 emissions. The Granger causality test results indicates a bilateral relationship between CO_2 emissions and industry value added. But Granger causality test does not show any relationship between industry value added and electricity consumption. The results of the tests are presented in Table (3).

Table 3 - Granger Causality Test

Null Hypothesis	F- value	Probability	Results
LCO variable is not casual Granger LELC	3.46	0.04	The hypothesis does not confirmed
LELC variable is not casual Granger LCO	3.6	0.04	The hypothesis does not confirmed
LCO variable is not casual Granger LI	9.58	0.000	The hypothesis does not confirmed
LI variable is not casual Granger LCO	4.5	0.02	The hypothesis does not confirmed
LI variable is not casual Granger LELC	0.87	0.42	The hypothesis confirmed
LELC variable is not casual Granger LI	1.81	0.18	The hypothesis confirmed

According to the above mentioned issues and the fact that Granger causality test examines the relationship between variables in the short-run, it can be concluded changes in electricity consumption and industrialization have influence on CO_2 emissions.

Vector Error Correction Model

This model is used to relate short-run fluctuations of variables to long-run equilibrium. VECM model is applied in order to evaluate the short run properties of the cointegrated series.

Applying this method can be used to test if a variable have a negative short-run effect on dependent results, the situation will continue in long-run too. So the VECM model is estimated as following:

(3) D(LCO) = - 0.019 - 0.67*(LCO(-1) - 0.17*LELC(-1) - 0.82*LI(-1) + 0.46*LOPEN(-1) + 8.62) + 0.74*D(LCO(-1)) + 0.28*D(LELC(-1)) + 0.103*D(LI(-1)) + 0.14*D(LOPEN(-1))

R2=0.44 F=3.83

Adjusted coefficients in the above equation is equal to -0.67, that means in each period 0.67 amount of the imbalance in the previous period will solve. And the adjustment will0.67 happen in line with long-run and in the rate of 0.67.

CONCLUSION

In this paper the impact of Electricity Consumption and CO_2 Emissions on Industrialization in Iran has examined by using Granger causality and Vector Error Correction Model. Granger causality results show a unidirectional causal relation between CO_2 emissions and electricity consumption. Also Granger causality results for the CO_2 emissions and industry value added show that there is a casual bilateral relationship between CO_2 emissions and industry value added. But Granger causality test does not show any causal relationship between industry value added and electricity consumption. Also, based on the results of the Johansen test, the long-run impact of electricity consumption on CO_2 emissions is positive, industrialization on Co_2emissions is positive and trade openness degree on CO_2 emissions is negative.

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