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Economic Growth and Renewable Energy in Iran

Vahid Mohamad Taghvaee[1], Jalil Khodaparast Shirazi*[2]
Mohamed Amine Boutabba[3], Alireza Seifi Aloo[4]

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Abstract

Energy plays an active role in sustainable development in Iran, both in the sustainable and the development aspects. This study aims to estimate the nexus of economic growth and the renewable energy in Iran during 1981-2012. We employ the Auto-Regressive Distributed Lag (ARDL) model to estimate a log-linear equation. The results suggest that renewable energy consumption is an insignificant driver to economic growth in Iran, accepting the neutrality hypothesis, despite the significantly corresponding effects of capital and labor force. Although Iran concentrates mainly on the non-renewable energies such as oil and gas, it has a high spare-capacity in the renewable energy field. It can be rooted in the focus of governors on the fossil fuel energies rather than the renewable ones. It leads to the negligible nexus of renewable energy and economic growth. In Iran, renewable energy has a passive role in economic growth both quantitatively and qualitatively. The governors should promote this kind of energy to assign a large part of total energy consumption to it.

Keywords: Renewable Energy, Economic Growth, Iran, ARDL.
JEL Classification: Q21, Q28, Q43.

1. Introduction

Generally, energy plays an active role in sustainable development in Iran, both in the sustainable and the development aspects (Shirazi et al., 2011). The renewable energies, specifically, are considered as the

1. Department of Economic Development and Planning, Faculty of Management and Economics, Tarbiat Modares University, Tehran, Iran (v.taghvaee@modares.ac.ir).
2. Department of Economics, Shiraz Branch, Islamic Azad University, Shiraz, Iran (Corresponding Author: jkshirazi@iaushiraz.ac.ir).
3. EPEE, Univ Evry, Université Paris-Saclay, 91025, Evry, France (mohamedamine.boutabba@univ-evry.fr).
4. Department of Economics, Mazandaran University, Babolsar, Iran (a.seifi@stu.umz.ac.ir).

guarantee for the sustainability, notwithstanding its indecisively economic influence on the development. Many believe that the promotion of renewable energy can impede the economic development owing to both the relatively high cost of their generation and the short supply of these energies in Iran (Stram, 2016; Brinkman, et al., 2016). Other researchers, however, claim that the promotion of renewable energies paves the way to new industries, opportunities, and economic activities, stimulating the economic growth (Inglesi-Lotz, 2016).

Economic growth might suffer from the patronizing renewable energies in the demand side due to the relatively high price and deficiency in the supply side of energy economics in Iran. The technology level has not exceeded the threshold to offer renewable energy with reasonable price. In contrast, the price of non-renewable ones is extremely low (Taghvaee and Hajiani, 2014; Taghvaee and Parsa, 2015). It is why the economic activities are not using the renewable energies in a high level, despite their environmental profits (Stram, 2016).

However, renewable energies provide us with not only the new economic horizons to fuel the economic growth but also the sustainability in the economic development. In order to transform the energy sector from the non-renewable sources to the renewable ones, a new infrastructure should be established in the country which provides new economic opportunities for the people, firms, and government. In addition to the infrastructural establishment phase, the maintenance of the structure is another factor accelerating the economic growth (Salim et al., 2014; Taghvaee et al., 2017).

This study aims to estimate the nexus of economic growth and the renewable energy in Iran. This helps the policy-makers how to manage the energy portfolio, considering the economic dimensions since energy as a key production input plays an important role in the economic growth. The flowchart of the study is as follows: section 2 explains the previous researches on this field; section 3 is a review of the renewable energies in Iran; section 4 presents the methodology of study; section 5 describes the data; section 6 shows the findings and results; and the final section is assigned to discussion and conclusion.

2. Literature Review

In general, the studies about energy consumption and economic growth are focusing on four distinctive hypotheses which are explained in the following paragraphs. We specify these hypotheses for analysis of the relationship between renewable energy consumption and economic growth. Furthermore, each hypothesis is tested using various methodologies and different sample economies.

Renewable energy plays a positive role in many dimensions of sustainability (Inglesi-Lotz, 2016; Stiglitz, 2002). It proposes these kinds of energies as the key elements in overcoming the obstacles to sustainable development such as energy insecurity, extinction risk of traditional energy sources, greenhouse gas emissions and other environmental problems, energy price shocks, non-renewable features of oil, natural gas and coals, and so forth. It is why the policy makers with long-term perspective are emphasizing on the increment of renewable energy share (Kocak and Sarkgunesi, 2017). However, it might put a hypothetical question concerning to nexus of renewable energy consumption and economic growth which the researchers claim four contradicting answers to.

These answers provide four testable hypotheses: A) Growth, B) Conservative, C) Feedback, and D) Neutrality. Although the other researchers employed them for energy as a whole including renewable and non-renewable ones (Asafu-Adjaya et al., 2016; Kocak and Sarkgunesi, 2017; Shahbaz et al., 2015; Zoumara, 2012), we describe them more specifically, considering merely the renewable energies, as below:

A) Growth hypothesis: there is a unidirectional causality relationship from renewable energy consumption to economic growth. Renewable energy has a significantly positive effect on economic growth; and the expansionary policies on renewable energy consumption leads to economic growth (Alper and Oguz, 2016; Bilgili, 2015; Bilgili and Ozturk, 2015; Inglesi-Lotz, 2015; Kocak and Sarkgunesi, 2017; Ozturk and Bilgili, 2015). In contrast with the total energy consumption in growth hypothesis, renewable energy consumption might have a negative effect on economic growth due to the increase in cost of energy producing (Marques and Fuinhas, 2012; Yang et al., 2002). We call it as “Anti-Growth” in this study.

B) Conservative hypothesis: there is a unidirectional causal relationship from economic growth to renewable energy consumption. Economic growth affects energy consumption considerably and positively. Based on the hypothesis, economic growth, however, is not affected by renewable energy consumption, neither regarding its share in the total energy consumption, nor considering its quantity in level. (Alper and Oguz, 2016; Salim et al., 2014)

C) Feedback hypothesis: there is a bidirectional causality relationship between renewable energy consumption and economic growth. Each affects another one significantly and positively. (Apregis and Payne, 2010a; Apregis and Payne, 2010b; Apregis and Payne, 2012; Kocak and Sarkgunesi, 2017; Ohler and Fetters, 2014; Shahbaz et al., 2016)

D) Neutrality hypothesis: there is no causal relationship between renewable energy consumption and economic growth. (Alper and Oguz, 2016; Bhattacharya, et al., 2016; Menegaki, 2011; Payne, 2009)

The above mentioned studies are summarized in the table 1. Each study about energy consumption and economic growth is concentrated on one or more hypothesis and each hypothesis, in turn, is tested by various methodologies ranging from Panel cointegration, OLS, FMOLS, Granger Causality, etc. In addition, many deal with one specific country or a group of economies. However, we are focusing on a single country, Iran, due to considering its individual, unique, and exclusive characteristics, especially as an oil-exporting country which the energy sector has a fundamental role in the economy.

Table 1: Summary of the Studies on the Causal Relationship between Renewable Energy Consumption and Economic Growth

Author	Methodology	Period	Sample	Conclusion
Payne, 2009	Toda Yamamoto, Granger causality	1949-2006	USA	Neutrality
Apregis and Payne, 2010a	Panel cointegration, panel FMOLS	1985-2005	OECD countries	Feedback
Apregis and Payne, 2010b	Panel cointegration, panel FMOLS	1992-2007	13 countries in Eurasia	Feedback
Menegaki, 2011	LSDV model, panel GLS	1997-2007	27 European countries	Neutrality
Apregis and Payne, 2012	Panel cointegration, panel FMOLS	1990-2007	80 countries	Feedback
Marques and Fuinhas, 2012	Panel data, Panel corrected standard errors	1990-2007	24 European countries	Anti-Growth

Author	Methodology	Period	Sample	Conclusion
Ohler and Fetters, 2014	Panel cointegration, panel OLS, DOLS, FMOLS	1990-2008	20 OECD countries	Feedback
Salim et al., 2014	Panel cointegration, Pooled Mean Group	1980-2010	OECD countries	Conservation
Bilgili, 2015	Wavelet coherence	1981-2013	USA	Growth
Bilgili and Ozturk, 2015	Panel cointegration, panel OLS and DOLS	1980-2009	G7 countries	Growth
Inglesi-Lotz, 2015	Panel cointegration, fixed effect and pooled estimation	1990-2010	OECD countries	Growth
Ozturk and Bilgili, 2015	Panel cointegration, panel OLS and DOLS	1980-2009	51 Sub-Sahara African countries	Growth
Bhattacharya, et al., 2016	Panel cointegration, panel FMOLS, DOLS, and Dumitrescu-Hurlin causality	1991-2012	38 top renewable energy consuming countries	Growth (in long-term for 57% of the countries) Neutrality (in short-term)
Hamit-Haggar, 2016	Panel cointegration, panel FMOLS, DOLS, DSUR, OLS and bootstrap-corrected Granger	1971-2007	11 Sub-Sahara African countries	Growth
Shahbaz et al., 2016	Panel cointegration, fixed effect, panel VECM	1991Q1-2015Q4	BRICS countries	Feedback
Alper and Oguz, 2016	Panel cointegration, Hatemi-J causality, ARDL	1990-2009	7 New EU-member countries	Mixed results
	ARDL		Bulgaria, Estonia, Poland, Slovenia	Growth
	Hatemi-J causality		Cyprus, Estonia, Hungry, Poland, Slovenia	Neutrality
			Czech Republic	Conservation
Kocak and Sarkgunesi, 2017	Panel cointegration, heterogeneous panel causality	1990-2012	9 black sea and Balkan countries in a panel set	Feedback
			Bulgaria, Greece, Macedonia, Russia, Ukraine	Growth
			Albania, Georgia, Romania	Feedback
			Turkey	

3. Renewable Energies in Iran

This section reviews the status of some renewable energies in Iran such as solar, wind, and geothermal energies summarily.

In absorption and usage of the solar energy, Iran is one of the most capable countries with about 300 sunny days per year covering more than two third of its approximately 2000 km^2 surface and 4.5-5.5 kwh/m^2 average solarization per day, affording the construction of so much solar power station to produce more than 60000 Mega Watt electricity. (Renewable Energy Organization of Iran, 2014)

Based on the data received from 60 nominal capacity of energy production is around 60000 Mega Watt in the wind power stations of Iran. (Renewable Energy Organization of Iran, 2014)

Due to the geographical location of Iran on volcanic belt, it has a great potential for geothermal energy plans. On the basis of projections, Iran has enough storage of geothermal energy to produce more than 200 Mega Watt electricity without any environmental pollution (Renewable Energy Organization of Iran, 2014). Although Iran plays an active role in the non-renewable energies such as oil and gas, it demonstrates a high spare-capacity in the renewable energy field.

4. Methodology

Following the energy economics literature (Payne 2009; Apergis and Payne, 2010a, 2010b and 2012; Ohler and Fetters, 2014; Bhattacharya et al. (2016) economic growth is considered as a function of capital, labor force, and renewable energy in Iran during 1981-2012 which can be seen in the specification written below.

$$Y = f(K, F, R) \tag{1}$$

where Y is economic growth, K is capital, F is labor force, and R is the renewable energy. According to the Cobb-Douglas production function, the log-linear model of the specification is as follows.

$$LY_t = C_t + \beta_1 LK_t + \beta_2 LF_t + \beta_3 LR_t + \beta_4 D + \varepsilon_t \tag{2}$$

where L shows the natural logarithm of the variables, D is the dummy variable, βs represent the coefficients, t is time, $\varepsilon \sim NID(0.\bar{\sigma}_\varepsilon)$ is residuals with the econometric classical properties, no-autocorrelation, normality, and homoscedasticity. These properties are assessed with the diagnostic tests. The other signs were described above.

This study employs the Auto-Regressive Distributed Lag (ARDL) model to estimate the above-mentioned log-linear equation. The most important advantage of this approach is that it can be applied irrespective of whether the regressors in the economic growth equation are at stationary or nonstationary levels, which avoids the well-known pre-testing problems associated with conventional methods. In addition, small sample properties of the ARDL approach are far superior to that of the Johansen and Juselius cointegration technique (Pesaran & Shin, 1999). The ARDL model is as follows.

$$\Delta LY_t = C_t + \sum_{i_1=1}^{l_1} \alpha_{1_i} \Delta LK_{t-i_1} + \sum_{i_2=1}^{l_2} \alpha_{2_i} \Delta LF_{t-i_2} + \sum_{i_3=1}^{l_3} \alpha_{3_i} \Delta LR_{t-i_3} + \sum_{i_4=1}^{l_4} \alpha_{4_i} \Delta LY_{t-i_4} + \beta_{1_j} LY_{t-j} + \beta_{2_j} LK_{t-j} + \beta_{3_j} LF_{t-j} + \beta_{4_j} LR_{t-j} + \varepsilon_t \quad (3)$$

where Δ is the first difference, “i”s and “j”s are the lags, and “l”s are the optimum lags, "$\alpha.\beta$“s are the coefficients, and the other signs were described previously.

What should be done before estimation of the coefficients and statistics is the assessment of the stationarity degree of the variables. This study uses the Augmented Dickey Fuller (ADF) with the null hypothesis of non-stationarity. All the variables are transformed into natural logarithm form before testing the unit root test.

5. Data

In this study, economic growth, capital, labor force, and renewable energy in Iran have a 31-year time series dataset within 1981-2012, all of which are transformed into natural logarithm. The limitation of the time period is due to the unavailability of data. The GDP is the proxy for the economic growth and the Gross Fixed Capital is the proxy for capital, both measured in constant 2005 Rial of Iran in billion Rial, and derived from the economic time series database of the Economic Research and Policy Department of Iran.[1] Employed persons are the proxy for the labor force, derived from the Statistics Centre of Iran. The renewable energy is the proxy for energy, measured in billion barrels of oil equivalent and derived from the Iran Energy Balance

1. A department in the Central Bank of the Islamic Republic of Iran. Available from: http://tsd.cbi.ir/

Sheets of various years. The dummy variable is one for the war years (1981-1988) and zero for the other years. All the mentioned data is delineated in the following line figures.

Figure 1, 2, 3, and 4 display GDP, capital, labor force, and renewable energy consumption in Iran during 1981-2012, respectively. All the time series are in natural logarithm. Their measurements and sources are mentioned in the previous paragraphs. These graphs show that GDP, capital, and labor force are increasing similarly while renewable energy consumption follows a different pattern.

The first three figures illustrate that GDP, capital, and labor force have experienced an upward trend in Iran within 1981-2012. GDP has risen considerably in the span except for the first eight years as the war happened between Iran and Iraq. It has gone upward from about 13 to 14.5 at the end. Similarly, capital and labor force represent the same increasing trends. They have increased from 15 and 9.2 at the first year to just below 16 and 10, respectively. However, the renewable energy consumption has another story.

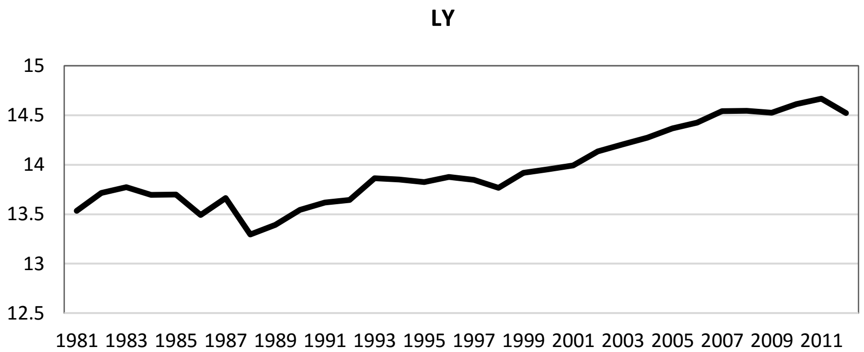


Figure 1: Per Capita GDP of Iran in Natural Logarithm during 1981-2012
Source: Central Bank of Islamic Republic of Iran

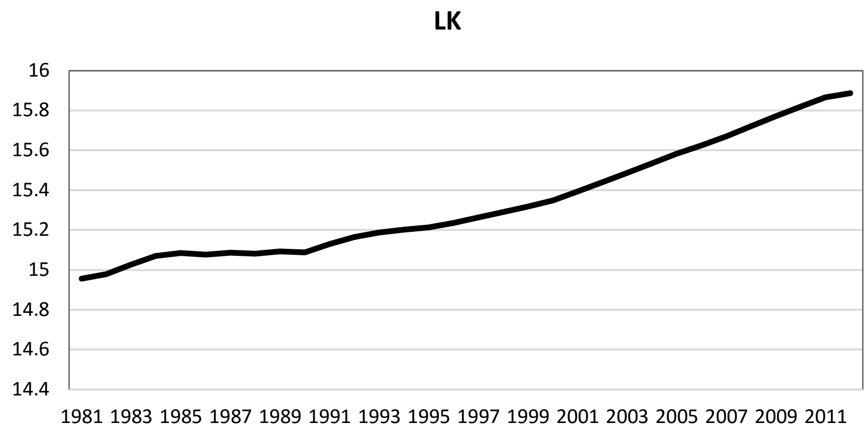


Figure 2: Gross Fixed Capital of Iran in Natural Logarithm during 1981-2012
Source: Central Bank of Islamic Republic of Iran

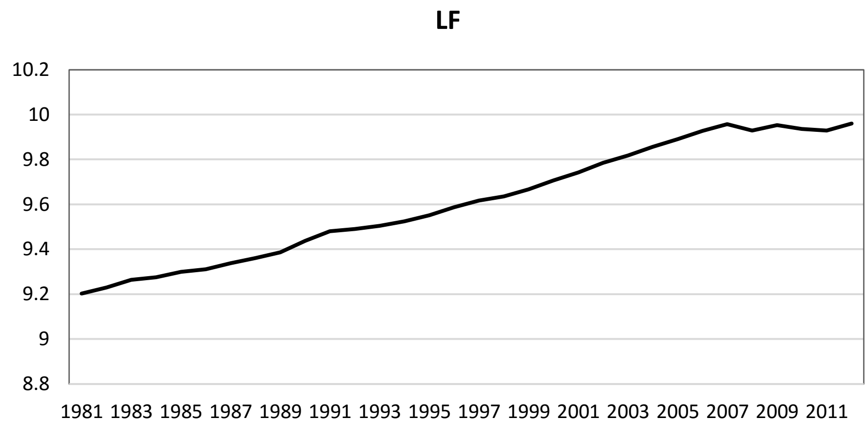


Figure 3: Labor force of Iran in Natural Logarithm during 1981-2012
Source: Statistics Centre of Iran

Figure 4 presents that the renewable energy consumption waxes and wanes slightly, except for the last eight years in which the fluctuation has widened. Although it has increased from 2 at the first year to just above 2.5 at the end of period, it does not show a clear increasing trend. Moreover, it displays significantly low values in comparison with the other variables, as it fluctuates between 1.5 and 3 through the span.

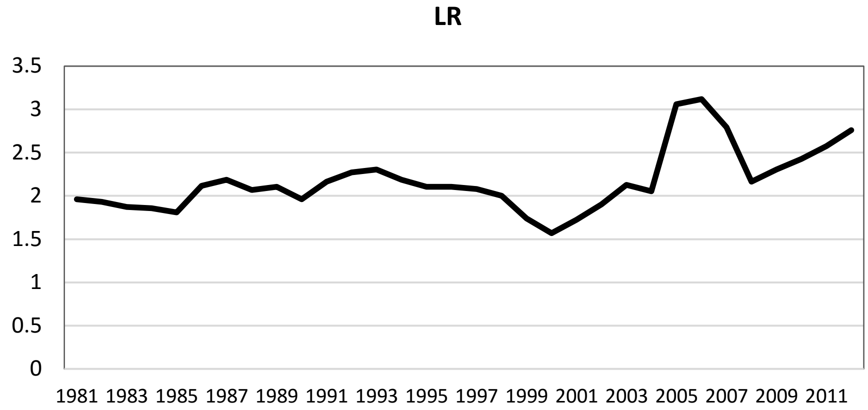


Figure 4: Renewable Energy Consumption of Iran in Natural Logarithm during 1981-2012
Source: Energy Balance Sheets of various years

As a result, capital and labor force can be considered as the inputs, boosting GDP, owing to their direct nexus, while the renewable energy consumption offers a various trend, rejecting its direct relationship with economic growth. Furthermore, the values of capital and labor force are more than three times greater, compared with those of renewable energy consumption which can be interpreted as the insignificant relationship between renewable energy consumption and economic growth in comparison with those of capital and labor force.

6. Results

The first step is to investigate the time series properties of the variables in order to ensure that none of the variable is integrated of order 2 or above. Indeed, ARDL bounds testing approach to cointegration does not allow for variables that are I(2); Table 1 presents unit root test results for each of income, capital, labor force, and renewable energy variables. Based on the critical values, the null hypothesis of a unit root for each variable in level was not rejected while the ADF test procedure applied to the first difference of the data series reject the null hypothesis of non-stationarity for all variables used in this study. With income, capital, labor force, and renewable energy variables best characterized as integrated of degree one, we thus conclude that all the variables used in this study are not I(2).

Table 2: Stationary Tests Results

Variable	Level[a]	L	First Difference[b]	L	Stationarity
LY	-2.311 (0.41)	0	-7.059 (0.00)	0	I(1)
LK	-1.184 (0.89)	1	-4.434 (0.00)	0	I(1)
LF	-2.918 (0.17)	3	-4.240 (0.00)	0	I(1)
LR	-3.020 (0.14)	1	-4.942 (0.00)	0	I(1)

a. The tests include intercept and trend and the parentheses show the probability values.
b. The tests include intercept and the parentheses show the probability values.

Table 2 reports the computed F-value for testing the existence of a cointegration relationships between the variables under the null hypothesis (i.e., with no long-run relationship between the regressors). The F-statistics in Table 2 need to be compared with the critical bounds provided in Pesaran et al. (2001). The outcome of the bounds test critically depends on the choice of the lag order. Thus, we estimate the conditional model Eq. (2) by imposing a maximum of four lags on the model and using Akaike–Information Criterion (AIC) to select the optimum number of lags. The null hypothesis (H0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$) that no long-run relationships between the variables exists is conclusively rejected and the serial correlation-free residuals were achieved when the lag order of 2, as suggested by AIC, were used. The estimated F-statistic was also compared with the critical values extracted from Narayan (2005) who presents two sets of critical values for sample sizes ranging from 30 to 80 observations. The calculated F-statistic F(Y/K, F, R, D) = 5.331 is greater than the upper bound of the critical value obtained from Narayan (2005) or Pesaran et al. (2001) at the 5% level of statistical significance, suggesting that the null hypothesis of no cointegration among variables in Eq. (2) cannot be accepted.

Having verified the existence of a cointegrating relationship between LY, LK, LF and LR established when LY is the dependent variable, we proceed to estimate equation 3. The estimated model outlined here is based on minimizing the AIC information criterion. The derived long-run elasticities resulting from the relationships of equation 3, along with a number of diagnostic tests for the underlying ARDL model are reported in Table 3.

Table 3: Cointegration Test Results

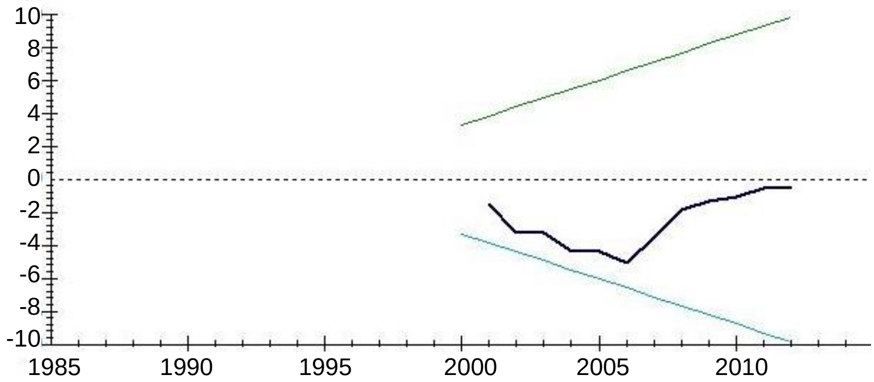
	Critical bounds at 5%		Estimated statistic
	Lower bound I(0)	**Upper bound I(1)**	
Pesaran et al. (2001) Statistics	2.850	4.049[a]	5.331
Narayan's (2005) Statistics	2.947	4.088[a]	

a. Since all the variables are stationary in first difference, only the upper bound is considered as the critical statistic.

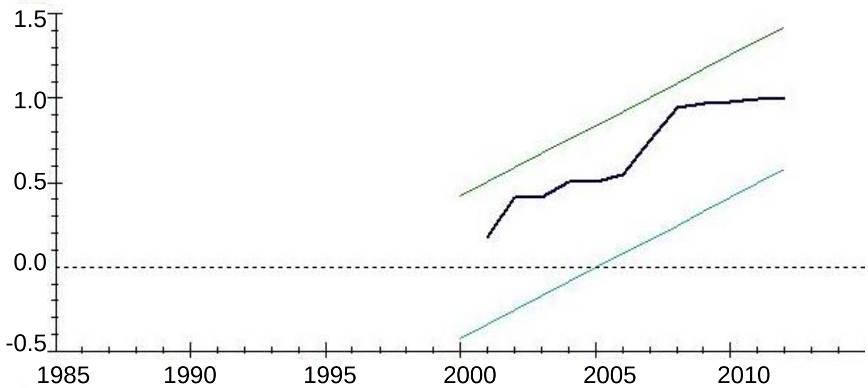
Table 4: Long Run Relationship, Diagnostic Tests, and Explanatory Power of the Model Results

	Variable	Versions	Coefficient	t-statistic	Prob.
Equation estimates	C		-4.255	-3.139	0.00
	LK		0.699	2.955	0.00
	LF		0.738	2.325	0.02
	LR		0.104	1.837	0.07
	D		-0.249	-3.721	0.00
Diagnostic tests	Serial Correlation	LM version		2.175	0.14
		F version		0.750	0.19
	Functional Form	LM version		1.614	0.20
		F version		1.274	0.27
	Normality	LM version		1.182	0.55
		F version		NA	NA
	Heteroscedasticity	LM version		2.492	0.11
		F version		2.535	0.12
Model validity	R squared				0.96
	Adjusted R squared				0.95
	Durbin Watson				1.87
	F statistic (9, 34)			116.693	0.00

The results in Table 3 indicate that real gross fixed capital had a long-run positive impact on income. A 1 per cent increase in real gross fixed capital will lead to a 0.699 per cent increase in income, which is significant at the 1 percent level. On the other hand, a 1 percent increase in labor force will lead to a 0.738 percent increase in income, which is significant at the 5 per cent level. The results in Table 3 also indicate that renewable energy consumption has a long-run positive impact on GDP. A 1 percent increase in renewable energy use will lead to a 0.104 per cent increase in income over the long-run, which is significant at only the 10 per cent level. This finding implies that renewable energy consumption would not be a significant driver to economic growth in the case of Iran.



The straight lines represent critical bounds at 5% significance level.
Figure 5: Plot of Cumulative Sum of Recursive Residuals



The straight lines represent critical bounds at 5% significance level.
Figure 6: Plot of Cumulative Sum of Squares of Recursive Residuals

The diagnostic test results of equation 2 for short-run estimations are also displayed in the bottom of table 3. The Breusch–Godfrey LM test statistic rejects serial correlation for the equation. The RESET test confirms the correct functional form of the equation. The Jarque–Bera statistic confirms the normality behavior of the estimated residuals and the ARCH test confirms that the residuals are homoscedastic. Globally, the battery of diagnostic tests indicates that the model has the desired econometric properties. The high value of R2 for the ARDL model shows that the overall fit was extremely good. The F-statistic which measures the joint significance of all regressors in the model is statistically significant at the1 percent level. Moreover, figures 5 and 6 show the stability of the coefficients through the span which can be considered as another evidence for the reliability of the results. Figure 5 represents the cumulative sum of recursive residuals and figure 6 displays the cumulative sum of squares of recursive residuals. At 5 percent significance, the straight lines are the critical values through which the estimated values are passing. It confirms the stability of the coefficients.

The existence of a cointegrating relationship among income, gross fixed capital, labor force and renewable energy consumption level suggests that there must be causality in at least one direction, but it does not indicate the direction of temporal causality between the variables. To infer the causal relationship between the variables, the Toda and Yamamoto (1995) test for long-run causality was displayed. This approach fits a standard vector auto-regression model on levels of the variables in order to minimize the risks associated with incorrect identification of the order of integration of the respective time series and co-integration among the variables. Toda and Yamamoto (1995) used a modified Wald test (MWALD) that avoids the problems associated with the ordinary Granger causality test (Wolde-Rufael, 2005). The basic idea of the Toda–Yamamoto long-run causality test is artificially augment the correct order of the VAR, k, by the maximum order of integration, d_{max}, and ensures that the usual test statistics for Granger causality have the standard asymptotic distribution.

The causality test results are presented in table 4. The table shows that there was a unidirectional Granger causality running from labor force to income without feedback. In contrast, we found no causality between income and gross fixed capital. In addition, we found no causality running from renewable energy consumption to labor force but we found the opposite unidirectional causality running from labor force to renewable energy use.

The results fail to reject the null hypothesis that renewable energy consumption does not Granger-cause income as well as the null hypothesis that income does not Granger-cause renewable energy consumption. Based on the result, the neutrality hypothesis is accepted about Iran. It suggests that Iranian renewable energy development is not be inclined by income and it has no impact on it. This result is consistent with Payne (2009), Menagaki (2011), Bhattachary et al. (2016), and Alper and Oguz (2016) whose studies show no long-term causality between renewable energy consumption and income for USA, a panel of 27 European countries, a panel of 11 countries, and a panel set of 7 new EU members, respectively. However, this finding contradict, on the one hand, those of Alper and Oguz (2016); Bilgili (2015); Bilgili and Ozturk (2015); Fang (2011) Inglesi-Lotz (2015); Kocak and Sarkgunesi (2017); Marques and Fuinhas (2012); Ozturk and Bilgili (2015); Tiwari (2011); and Yang et al. (2002).as they found long-run uni-directional causality that run from renewable energy to economic growth and, on the other, those of panel data analyses by Apergis and Payne (2010a) (20 OCDE countries); Apergis and Payne (2010b) (13 countries within Eurasia); Apergis and Payne (2012) (a panel of 80 countries); Apergis and Payne (2014) (7 central American countries); Kocak and Sarkgunesi, 2017; Ohler and Fetters (2014) (20 OECD countries); and Shahbaz et al., 2016 who note the presence of long-run bi-directional causality between real income and renewable energy consumption.

Table 5: Toda-Yamamoto Causality Test Results

Causal Flow	Wald Statistic	Prob.	Causal Flow	Wald Statistic	Prob.	Accepted Causal Flow
$LY \rightarrow LK$	0.179	0.30	$LY \leftarrow LK$	2.349	0.30	No causality
$LY \rightarrow LF$	0.375	0.82	$LY \leftarrow LF$	15.724	0.00	$LY \leftarrow LF$
$LY \rightarrow LR$	0.458	0.79	$LY \leftarrow LR$	2.136	0.34	No causality
$LK \rightarrow LF$	1.524	0.46	$LK \leftarrow LF$	9.846	0.00	$LK \leftarrow LF$
$LK \rightarrow LR$	0.837	0.65	$LK \leftarrow LR$	1.521	0.46	No causality
$LF \rightarrow LR$	2.4730	0.06	$LF \leftarrow LR$	3.080	0.21	$LF \rightarrow LR$

7. Conclusion and Discussion

In this study, we estimate the relationship between economic growth and renewable energy consumption in Iran during 1981-2012. Although labor force and capital show significant effect on economic growth, renewable energy has an insignificant effect, accepting the neutrality hypothesis, which can be rooted in the focus of governors on the fossil fuel energies rather than the renewable ones. It leads to the negligible role of renewable energy on economic growth. In Iran, renewable energy plays a passive role in economic growth both quantitatively and qualitatively.

From quantitative perspective, the renewable energy share is too small in the total energy consumption. This small share is incapable to affect the economic growth due to the dominant role of fossil fuel energy. The dominancy is due to the high income earned in the sector leading to a considerable R&D investment in fossil fuel plans. It makes the renewable sector stay passive permanently. The policy makers are advised to develop new strategies to flow the investments into the renewable sector. It makes the sector to inflate as it increases its share in the total energy consumption to be effective in economic growth.

From qualitative point of view, the renewable energy is not consumed in the productive process. Since its price is high, the economic firms are not willing to employ it as an input; instead they use fossil fuel fuels which have comparably lower price. It is another element weakening the effect of renewable energy consumption in economic growth. The authorities are suggested to promote the renewable energy consumption in the energy portfolio of the factories by allocating loans, facilities, discounts in customs tariffs for import of the related technologies and plants.

All in all, renewable energy is ineffective in the economic growth of Iran. Due to the low price of fossil fuel energies, the consumers and producers are not motivated to consider the renewable ones. The governors should promote this kind of energy to assign a large part of total energy consumption to it. As a future study, it is proposed to investigate the relationship between economic growth and different sorts of renewable energies to find those kinds of renewable energies which have more effects on economic growth to select them as the energy type with higher priority for investment.

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