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Reinvestigation of Relationship Between Macroeconomic Indexes and Energy Consumption in Iran

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Abstract: In this study attempted to investigation the relationship between energy consumption in economic sectors and macroeconomic indexes of Iran for 1970-2000 by using Vector Error Correction Model (VECM). Result showed that a long run relationship existence between total energy consumption, price index and gross national product. With respect to results stabilization energy price policy in economical growth conditions will encourage energy demand dimension. So, government must change energy price policy towards variable pricing based on amount of consumption especially in peak and load duration.

Key words: Price stability, stationary, economic sectors, cointegration, Iran

INTRODUCTION

Although energy have an important role in economical development and countries welfare, but energy crisis in 1970 decade and high level and unforeseen of energy conveyer prices specially about oil, cause execute limitation policies and saving in energy consumption, as many of industrial countries have leaded toward gradual management of increasing energy consumption (Emadzadeh *et al*., 2002). In the end of 1970 decade and early of 1980 decade relationship between energy consumption and economical growth located in focus point of economical analyzer attention. Therefore in this period many studies have been accomplished about effect of increasing energy price and consequently its consumption limitation on economical growth and study it from different views (Abrishami and Mostafaie, 2000). Marginal energy consumption in year 1958 was equal to 53.4 million oil barrels and in year 1968 this measure increased to 206.9 million barrels oil as annual average having growth equivalent to 14.6%. After Iran revolution and political and economical changes, specially imposed war, energy consumption gently flows its increasing trend and from 199.7 million barrels in year 1969 increased to 331.4 million barrels in year 1979. After obtain liberation oil products consumption in year 1979, again energy consumption become increase fast as in years 1979 to 1983 (across first development program) having a growth equivalent to 5.88%. This growth in 1980-2000 decreased fewly and equal to 3.1%. Masih and Masih (1997) showed that energy consumption for Malaysia, Singapore and Philippines is none related with income but there is an aside relation from energy consumption to GNP for India. Aqeel and Butt (2001) with utilized Granger causality test showed that economical growth is that cause of energy consumption in Pakistan and economical growth cause consumption growth of oil products. About gas part, there isn't a causality relationship between gas consumption and economical growth. In part of power, electronic consumption cause economical growth. But there isn't a reflected effect from gas consumption to economical growth. Chiou-Wei *et al*. (2008) found evidence supporting a neutrality hypothesis for the United States, Thailand and South Korea. However, empirical evidence on Philippines and Singapore revealed a unidirectional causality running from economic growth to energy consumption while energy consumption may have affected economic growth for Taiwan, Hong Kong, Malaysia and Indonesia. In the low income group, there existed no causal relationship between energy consumption and economic growth; in the middle income groups (lower and upper middle income groups), economic growth leads energy consumption positively; in the high income group countries, economic growth leads energy consumption negatively. Jinke *et al*. (2008) discovered that unidirectional causality running from GDP to coal consumption exists in Japan and China and no causality relationship exist between coal consumption and GDP in India, South Korea and South Africa while the series are not cointegrated in USA. The major OECD or non-OECD countries especially China, India and South Africa should reduce their CO_2 emissions in coal

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consumption to reach sustainable development. Although economic growth and energy consumption lack short-run causality, there is long-run unidirectional causality running from energy consumption to economic growth i.e., reducing energy consumption does not adversely affect GDP in the short-run but would in the long-run. Zamani (2007) discovered that there is A long-run unidirectional relationship from GDP to total energy and bidirectional relationship between GDP and gas as well as GDP and petroleum products consumption for the whole economy. Causality is running from value added to total energy, electricity, gas and petroleum products consumption and from gas consumption to value added in industrial sector. The long-run bidirectional relations hold between value added and total energy, electricity and petroleum products consumption in the agricultural sector. The short-run causality runs from GDP to total energy and petroleum products consumption and also industrial value added to total energy and petroleum products consumption in this sector. Fatia *et al.* (2004) showed that in Newzeland there isn't a causality relationship between oil, gas and coal consumption and real gross national product and variables are endogenous toward each other. On the other hands, there is an aside Granger causality relationship from gross national product to total marginal energy consumption and energy consumption in industrial department. According to these studies reveal that their results about causality relationship between energy consumption and economical growth isn't equal which may be resulting of structural, constructional and political changes adopted with countries and difference in research methodology. In addition, using of Engle and Granger (1987) tests utilized have encountered with many criticisms. Time series properties effect on sensitivity of tests. Also, the most of studies suppose that time series data are stationary and because of this result haven't utilized from suitable estimation. The main objective of this study is to find whether in Iran economical growth is a factor for energy consumption or energy consumption can make economical growth field from direct and indirect channels such as increasing total consumption, increasing profitability, promotion efficiency and etc. Therefore, this study tries to find causality relationship between energy consumption in there area: total consumption, housing consumption and commercial consumption and industrial consumption and GNP.

MATERIALS AND METHODS

Theoretical foundation of relationship between total product and energy consumption: Nowadays addition to labor and capital inputs, also energy is propounded as one of important inputs in macroeconomic models. Therefore, production is a function of labor, capital and energy inputs.

$$Q = f(K, L, E) \quad (1)$$

Where:
Q = Total product
K = Capital input
L = Labor input
E = Energy input (Abrishami and Mostafaie, 2000)

Energy input can provide with a collection of factors such as oil, gas, electricity and etc which named energy carrier (Abrishami and Mostafaie, 2000). Pindyck (1979) believed that energy price effect on economical growth depend on energy role in products structure. With his standpoint in industries which energy utilized as an intermediate input in production, price increase and consequently energy consumption decrease, national product will be reduced. While a country want to fallow its growth, in spite of rising in prices and adjusting its economical structure, must concentrate domestic products supply on investment goods which proportionally use less energy. Therefore inside of parts also demand for investment goods and none investment goods cause structural changes and investigations which can reduce energy consumption reserving suitable and lead economic to a side which reduce consumption intensity and increasing efficiency.

Causality concept: Although regression analyzing can study dependence of one variable to other variables, but necessarily don't give causality means. In detail of causality means this question is propounding whether can find a statistically causality relationship between two variables that have regency and primacy. In the answer of this question a test which inclusive estimate below regression defined by Granger (1986, 1988):

$$X_t = \sum_{i=1}^{n} \alpha_i y_{t-i} + \sum_{i=1}^{n} \beta_i x_{t-i} + u_{1t} \quad (2)$$

$$Y_t = \sum_{i=1}^{n} \gamma_i y_{t-i} + \sum_{i=1}^{n} \delta_i x_{t-i} + u_{2t} \quad (3)$$

- If sum of estimated lagged coefficient y_t in Eq. 2 statistically opposed zero ($\Sigma\alpha_i = 0$) and sum of estimated lagged coefficient x_t in Eq. 3 equal zero ($\Sigma\delta_i = 0$) there is a aside causality from y_t to x_t
- If inverse of above condition happened there is causality from x_t to y_t

- If sum of coefficient x_t and y_t in both of regression is statistically significant and opposed zero then two variables are independent

Data of this study for 1970-2000 collected from power ministry statistic yearbook of Iran and to improve results, variables utilized with logarithm form. In this study LTEC means total energy consumption, LREC is housing and commercial energy consumption, LIEC is industrial energy consumption, LGDP is gross national product and LCPI is price index. In this study first with utilized Augment Dickey Fuller (ADF) test for unit root, stationary of variables have studied (Dickey and Fuller, 1979, 1981). Then with utilized Johansen cointegration test (Johansen, 1988, 1992), number of cointegration vectors between variable national product, energy consumption in different parts and price level have studied and side of causality between variables have studied from Granger opinion with utilized three vector error correction models that each of them inclusive one of the energy consumption parts with two variables: national product and price level and according to it, exogenous and endogenous of each variables have estimated. This study is done in Iran in 2007.

RESULTS AND DISCUSSION

According to stationary augment Dickey Fuller test (Table 1) obtained that all variables in their level are non-stationary and in type of first difference are stationary. This means those variables are I (1). In the next step by using of Johansen-Julius, cointegration test (according to λ_{max}, λ_{trace} indexes) have done. In this study three model have studied where each of them include three variables. This test has made for each of pattern. First model including LCPI, LGDP, LTEC, second model including LREC, LGDP, LCPI and third model including LIEC, LGDP, LCPI.

According to Table 2 information, tests results for each pattern show that each of them will have a cointegration vector. After determine number of cointegration vectors for each model, can estimate error correction equations. Error correction equations include short run and error correction component processes. Now, by using Wald test can determine causality relationship between variable separately in each of model. Estimated results of this test showed in Table 3.

Three first column (from left side) show χ^2 statistic about significantly test for summation of lags which

Table 1: Estimated results of stationary test

Variables level	ADF statistic	Critical level	Variables first difference form	ADF statistic	Critical level
LTEC	-1.25170	-2.9907	DLTEC	-3.9489	-2.9907
LREC	-1.53610	-2.9907	DLREC	-5.0688	-2.9907
LIEC	-2.77450	-2.9907	DLIEC	-6.3244	-2.9907
LGDP	2.02670	-2.9907	DLGDP	-4.5633	-2.9907
LCPI	-0.06057	-2.9907	DLCPI	-3.2934	-2.9907

Table 2: Results of determining number of cointegration vectors

Hypothesis H_0	Hypothesis H_1	Statistic measure	Critical measure at 95%	Critical measure at 90%
LTEC, LGDP, LCPI				
Max eigenvalue				
r = 0	r = 1	121.572	25.420	23.10
r≤1	r = 2	17.325	19.220	17.18
Trace				
r = 0	r≥1	144.939	42.340	39.34
r≤1	r≥2	23.366	25.770	23.08
LREC, LGDP, LCPI				
Max eigenvalue				
r = 0	r = 1	15.822	17.681	15.57
r≤1	r = 2	8.408	11.030	9.28
Trace				
r = 0	r≥1	24.420	24.150	21.46
r≤1	r≥2	8.600	12.260	10.25
LIEC, LGDP, LCPI				
Max eigenvalue				
r = 0	r = 1	25.656	22.040	19.86
r≤1	r = 2	10.694	15.870	13.81
Trace				
r = 0	r≥1	45.517	34.870	31.93
r≤1	r≥2	16.860	20.180	17.88

Table 3: Results of Wald test for determining of long and short run causality

	Short run causality					Error correction coefficient	Long run causality				
	dLTEC	dLREC	dLIEC	dLGDP	dLCPI	ECM	dLTEC and ECM	dLREC and ECM	dLIEC and ECM	dLGDP and ECM	dLCPI and ECM
dLTEC				6.260*	4.037*	-0.88*				13.480*	175.200*
dLGDP	0.230				0.3969	-0.034	0.681				0.817
dLCPI	0.024			0.1141		-0.001	0.036			0.125	
dLREC				0.2070	2.820*	-0.872*				9.935*	10.010*
dLGDP		1.76			2.690**	-0.067*		3.225			4.470**
dLCPI		2.65		0.6020		0.101*		6.050*		6.400*	
dLIEC				4.3200*	0.397	-0.273*				37.069*	4.470*
dLGDP			0.122		0.040	-0.064**			2.99		2.607
dLCPI			0.046	0.2880		-0.045			0.80	1.020	

*Significant at 5% level, **Significant at 10% level

actually can say this explain short run causality. Fourth column shows error correction coefficient and it's t-test. Last three columns contemporary consider short run relationship and cointegration vector and its test which can consider as long run causality. According to results revealed that in total energy consumption equation, Null hypothesis based on being zero sum of LPCI and lagged LGDP coefficient has reject in 5% significant level. This matter show that in short run price index and gross national income effect on total energy consumption in Iran and their changes can influence total consumption. According to positive relationship between total energy consumption and these two variables can say that in short run with increasing price indexes or gross national products, total energy consumption increase too. Also, it shows that in long run, price index and gross domestic product are effective factors on total energy consumption. In fact, GDP increase directly through increasing society income and therefore increasing on energy demand. With increasing investigation and therefore increase demand for energy can effect on energy consumption. In equation GDP and CPI in model one observes that none of variables have significant effect on them either short or long run. Therefore, these two variables are weak exogenous for first pattern. This subject show that error correction term is not being significant of each equation. In second model which studied relationship between housing energy consumption, total product and price index, although total product doesn't influence housing and commercial consumption but in long run have effect on housing and commercial consumption. This subject is completely compatible with reality because increasing incomes in long run demand will be increase for energy directly and indirectly. In long run housing and commercial consumption and also gross domestic production measure having significant influence one price index. This event can be consider as a result of inflation pressure of increasing total demand which makes of economical growth and increasing energy consumption in long run. Also prices index in short and long run influence on housing and commercial consumption. In third pattern industrial energy consumption has studied with gross domestic production and prices index. Also in this model total product, either in short or long run takes account as an effective factor on energy consumption in industrial level. This matter show that with increasing domestic product, needed to energy, increased specially on industrial sector. Generally results of this study show that energy consumption in three fields: total consumption, housing, commercial consumption and industrial consumption mustn't receive exogenous from gross domestic production and inflation rate. Energy consumption in Iran haven't key role on gross domestic production and domestic production in Iran mainly depend on other factors which energy consumption is the less important of it rather than other. In fact, these results show to us that about Iran there is aside causality from domestic product to energy consumption. Results of this study confirm results of the most studies. With respect to results, government must do optimum pricing in energy sector in sub sectors of commercial, housing and industrial in parallel to economic growth and increasing of gross national domestic product. This strategy cause optimum management in this area. In other words, energy consumption must not consider exogenous of GDP and inflation rate. In fact, impose stabilization energy price policy in economical growth conditions are not good phenomena and will encourage energy demand dimension. So, government must change energy price policy towards variable pricing based on amount of consumption especially in peak and load duration.

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