International Journal of Academic Research in Business and Social Sciences
January 2013, Vol. 3, No. 1
ISSN: 2222-6990

Oil products Consumption, Electricity Consumption - Economic growth Nexus in the Economy of Iran: A Bounds Testing Co-integration Approach

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Abstract

In this study we investigate the inter-temporal causal relationship among Economic growth, Oil products consumption, Electricity consumption and Price (intermittent variable) during 1973-2006. We employ the Autoregressive Distributed Lag (ARDL)-Bounds Testing approach by Pesaran et al (2001). The result of bounds test shows that there is long run co-integration among economic growth, Price, Oil products consumption and economic growth, Price, Electricity consumption. Also the result shows that there is unidirectional casual effect of Oil products consumption and Electricity consumption on economic growth and the impact of these two variables on economic growth in long run is negative. Hence, waste and deficient of oil product consumption and electricity consumption in long run are a deterrent for economic growth in Iran's economy. Thus, energy saving policies should be selected by policymakers in Iran's economy.

Keywords: Growth, Oil products, Electricity, ARDL

1. Introduction

In the past two decades, the casual relationship between economic growth and energy consumption had been examined in numerous studies, though the direction of the causality relationship remains unresolved. The discussion has focused on whether economic growth affects energy consumption or energy consumption affects economic growth, or whether a bidirectional relationship exists.

Two views are identified in the literature analyzing the relationship between economic growth and energy consumption: the first view include the proponents of energy consumption as a primary means to achieve economic growth. From the perspective of Dunkerley, (1982); Templet, (1999) energy is expected to play a primary role in achieving economic, technological and social progress and to complement capital and labor in production. The second view, suggests that energy is neutral to growth. This is known in the literature as the neutrality hypothesis. According to this hypothesis, the cost of energy and electricity consumption is small proportion of GDP, and so it should not have significant impact on output growth (Yu and, Choi, 1985).

As debated by lee (2005), Narayan and Singh, (2007), when unidirectional causality flows from energy consumption to income, then it implies that an economy is theoretically dependent on energy and therefore energy is a stimulus to growth. Also it implies that a shortage and deficient of energy, possibly, negatively affects economic growth and leads to a decrease in economic growth and employment. On the other hand, if unidirectional causality flows from income to energy consumption, this implies that an economy is not dependent on energy. Hence energy conservation policies may be implemented with no contrary effect on economic growth and employment (Masih, 1996). Also Bi-directional causality, suggests that energy and economic growth complement each other.

The economy of Iran, as a developing country, enjoys rich and widespread energy resources and despite large storage of oil, huge underground mines and huge potential energy, is considered as one of the growth pattern instances with reliance on natural resources. Hence, planning for energy production and consumption has great importance and should be done with great care. As to close relationship between energy consumption (oil products consumption and electricity consumption) and economic growth (figure 1), determining and investigating the relationship between two variables can help to establish effective policies of energy sector.

Therefore in this study, we attempt to consider the inter-temporal causal relationship among oil products consumption, electricity consumption, price and economic growth in Iran's economy. The study uses the recently developed ARDL-bounds testing approach by Pesaran et al, (2001) to examine this connection. In this study in comparison to other studies of Iran's economy, we entered price level as an intermittent variable because of its effects on both energy consumption and economic growth. For example, if price level rises, two effects can be seen: 1- A rise in price level is expected to lead to a fall in energy demand and hence it causes a fall in energy consumption. 2- A rise in prices leads to a fall in demand and therefore causes a contraction in aggregate output. Also a decrease in price level can be survived adversely (Odhiambo, 2010).

The remainder of this paper is organized as the following: Section2 presents a brief overview of energy uses and economic growth in Iran's economy. Section 3 presents a summary of previous literate reviews. Section 4 describes the data sources and the methodology employed respectively. Section 5 investigates empirical results and conclusions are presented in section 6.

2. An overview of energy policies in Iran

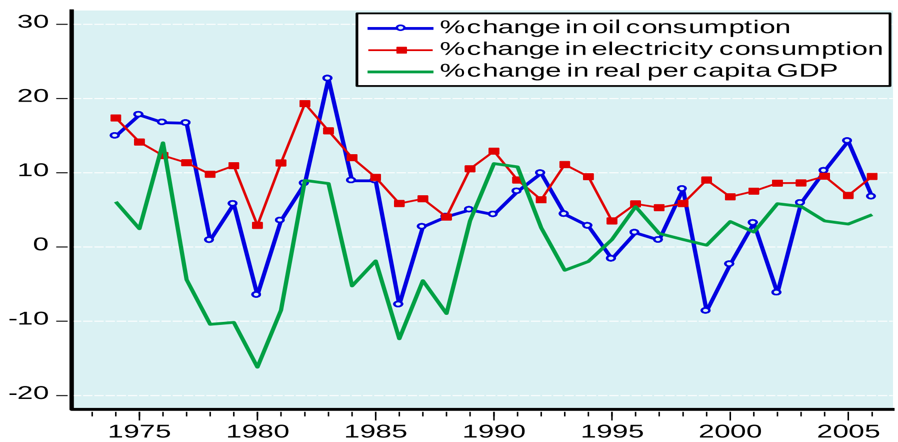
Islamic Republic of Iran is the world's 17th largest country in terms of territory in world and has a population of more than 74 million people. Energy plays an important role in Iran's politics. Iran with possessing huge resources of energy, in particular oil and gas, and also taking advantage of its political and economic geography, has valuable and unique position in the world. It is the fourth producer and exporter of the world' oil and is the second exporter of OPEC' oil. The Iranian government is heavily reliant on oil revenues and they have heavily subsidized the energy industries which figures out to be about 12% of Iran's GDP. The energy consumption in this country is extraordinarily higher than international standards. Iran is one of the most energy inefficient countries of the world, with the energy intensity three times higher than global average and 2.5 times higher than the Middle Eastern average, due to huge energy subsidies. Oil product consumption and electricity consumption are two important sources of energy consumptions in the economy of Iran:

Oil products consumption in Iran is includes: Liquefied Gas, Gasoline, White oil, Gas oil and Fuel oil. During 1995-2006, Oil products consumption has been growing near 3%. Gas Oil and Gasoline have the most share of oil products consumption, as in 2006 the share of Gas Oil and Gasoline consumption were 38.1 and 27.5% of total oil products consumption respectively. Also in this year Liquefied Gas had the least share of total Oil products consumption by 5/4%.Gasoline consumption in 2006 with 12.4 percent reduction in comparison to its previous years, receipt to 23525 million liters. This process was arisen due to Gasoline rationing plan and the increased consumption of Natural Gas and Liquefied Gas in the transportation sector. Transportation sector with more than 99% share is the main Gasoline consumption sector in Iran.

Increase in production and high demand of automobiles in the recent years, high average age of cars and thus their low efficiency, and high fuel consumer vehicles due to low domestic technology used in it, are main reasons for the high consumption of transportation sector. Gas oil is used in different sections. In transportation section to fuel diesel engines, in agriculture section to fuel agricultural machinery and irrigation pumps, in industries section to fuel machinery and industrial equipment and in domestic and commercial section is used for product fuel systems heating and hot water. Transportation sector with a share of about 55.3 percent is the largest Gas Oil consumer in country. In 2006 Gas Oil consumption with 4% growth was compared to previous years receipt to 32689/1 million liters. In the recent years, following alternating policies with more natural Gas instead of Gas Oil in the domestic sector and greater household access to Natural Gas, Gas oil consumption decreased in this section. During 1996-1999 and 2000-2006 average decrease of Gas Oil consumption in domestic section was 9.7% and 11/3 % respectively.

Also today Iran is ranked the 20th largest consumer of electricity and the 19th largest producer in the world. In recent years Iran has put greater emphasis on participation of domestic and foreign investors in electricity generation sector, with projects underway to add 40,000 Million kilowatt hours more capacity to the national Grid. 18.5 percent of electricity generated in Iran is wasted before it reaches consumers due to technical problems. In 2006, total electricity sales of Energy and large Industry has been about 157047.2 MW with respect to previous years its growth is equivalent to 5/6. In this year more than 97/3 electricity consumption has been providing by the Department of Energy and private sector power. Electricity consumption in Iran is divided into several parts: Public, domestic, business industries, transportation, agricultural, etc. In the recent years household section has allocated 33/4 of Country's total electricity consumption. One of the important reasons of electricity consumption growth in this section is the increased consumers of the household sector that has been equivalent to 781000 subscribers. Industry section after household section, with 32/5 of total electricity consumption is the second electricity consumer in Iran. (Energy balance sheet of Iran's economy, department of energy, 2007). The percentage of change of Oil consumption; Electricity consumption and economic growth in Iran's economy during1973-2006 are presented in figure 1.

Figure1:oil consumption, electricity consumption and economic growth during 1973-2006



Sources: Central bank of Iran

3. Literate review

A large number of studies in recent years surveyed the casual relationship between energy consumption and economic growth in Iran and other countries that is shown in table1:

Table1: Previous studies about causality relationship between energy consumption and growth

Author(s)	***Country(Countries)***	***Directional of causation***
Yu and Hwang (1984)	USA	Energy consumption [0] GNP
Cheng (1997)	Brazil, Mexico and Venezuela	Energy consumption [0] Economic growth in Mexico and Venezuela
Glasure (2002)	Korea	Energy consumption ↔ Economic growth
Soytas and Sari (2003)	G-7 countries and emerging markets	GDP → Energy consumption in Italy and Korea
Shiu and Lam (2004)	china	Electricity consumption → GDP
Hatemi-J and Irandoust(2005)	Sweden	Economic growth → Energy consumption
Lee (2005)	Developing countries	Energy consumption → GDP
Narayan and Smyth (2005)	Australia	GDP → Electricity consumption
Tehranchian(2006)	Iran	GDP → Energy consumption
Chen et al. (2007)	Chin, Hong Kong, India, Indonesia, Korea, Malaysia, Singapore, Taiwan and Thailand	GDP ↔ Electricity consumption
Mehrara 2007	Iran, Kuwait and Saudi Arabia	economic growth → Energy consumption in Iran and Kuwait
Mozumder and Marathe(2007)	Bangladesh	GDP → Electricity consumption
Squalli (2007)	11OPEC countries	Electricity consumption ↔ Economic growth in Iran and Qatar
Odhiambo (2009)	Tanzania	Energy consumption → GDP
Odhiambo (2009b)	South Africa	Electricity consumption → Economic growth
Odhiambo 2010	South Africa, Kenya and Congo	Energy consumption → Economic growth in Africa and Kenya
Abbasian, Nazary ,Nasrindoost (2010)	Iran	Economic growth → Total energy consumption

Notes : $\rightarrow$, $\leftrightarrow$ and [0] denote unidirectional causality, bi-directional causality and neutrality (no causality), respectively.

4. Data and methodology

4.1. Data

Annual time series data used in this paper which cover 1973-2006 is obtained from Central Bank of Iran and include: real GDP per capita, consumer price index, total electricity consumption per capita and total oil products consumption per capita.

4.2. Cointegration and Granger non-causality test

In the last two decades, several methods were proposed to investigate the long-run cointegration among time-series variables and are widely used in empirical research. For example univariate cointegration include Engle and Granger (1987) and the fully modified OLS procedures of Phillips and Hansen's (1990). Also multivariate cointegration that had been investigated by Johansen and Juselius (1990), and Johansen's (1996) full information maximum likelihood procedures.

In this study we employ the Autoregressive Distributed Lag (ARDL)-bounds testing approach suggested by Pesaran et al. (2001) to investigate the long-run relationship between variables. ARDL bounds testing approach represented by pesaran et al. (2001), in comparison to other cointegration procedures, such as Engle-Granger (1987), Johansen and Juselius (1990), has several advantages: 1- The short-run and long-run parameters of the model are estimated simultaneously. 2- Some of the cointegration techniques are sensitive to the sample size, but in the small samples, ARDL approach can be appropriate. 3- Inability to test hypotheses on the estimated coefficients in the long-run associated with the Engle-Granger method is avoided. 4- The ARDL approach can be suitable irrespective of the order of integration whether the variables under consideration are purely [I (1)], purely [I (0)] or fractionally integrated. The ARDL model used in the current study is based on the following models:

Model 1- real GDP, consumer price index, oil products consumption

$$\Delta Lngdp_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta Lngdp_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta Lnoil_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta Lnprice_{t-i} + \alpha_4 Lngdp_{t-1} + \alpha_5 Lnoil_{t-1} + \alpha_6 Lnprice_{t-1} + \mu_t \quad (1)$$

$$\Delta Lnoil_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta Lnoil_{t-i} + \sum_{i=0}^{n} \beta_{2i} \Delta Lngdp_{t-i} + \sum_{i=0}^{n} \beta_{3i} \Delta Lnprice_{t-i} + \beta_4 Lnoil_{t-1} + \beta_5 Lngdp_{t-1} + \beta_6 Lnprice_{t-1} + \mu_t \quad (2)$$

$$\Delta Lnprice_t = \gamma_0 + \sum_{i=1}^{n} \gamma_{1i} \Delta Lnprice_{t-i} + \sum_{i=0}^{n} \gamma_{2i} \Delta Lngdp_{t-i} + \sum_{i=0}^{n} \gamma_{3i} \Delta Lnoil_{t-i} + \gamma_4 Lnprice_{t-1} + \gamma_5 Lngdp_{t-1} + \gamma_6 Lnoil_{t-1} + \mu_t \quad (3)$$

And,

Model 2- real GDP, consumer price index, electricity consumption

$$\Delta Lngdp_t = \delta_0 + \sum_{i=1}^{n} \delta_{1i} \Delta Lngdp_{t-i} + \sum_{i=0}^{n} \delta_{2i} \Delta Lnelec_{t-i} + \sum_{i=0}^{n} \delta_{3i} \Delta Lnprice_{t-i} + \delta_4 Lngdp_{t-1} + \delta_5 Lnelec_{t-1} + \delta_6 Lnprice_{t-1} + \mu_t \quad (4)$$

$$\Delta Lnelec_t = \varepsilon_0 + \sum_{i=1}^{n} \varepsilon_{1i}\, \Delta Lnelec_{t-i} + \sum_{i=0}^{n} \varepsilon_{2i}\, \Delta Lngdp_{t-i} + \sum_{i=0}^{n} \varepsilon_{3i}\, \Delta Lnprice_{t-i} + \varepsilon_4 Lnelec_{t-1} + \varepsilon_5 Lngdp_{t-1} + \varepsilon_6 Lnprice_{t-1} + \mu_t \quad (5)$$

$$\Delta Lnprice_t = \theta_0 + \sum_{i=1}^{n} \theta_{1i}\, \Delta Lnprice_{t-i} + \sum_{i=0}^{n} \theta_{2i}\, \Delta Lngdp_{t-i} + \sum_{i=0}^{n} \theta_{3i}\, \Delta Lnelec_{t-i} + \theta_4 Lnprice_{t-1} + \theta_5 Lngdp_{t-1} + \theta_6 Lnelec_{t-1} + \mu_t (6)$$

Here, $Lngdp$ denotes to logarithm of real GDP per capita; $Lnprice$ is the logarithm of consumer price index; $Lnoil$ is the logarithm of oil products consumption per capita; $Lnelec$ is the logarithm of electricity consumption per capita; Δ is the first difference operator and μ the white noise error term.

Examination of the presence of a long-run relationship between the variables of two models is tested by means of bounds testing procedure of Pesaran et al (2001). The bounds testing procedure is based on the F-statistics (Wald-statistics) and is the first stage of the ARDL cointegration method. The asymptotic distribution of the F-statistics is non-standard under the null hypothesis of no cointegration between examined variables. When a long-run relationship exists amongst the variables, the F test indicates which variable should be normalized. The null hypothesis of no cointegration (H_0) and alternative hypothesis of coitegration (H_1) amongst two models and 6 Equation are shown in following tables:

Model 1- real GDP, consumer price index, oil products consumption

	null hypothesis(H_0)	alternative hypothesis(H_1)	Function
Equation (1)	$\alpha_4 = \alpha_5 = \alpha_6 = 0$	$\alpha_4 \neq \alpha_5 \neq \alpha_6 \neq 0$	$F_{Lngdp}(Lngdp \mid lnoil, lnprice)$
Equation (2)	$\beta_4 = \beta_5 = \beta_6 = 0$	$\beta_4 \neq \beta_5 \neq \beta_6 \neq 0$	$F_{Lnoil}(Lnoil \mid lngdp, lnprice)$
Equation (3)	$\gamma_4 = \gamma_5 = \gamma_6 = 0$	$\gamma_4 \neq \gamma_5 \neq \gamma_6 \neq 0$	$F_{Lnprice}(Lnprice \mid lngdp, lnoil)$

Model 2- real GDP, consumer price index, electricity consumption

	null hypothesis(H_0)	alternative hypothesis(H_1)	Function
Equation (4)	$\delta_4 = \delta_5 = \delta_6 = 0$	$\delta_4 \neq \delta_5 \neq \delta_6 \neq 0$	$F_{Lngdp}(Lngdp \mid lnelec, lnprice)$
Equation (5)	$\varepsilon_4 = \varepsilon_5 = \varepsilon_6 = 0$	$\varepsilon_4 \neq \varepsilon_5 \neq \varepsilon_6 \neq 0$	$F_{Lnelec}(Lnelec \mid lngdp, lnprice)$
Equation (6)	$\theta_4 = \theta_5 = \theta_6 = 0$	$\theta_4 \neq \theta_5 \neq \theta_6 \neq 0$	$F_{Lnprice}(Lnprice \mid lngdp, lnelec)$

Two sets of critical *F*-values have been provided by Pesaran*et al*. (2001) for large samples and by Narayan (2005) for sample size ranging from 30 observations to 80 observations. One set assumes that all variables are I (0) and the other set assumes they are all I (1). If the computed F-statistic exceeds the upper critical bounds value, then the null hypothesis of no cointegration (H0) is rejected, that implies to cointegration. If the F-statistic is below the lower critical bounds value, the alternative hypothesis of cointegration (H1) is rejected that implies no cointegration. Lastly if the computed F- statistic falls between the critical lower and upper bounds values, then no conclusion can be reached about cointegration status.

In this stage we need to augment the Granger causality test between variables if we found evidence for cointegration. A time series (X) is said to Granger-cause another time series (Y) if the prediction error of current Y decline by using past values of X in addition to past values of Y. Causality from Y to X can also be defined in the same way. The existence of a long-run relationship between variables does not indicate the direction of temporal causality between the variables; it only suggests that there must be Granger causality in at least one direction. The direction of causality can be determined through the lagged Error Correction term for long-run causality effects. Also the coefficient of the ECM shows the speed of the adjustment back to the long run equilibrium after short run shock. The optimal lag length is selected by the Schwarz Bayesian Criterion or Akaike information criterion (AIC). In our study, tests for Granger causality can be done through following equations:

Model 1-real GDP, consumer price index, oil products consumption

$$Lngdp_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta Lngdp_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta Lnoil_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta Lnprice_{t-i} + ECM_{t-1} + \mu_t \quad (7)$$

$$\Delta Lnoil_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta Lnoil_{t-i} + \sum_{i=0}^{n} \beta_{2i} \Delta Lngdp_{t-i} + \sum_{i=0}^{n} \beta_{3i} \Delta Lprice_{t-i} + ECM_{t-1} + \mu_t \quad (8)$$

$$\Delta Lnprice_t = \gamma_0 + \sum_{i=1}^{n} \gamma_{1i} \Delta Lnprice_{t-i} + \sum_{i=0}^{n} \gamma_{2i} \Delta Lngdp_{t-i} + \sum_{i=0}^{n} \gamma_{3i} \Delta Lnoil_{t-i} + ECM_{t-1} + \mu_t \quad (9)$$

And,

Model 2-real GDP, consumer price index, electricity consumption

$$\Delta Lngdp_t = \delta_0 + \sum_{i=1}^{n} \delta_{1i} \Delta Lngdp_{t-i} + \sum_{i=0}^{n} \delta_{2i} \Delta Lnelec_{t-i} + \sum_{i=0}^{n} \delta_{3i} \Delta Lnprice_{t-i} + ECM_{t-1} + \mu_t \quad (10)$$

$$\Delta Lnelec_t = \varepsilon_0 + \sum_{i=1}^{n} \varepsilon_{1i} \Delta Lnelec_{t-i} + \sum_{i=0}^{n} \varepsilon_{2i} \Delta Lngdp_{t-i} + \sum_{i=0}^{n} \varepsilon_{3i} \Delta Lnprice_{t-i} + ECM_{t-1} + \mu_t \quad (11)$$

$$\Delta Lnprice_t = \theta_0 + \sum_{i=1}^{n} \theta_{1i} \Delta Lnprice_{t-i} + \sum_{i=0}^{n} \theta_{2i} \Delta Lngdp_{t-i} + \sum_{i=0}^{n} \theta_{3i} \Delta Lnelec_{t-i} + ECM_{t-1} + \mu_t \quad (12)$$

It should be noted that only the cointegration vectors in the previous step will be estimated with an error-correction term (Narayan, Singh2007, Odhiambo, 2010).

5. Empirical Results

5.1. Unit root test

Our first purpose is to investigate the unit root properties of the data series. Table 2 and 3 presents the result of Phillips–Perron and Ng–Perron tests on first difference of variables. The ARDL bounds testing approach to cointegration is practicable only in the presence of I (0) or I (1) variables and for I (2) variables the assumption of bounds testing are collapsed. This is because both the critical values of the F-statistics computed by Pesaran et al.(2001) and Narayan (2005) are based on assumption I(0) or I(1) on variables. As table 2 and 3 shows, all variables are stationarity in first difference and null hypothesis of non stationarity was rejected for all variables.

Table2- results of Philips–Perron (PP) unit root test

variables	T statistic	Unit root
D($Lnelec$)	**-4.220****	Stationarity
D($Lngdp$)	**-4.020****	Stationarity
D($Lnoil$)	**-3.568****	Stationarity
D($Lnprice$)	**-3.221*****	Stationarity
critical values	1% level	5% level	10% level
	-3.6537	-2.9571	-2.6174

Note: *** and ** denote significance at 10% and 5% *respectively*

Table3-result of Ng–Perron unit root test

Variables	MZa	MZt	MSB	MPT	Unit root
D($Lnelec$)	-12.5752	-2.4689	0.1963	7.4546	Stationarity
D($Lngdp$)	-12.3860	-2.4798	0.2002	7.4042	Stationarity
D($Lnoil$)	-13.9462	-2.6101	0.1680	6.7068	Stationarity
D($Lnprice$)	- 12.9522	-2.5263	0.19505	7.1372	Stationarity
critical values	MAa	MZt	MSB	MPT	
1%	-13.8	-2.58	0.174	1.78	
5%	-8.10	-1.98	0.233	3.17	
10%	-5.70	-1.62	0.270	4.45	

5.2. Co-integration

Our next goal is to investigate the long run relationship between variables in model 1: economic growth, Price, Oil products consumption and model 2: economic growth, Price, Electricity consumption for Iran's economy, using ARDL bound test approach (Narayan, Singh 2007, Odhiambo, 2010). We have 2 steps in this process: In the first step, the optimal order of lags on the firs difference in Eqs. (1)– (6) is selected based on Akaike information criterion (AIC) and/or Schwarz-Bayesian criterion (SBC) as suggested by Pesaran*et al.* (2001). The optimal lag for models 1 and 2 according to Akaike information criterion (AIC) are 2. In the second step, we applied the bounds F-test in Eqs. (1) – (6), to investigate the long run relationship between variables. The results are reported in table 4 and 5.

Table 4- result of bounds testing for Model 1***: real GDP, consumer price index, oil products consumption***

Dependent variable	Function	F -Statistic		
$Lngdp$	$F_{Lngdp}(Lngdp\|lnoil, lnprice)$	8.6164*		
$Lnoil$	$F_{Lnoil}(Lnoil\|lngdp, lnprice)$	5.2164		
$Lnprice$	$F_{Lnprice}(Lnprice\|lngdp, lnoil)$	1.3865		
Asymptotic critical values	1%		5%	
	I(0)	I(1)	I(0)	I(1)
Narayan (2005), p. 1989, Appendix: Case IV	6.183	7.873	4.267	5.473

Note: * denote significance at 1% level

Table 5- result of bounds testing for Model 2: ***real GDP, consumer price index, electricity consumption***

Dependent variable	Function	F -Statistic		
$Lngdp$	$F_{Lngdp}(Lngdp\|lnelec, lnprice)$	9.4360*		
$Lnelec$	$F_{Lnelec}(Lnelec\|lngdp, lnprice)$	3.6598		
$Lnprice$	$F_{Lnprice}(Lnprice\|lngdp, lnelec)$	1.1938		
Asymptotic critical values	1%		5%	
	I(0)	I(1)	I(0)	I(1)
Narayan (2005), p. 1989, Appendix: Case IV	6.183	7.873	4.267	5.473

Note: *denote significance at 1% level

The result in the model 1 indicates that, co-integration is only present when $Lngdp$ is the dependent variable .This is due to this fact that F-static ($F_{Lngdp}(Lngdp|lnoil, lnprice)$ is higher than the upper bound critical value at 1% critical value and the null hypothesis of no co-integration is rejected. Also in model 2 when $Lngdp$ is the dependent variable ($F_{Lngdp}(Lngdp|lnelec, lnprice)$the F– staticis higher than the upper bound critical value at 1% critical value but when $Lnprice$ and $Lnelec$ are dependent variables the F – static is lower than the lower bound critical value at 5%.

5.3. Long-run coefficient

In this section we present the estimated long run coefficient, using the ARDL approach, when we discovered the long run relationship in model 1"$Lngdp|lnoil, lnprice$" and model 2"$Lngdp|lnelec, lnprice$". As table 6 shows, in the model 1 that $Lngdp$ is dependent variable, all of the coefficients are statistically significant at 5% level. We focus on the long run coefficient of $Lnoil$ variable. The impact of $Lnoil$ on $Lngdp$ in long run is negative as 1 perecent increase in loil lead to -1.4345% decreases in $Lngdp$ for Iran's economy. Also in model 2 shown in table 7, the impact of $Lnelec$ on $Lngdp$ is negative but this coefficient is not significant statistically.

Table 6-Estimated Long Run Coefficients using the ARDL Approach in model 1

Dependent variable $Lngdp$		
variable	Coefficient	T-Ratio
$Lnoil$	-1.4345	-2.7360**
$Lnprice$	0.21331	3.3230**
C	-5.0731	-2.1883**

Note: ** denote significance at 5% level

Table 7-Estimated Long Run Coefficients using the ARDL Approach in model 2

Dependent variable $Lngdp$		
variable	Coefficient	T-Ratio
$Lnelec$	-1.4602	-1.4918
$Lnprice$	0.66124	1.9544***
C	-1.9171	-1.2754

Note: *** denote significance at 10% level.

5.4. Analysis of causality test based on error-correction model

The results of the long run granger causality tests and the short run elasticities are shown in table— as the table has shown, the impact of Oil products consumption and electricity consumption on Per capita GDP in the short run is positive and statistically significant. Also the coefficient of ECM in these equations are negative and statistically significant that implies the long run causality exist from LnOIL and Lnelec to LnGDP. Also in these two equations the coefficient of ECM implies that 20% and 12% of the disequilibria in LnGDP of the previous year's shock adjust back to the long run equilibrium in the current year respectively.

Table 8- Model 1-ARDL (1, 2, 0) selected based on Akaike Information Criterion

Dependent variable	$DlnOIL$	$DlnOIL(-1)$	$DlnPRICE$	$ECM(-1)$	F-Statistic
$DlnGDP$	0.399** (2.347)	0.279 (1.613)	0.043* (4.276)	-0.202* (-3.0916)	10.147*

Note: * and ** denote significance at 1% and 5% level respectively. T-statistic is in parenthesis

Table 9- Model2-ARDL(1,2,0) selected based on Akaike Information Criterion

Dependent variable	$DlnELEC$	$DlnELEC$(-1)	$DlnPRICE$	$ECM(-1)$	F-Statistic
$DlnGDP$	1.309* (4.1428)	0.764** (2.4188)	0.081*** (1.898)	-0.123** (-2.337)	14.4176*

Note: *** , ** and * denote significance at 10% ,5% and 1% level respectively. T-statistic is in parenthesis

5.5. Stability test

In continue, the stability of the estimated models is checked by using cumulative sum (CUSUM) and cumulative sum of squares (CUSUMQ) stability test. This test employs recursive residuals. As the Figure 1, Figure 2, Figure 3 and Figure 4 have shown that all coefficients in the estimated models are stable over the sample period because of the plots of CUSUM and CUSUMQ statistics are within the 95% critical bounds.

Figure 1 cumulative sum of recursive residuals in model1

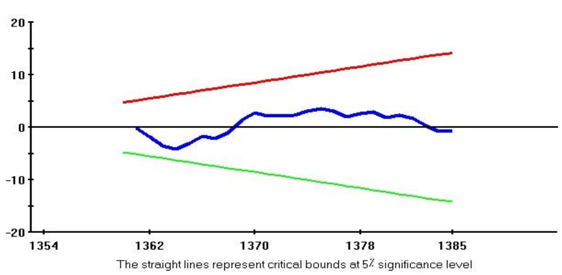


Figure 2 cumulative sum of squares recursive residuals in model 1

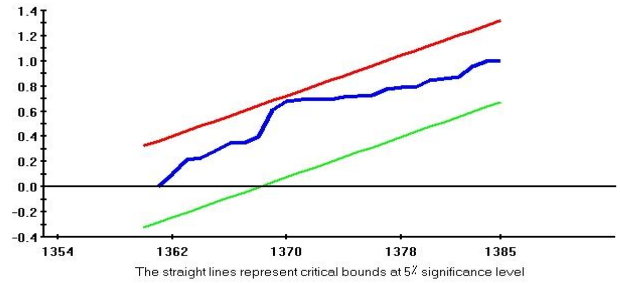


Figure3 cumulative sum of recursive residuals in model 2

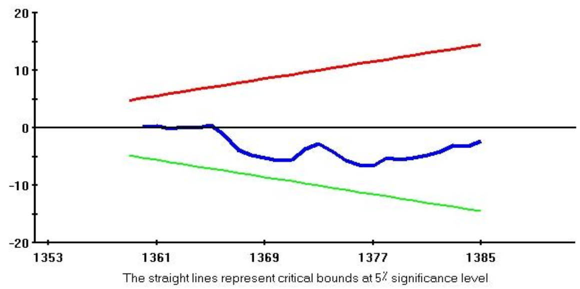
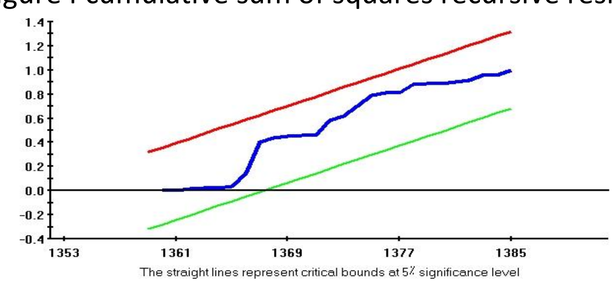


Figure4 cumulative sum of squares recursive residuals in model 2



6. Conclusion

In this study, we investigated the inter-temporal causal relationship between economic growth, oil products consumption and electricity consumption in Iran's economy during 1973-2006. We employed the autoregressive distributed lag (ARDL)-bounds testing approach by Pesaran et al (2001) than other co-integration procedures, such as Engle-Granger (1987), Johansen and Juselius (1990). In this study in comparison to other studies about the economy of Iran we enter price level as an intermittent variable because of its effects on both energy consumption and economic growth. The results show there is unidirectional casual from oil products consumption and Electricity consumption to economic growth in long run. Also the long run coefficient shows that the impact of oil products consumption and Electricity consumption on Economic growth are negative and statistically significant and insignificant respectively. Hence the results expressed that when unidirectional causality flows from oil products consumption and electricity to economic growth, it implies that Iran's economy using inefficient energy consumption and therefore energy is a deterrent to Iran's economic growth. Also it implies that it is likely that an energy saving policy positively affect economic growth and leads to an increase in economic growth because of energy consumption in this country is extraordinarily higher than international standards. Therefore, energy saving policies should be selected by policymakers in Iran's economy to achieve economic growth.

References

Abbasian, E. Nazari, M. Nasrindoost, M.(2010).Energy consumption and Economic growth in the Iranian economy: Testing the causility relationship. Middle-east journal of scientifice reserch 5(5) 374,381

Cheng, B.S. (1997). Energy consumption and economic growth in Brazil, Mexico and Venezuela: a time series analysis. Applied Economics Letters 4, 671–674

Chen, S.-T., Kuo, H.-I., Chen, C. (2007). The relationship between GDP and electricity consumption in 10 Asian Countries. Energy Policy, 35, 2611-2621

Dunkerley, J. (1982). Estimating energy demand: the developing countries. Energy Journal 23, 79–99

Energy balance sheet of Iranian economy, department of energy. 2007

Engle, R.F., Granger, C.J. (1987). Cointegration and error-correction-representation, estimation and testing.Econometrica 55, 251–278.

Glasure, Y.U. (2002). Energy and national income in Korea: further evidence on the role of omitted variables. Energy Economics 24, 355–365

Hatemi-J, A., Irandoust, M.(2005). Energy consumption and economic growth in Sweden: a leveraged bootstrap approach (1965–2000). International Journal of Applied Econometrics and Quantitative Studies 2, 87-98.

Johansen, S., Juselius, K. (1990).Maximum likelihood estimation and inference on cointegration with applications to the demand for money. Oxford Bulletin of Economics and Statistics 52, 169–210.

Johansen, S., 1996 Likelihood-Based Inference in Cointegrated Vector Auto-Regressive Models 2nd edn.Oxford university press.

Lee, C.C. (2005). Energy consumption and GDP in developing countries: A cointegrated panel analysis. Energy Economics, 27, 415-427

Masih, A.M.M., Masih, R. (1996). Electricity consumption, real income and temporal causality: results from a multi-country study based on cointegration and error correction modeling techniques. Energy Economics 18, 165–183

Mehrara, M. (2007). Energy–GDP relationship for oil-exporting countries: Iran, Kuwait and Saudi Arabia. Organization of the petroleum exporting countries

Mozumder, P., Marathe, A. (2007). Causality relationship between electricity consumption and GDP in Bangladesh. Energy Policy 35, 395–402

Narayan, P.K. (2005). The saving and investment nexus for China: evidence from cointegration tests. Applied Economics 37, 1979–1990.

Narayan, P.K., Singh, B. (2007). The electricity consumption and GDP nexus for Fiji Islands. Energy Economics 29, 1141–1150.

Narayan, P.K., Smyth, R. (2005). Electricity consumption, employment and real income in Australia: evidence from multivariate Granger causality tests. Energy Policy 33, 1109–1116.

Ng, S., Perron, P.(2001). Lag length selection and the construction of unit root tests with good size and power.Econometrica 69, 1519–1554

Pesaran, M., Shin, Y. (1999). An autoregressive distributed lag modeling approach to cointegration analysis. In: Strom, S. (Ed.), Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch centennial Symposium. Cambridge University Press, Cambridge.

Pesaran, M., Shin, Y., Smith, R.(2001). Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics 16, 289–326.

Phillips, P. and Hansen, B. (1990). "Statistical inference in instrumental variables regression with I(1) process", Review of Economic Studies, 57, 99-125

Odhiambo, N. (2010). Energy consumption, prices and economic growth in three SSA countries: A comparative study. Energy Policy 38, 2463–2469

Odhiambo, N. (2009). Energy consumption and economic growth nexus in Tanzania: An ARDL bounds testing approach. Energy Policy 37, 617– 622

Odhiambo, N.M. (2009b). Electricity consumption and economic growth in South Africa: a trivariate causality test. Energy Economics 31, 635–640

Shiu, A., Lam, P.L. (2004). Electricity consumption and economic growth in China. Energy Policy 32, 47–54

Soytas, U., Sari, R. (2003). Energy consumption and GDP: causality relationship in G7 countries and emerging markets. Energy Economics 25, 33–37

Squalli, J. (2007).electricity consumption and economic growth: bounds and causality analyses for OPEC members. Energy Economics 29, 1192-1205

Stern, D. (2000) A Multivariate Cointegration Analysis of the Role of Energy in the US economy. Energy Economics 22, 267-283

Tehranchian, A. (2006). On the relationship between Energy consumption and Real GDP in iran: An Application of VEC .Iranian Economic Review 11

Templet, P. H. (1999). Energy, diversity and development in economic systems; an empirical analysis. Energy Policy 30, 223-233,

Yu, E.S.H., Choi, J.Y. (1985). The causal relationship between energy and GNP: an international comparison. Journal of Energy and Development 10, 249–272.

Yu, E.S.H., Hwang, B.K. (1984). The relationship between energy and GNP: further results. Energy Economics 6, 186–199