International Journal of Academic Research in Accounting, Finance and Management Sciences
Vol. 8, No. 2, April 2018, pp. 170–177
E-ISSN: 2225-8329, P-ISSN: 2308-0337

www.hrmars.com

To cite this article: Al-Khawaldeh, M., Al-Qudah, A.M. (2018). *The Effect of Energy Consumption on Economic Growth in Jordan,* International Journal of Academic Research in Accounting, Finance and Management Sciences 8 (2): 170-177.

www.hrmars.com
ISSN: 2225-8329

http://dx.doi.org/10.6007/IJARAFMS/v8-i2/3782 (DOI: 10.6007/IJARAFMS/v8-i2/3782)

The Effect of Energy Consumption on Economic Growth in Jordan

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Abstract

This study examined the effect of energy consumption represented by electric and oil energy on economic growth in Jordan for the period of time (1992-2016). The study used the multiple linear regression model to test the hypothesis of the study. The study concluded that the energy consumption in general has a statistically significant effect on economic growth in Jordan, and the study found that the consumption of electric power has a positive and statistically significant impact on economic growth in Jordan, i.e., the increase in consumption of electric power by 1% leads to an increase in economic growth by 1.870686% .The results also showed that oil consumption has a positive and statistically significant impact on the economic growth in Jordan, where the increase of 1% of oil consumption leads to an increase in economic growth by 1.969848%. The study reached a number of recommendations, the most important of which is increasing interest in the energy sector by investing in it and using the best technologies to maintain the positive energy effect on economic growth and work to improve it.

Key words

Economic growth, energy consumption, Jordan

Received: 30 May 2018
Revised: 18 Jun 2018
Accepted: 28 Jun 2018
Published Online: 10 Jul 2018

1. Introduction

Energy is the nerve of modern life. It plays an important role for humanity. Modern civilization has relied on energy with its various resources to transform economic resources from its primary form to other forms of production of goods and services. It is also an important factor in achieving the economic and social well-being of mankind. It is the main engine of industrial and technological progress, in particular and economic progress, in general.

petroleum has been the main source of energy since the beginning of the twentieth century. petroleum is the largest contributor to the production of electric power, which plays an important role in the process of economic and social development. It is the main engine in all economic, social and service sectors. It plays a pivotal role in the growth of any modern economy. Energy is one of the primary inputs in production processes such as raw materials and others.

In the early seventies of the twentieth century there was a strong concentrate on the subject of energy at both the scientific and theoretical levels. Previous studies have focused on the need to determine the nature of the relationship between energy consumption and economic growth; the first study emerged in the United States pioneered by Kraft in 1978, which examined the causal relationship between energy consumption and gross national product (GNP) of the United States. This pioneering work has intensified

the interest of researchers in studying the relationship between energy consumption and economic growth and how to deal with energy as consumer goods or as a productive component. Energy as a consumer commodity has an increasing demand as population increases, technological development and economic growth, and economic scientists have agreed on the importance of energy as one of the modern determinants of economic growth.

Energy is considered as the driving force of all economic activities. Also, Energy consumption goes hand in hand with production since individual consumption of energy is a source of economic growth, and the energy industry in various forms, especially electric and petroleum, has created jobs for a large number of the unemployed. Energy utilization has also improved infrastructure, social and economic activities for societies.

Energy is a major challenge for Jordan because of its lack of domestic sources and dependence on imports, while Jordan needs relatively large amounts of energy for sustainable development and economic growth. Jordan imports about 97% of its energy needs, which mainly includes crude oil, petroleum products and natural gas. Local sources do not contribute more than 3% of Jordan's energy needs. The absence of energy sources in Jordan, such as the oil, exposed the Jordanian economy to shocks and the interruption of energy supplies from abroad, especially after the war of the Republic of Iraq in 2003, since Jordan was getting oil at special prices.

The increase in oil prices during the period (2005-2008) led to an increase in the cost of the energy bill, the increase in the trade deficit, the decline in the economic growth rate, and the increase in the budget deficit. The poor conditions surrounding Jordan. led to the influx of Iraqi and Syrian refugees which caused an increase in energy consumption, in addition to the stopping of Egyptian gas in 2011 led to strong loss to the national electricity company, because the alternative was more expensive. so, Jordan needs large amounts of energy to meet its needs and to stimulate the rate of economic growth.

On the basis of the above problem the purpose of this study is to examine the impact of energy consumption represented by the consumption of petroleum and electric energy on the economic growth in Jordan. The rest of the study is arranged as follow: section 2, literature review, section 3 data and methodology, section 4 empirical analysis and results discussion and section 5 conclusions.

2. Literature review

2.1. Theoretical Literature Review

The world's primary sources of energy, such as fossil fuels, petroleum, natural gas and coal, range from renewable energies such as water, electric, biomass, wind, solar and ocean energy to other energies such as thermal energy and nuclear power (Gawish, 2000).

Energy sources are divided according to the degree of consumption to the main and secondary sources. The main sources are the energy sources that are mainly depended on and contribute significantly to the world's energy consumption. These are oil, coal, natural gas and nuclear power. They represent about 90% of the world's exploited energy, while secondary sources contribute little to the world's energy needs: wind, solar, tidal energy and ocean energy (Ghana, 2016).

World energy consumption refers to the total energy used by all human societies and is usually measured per year. It includes all types of energy for industrial and technological purposes in various sectors of the world (Seghir, 2016).

Energy consumption promotes all human activities and allows for social, economic and technical progress. Energy is consumed in lighting, heating, cooling, health, food, factory operation, industrial production and transport, Energy consumption is therefore a function of economic growth and the growth and progress of countries (Gawish, 2000).

However, when energy is scarce, it imposes restrictions on economic growth, while relative scarcity requires a practical alternative to energy-consuming machinery and equipment. The availability of low-cost energy increases production and is an incentive for investment in capital equipment and labor. Produce more goods and services, and push forward economic growth, which explains the role of the revolution have been constrained by economic growth due to the development of coal consumption methods, which has led to the discovery of new resources such as fossil fuels (Stren, 2010).

Since the production processes are closely related to energy because of what it causes within the production process of treatment, energy is considered as an engine of the economic system because it addresses the inputs to generate production and a drive for the consumption of goods and services. Moreover, it has a great role in technological progress, which leads to the discovery of new sources of energy and find new elements of production and improve production (Gonzalez, 2009), so the inputs of the production process have captured the attention of economists and have seen them as part of the capital.

Most economic and applied studies point to a close relationship between energy consumption and economic growth. Economic growth is moving in the same direction as energy consumption or vice versa. This relationship varies among countries. This relationship varies in the same country from time to time as a result of changes in the determinants of economic growth. The change in energy consumption and its impact on economic growth is due to the change in energy consumption intensity due to technological changes in production processes in various economic sectors, and the change in the level of economic activity. This change is reflected in the final demand for goods and services. In this case, the change in the level of energy consumption includes the change in both direct energy consumption by final consumers and indirect consumption in intermediate sectors (Stren, 2010).

The invention and application of electric power technology led to a third industrial revolution in the world, which brought the world into the age of electricity. Electricity is also the energy that contributes to economic and social development. With technological progress, electricity consumption has increased. This has led to the progress of the global industrial economy and its consumption rate as an indicator for economic growth as electricity consumption does not only improves the quality of life, reduces unemployment and poverty, but also has an active role in the industrial and agricultural sectors and technological progress. Electricity consumption, in turn, enhances industrial and agricultural production, which increases the economic growth rate (Zhang and Shao, 2017). In the framework of development plans aimed at developing electric power and raising its production capacity in light of the continuous development of global consumption from year to year as a vital energy resources.

2.2. Empirical Literature Review

The subject of energy consumption has been the interest of many economists and has emerged from many theoretical and scientific studies, especially on the subject of energy consumption rates and their impact on economic growth rates in different countries of the world, because of the strong

relationship between energy consumption and global economic growth. Some of these studies are presented below.

The study Yosar (2017) empirically analyzed the relationship between energy consumption and economic growth of 119 countries during the period (1970-2015). Using a causal test. It was divided into four groups based on the World Bank's income classification and the main motive is whether the causal relationship varies between different income groups in countries. The results of the study indicate that the causal relationship between energy consumption and economic growth varies from country to country. The results also indicate that the feedback hypothesis is supported by high-, middle- and low-income countries and in the short term support the rationalization hypothesis in high- and middle-income countries. For low-income countries in the short term.

The study of Sama & Tah. (2016) examined the impact of energy consumption on economic growth in Cameroon for the period 1980-2014. The energy resources studied during the study were oil and electricity. The results showed that both GDP, population growth rate and oil prices were in direct relationship with oil consumption. Both the GDP, the population growth rate and the electricity prices were linked to a constant relationship with electricity consumption. The empirical result indicated that inflation and economic growth were positively correlated. Based on the findings of the study, the government recommended expanding existing sources of energy and exploitation of other energy sources such as solar, wind and thermal energy to increase production and consumption of energy to increase economic growth.

The study of Naseem and Khan (2015) investigated the relationship bewteen economic growth and energy consumption in Pakistan based on statistical data for the period (1982-2011). The results of the study indicate that there is a strong relationship between the variables of the study, as if the energy consumption increases one kilo tons of equivalent fuel, the GDP will increase by $ 2.517 million. This result showed the strength of the relationship between economic growth and energy consumption in Pakistan. The study recommended that the Pakistani government should focus on the exploitation of energy resources, which in turn will pave the way for economic growth.

The study of Hammami and Saidi (2014) aimed at measuring the relationship between energy consumption and economic growth in Tunisia for the period (1974-2011) and using the technique of co-integration. The results of the study indicated that there is a long-run relationship between energy consumption and economic growth. The study indicates that the energy policies need to identify the differences in the relationship between energy consumption and economic growth in order to maintain sustainable growth in Tunisia.

The study of Fatai (2014) aimed to reassess the causal relationship between energy consumption and economic growth in 18 sub-Saharan African countries (1980-2011). The causal test results indicate that there is a one-way causal relationship between energy consumption and economic growth in East Africa and South Africa, which supports the growth hypothesis, but there is no causal relationship between energy consumption and economic growth in the central region and West Africa, which is in line with the hypothesis of neutrality.

The study of Ucan, Aricioglu and Yucel (2014) analyzed the relationship between renewable and non-renewable energy consumption by comparison to economic growth and was used by a co-integration analysis conducted on a segment of fifteen European countries in the period 1999-2011. The test of this group of countries provided a long-term equilibrium relationship between real GDP and consumption renewable and non-renewable energy and greenhouse gas emissions.

The study of Onakoya, Salami and Odedairo (2013) aimed to analyze the impact of energy consumption on economic growth in Nigeria for the period (1975-2010). Time series data were analyzed through co- integration. Energy consumption has had a positive impact on Nigeria's long-term economic growth. The results revealed that oil and electricity consumption has a positive impact on economic growth and that gas consumption and coal consumption have no impact on economic growth.

The study of Apergis and Payne (2009) aimed to analyze the relationship between energy consumption and economic growth during the period (1980-2004) for segmental data for six Central American States: El Salvador, Costa Rica, Guatemala, Honduras, Nicaragua and Panama. The results of the study indicate that there is a positive relationship between economic growth, energy consumption, labor forces and capital formation. The increase of 1% in energy consumption leads to a 0.28% increase in gross domestic product (GDP). The results showed a positive relationship in the short and long term from energy consumption to economic growth, which means supporting the growth hypothesis and the impossibility of using energy conservation policy.

The previous studies examined the effect of energy in various forms of electricity, petroleum and renewable energy on the economic growth in many countries of the world and found that energy in all its forms and in general have a positive and statistically significant impact on economic growth, except for some countries where consumption rates are low. In general energy didn't have neutral effect.

The current study is intended to provide additional proof of the impact of oil and electric power consumption on economic growth in Jordan. at the best known of the study, this study is considered the first to examine the impact of energy consumption on economic growth in Jordan.

3. Methodology of research

3.1. Data

The study was based on the data base of the Central Bank of Jordan in obtaining data on GDP and on the reports of the Ministry of Energy and Mineral Resources of Jordan and the reports of the International Energy Agency and the World Bank in obtaining data on Jordan's consumption of oil energy and electricity energy.

3.2. The Model

This study used econometrics analysis methodology to test the hypotheses of the study by applying the following multiple linear regression model, based on Sama & Tah study (2016).

$GDP = \beta_1 + \beta_2 PC + \beta_3 EC + Ui$

Gross domestic product (GDP), petroleum consumption (PC), Electricity Consumption (EC), β_1, β_2, β_3 (parameters), Ui (error term).

3.3. Study Variables

Gross Domestic Product: It is the sum of the added values of all production units operating in different sectors of production in a given economy, such as agriculture, mining and industry, where the added values to a certain production unit represent the difference between the total production value of this unit and the value of intermediate goods and services used in that production.

Petroleum Consumption: It is the total petroleum derivatives used by households, companies, establishments and industries in a given period of time and is measured in barrels (Sama and Tah, 2016).

Electricity Consumption: Electricity consumption is defined as the total electricity used by households, enterprises and industries in a given period of time and measured in kilowatt per hour or per million tons of oil equivalent (Sama and Tah, 2016).

3.4 Study Hypotheses

The study examines the following null hypotheses:

Hypothesis 1: There is no statistically significant effect of the rate of energy consumption on the Jordanian economic growth.

Hypothesis 2: There is no statistically significant effect of the rate of oil consumption on the Jordanian economic growth.

Hypothesis 3: There is no statistically significant effect of the rate of electricity consumption on the Jordanian economic growth.

4. Empirical Analysis and Results Discussions

4.1. Unit Root Test/Stationary Test

In order to test the stability of the time series of the study variables, both the Augmented Dickey Fuller test (ADF) and Phillips-Perron (pp)test were used to ascertain the stability of the time series. The non-stability of the time series results in false regression results. Thus, the two tests were carried out for the study variables at the level. Table 1 shows that all variables are not stationary at the level and the first difference. The value of both tests is greater than 5%. Thus, we accept the null hypothesis that states that there is a unit root (time series is not stationary) for the study variables and then re-test, and after taking the second difference found through tests (Augmented Dickey Fuller test (ADF) and Phillips-Perron(pp)) and from the probability value which were less than 5% for both tests, thus rejecting the null hypothesis and accepting the alternative hypothesis that states that there is no unit root or the time series of the study variables are stationary.

Table 1. Phillips-Perron(pp) (PP) and Augmented Dickey Fuller test (ADF)

Variable		ADF	PP	Result
PC	Level	0.1788	0.3666	Not stationary
	1st difference	0.0276	0.1229	Not stationary
	2nd Difference	0.000	0.000	stationary
EC	Level	0.9875	0.9999	Not stationary
	1st Difference	0.3057	0.0999	Not stationary
	2nd Difference	0.0243	0.000	stationary
GDP	Level	0.8230	0.9997	Not stationary
	1st Difference	0.6317	0.2075	Not stationary
	2nd Difference	0.000	0.000	stationary

4.2. Multicollinearity Test

Before the multiple regression procedure, it is necessary to ensure that there is no high correlation between the independent variables. Table 2 shows the correlation results between the independent variables, where the results show that there is no high correlation between the independent variables.

Table 2. Pearson correlation coefficient results between independent variables

	Petroleum Consumption	Electricity Consumption
Petroleum Consumption	1	-0.42
Electricity Consumption	-0.42	1

4.3. Autocorrelation Test

The Breusch-Godfrey test was used to ensure that there is no autocorrelation between the errors. from Table 3. The probability value, which is greater than 5%, shows no auto-correlation between the errors.

Table 3. Results of Autocorrelation Test

Breusch-Godfrey Serial	Correlation	Probability
F-Statistic	2.5412	0.3214
Obs-R-Square	5.1021	0.1678

4.4. Heterogeneity Test

The Breusch-Pagan-Godfrey Test was used, where the results in Table (4) and the probability value, which is greater than 5%, shows the acceptance of the null hypothesis that states the homogeneity of variance of errors.

Table 4. Results of the Heterogeneity Test

Heteroskedaticity Test	Breusch-Pagan-Godfrey	Probability
F-Statistic	4.7691	0.230
Obs-R-Square	4.9854	0.151
Scaled Explained	0.5346	0.632

4.5. Normality Distribution Test

The tests of Kolmogorov-Smirnov and Shapiro-Wilk were used to determine if the data obtained from the study sample were distributed normally or not. Kolmogorov-Smirnovo and Shapiro's test showed that the data follow the normal distribution, as shown in Table 5, and the probability value, which is greater than 5% for both tests, and thus accept the null hypothesis that the distribution of data follows normal distribution.

Table 5. Normal Distribution Test Results

Test of Normality	Kolmogorov-	Simirnov	Shapiro-Wilk	
	Statistic	Sig.	Statistic	Sig.
Electricity Consumption	**0.07**	**0.200(*)**	**0.935**	**0.243**
Petroleum Consumption	**0.154**	**0.197**	**0.795**	**0.372**
Economic Growth	**0.235**	**0.186**	**0.876**	**0.356**

4.6. Co-Integration Test

The results in Table 6 indicate that there is no co-integration between the study variables according to Max Eigen Value Test, and Trace Test. Therefore, the results of the co-integration test indicate that there is no long-term equilibrium relationship between the variables of the study, that is, they do not show similar behavior in the long run.

Table 6. Co-integration Test

Number of vectors integration	Eigen Value	Trace Statistic	Critical Value 5%	Max Eigen Value	Critical Value 5%
None	0.54	27.90	29.79	18.07	21.13
At Most 1	0.34	9.83	15.49	9.62	14.26

Trace Test indicate no co integration at the 0.05 level

Max-Eigen value test indicates no co integration at the 0.05 level

4.7. Multiple linear Regression Results

Table (7) shows the results of the multiple regression. The table shows a significant effect of petroleum consumption on economic growth. The coefficient of petroleum consumption effect, is 1.969848, i.e., with the remaining of the other factors fixed, 1% of the change in petroleum consumption leads to 1.969848% change in economic growth, thus rejecting the first null hypothesis (there is no statistically significant effect at the level of (α ≤0.05) for petroleum consumption in economic growth, and accepting the alternative hypothesis that there is a statistically significant effect of petroleum consumption in economic growth, The high standard of living of citizens leads to an increase in the demand for cars, machinery and equipment that depend on their work on petroleum consumption, which leads to increased production, investment, employment and income and thus increase economic growth. The study result is consistent with results of (Onakoya, Salami and Odedairo, 2013; Sama & Tah, 2016).

For the electricity consumption variable , the table shows a significant effect on economic growth. The coefficient of the variable electricity consumption is 1.870686%. In other words, the increase of 1% in electricity consumption leads to an increase in economic growth by 1.870686% Thus, the second hypothesis is rejected (there is no statistically significant effect at (α ≤0.05) level of electricity consumption on economic growth), and acceptance of the alternative hypothesis that there is a statistically significant effect of electricity consumption on economic growth. This is due to the fact that the increase in electric consumption resulting from increased demand for goods and services whose production or consumption depends on electric power leads to increased production of goods and services, investment, employment and increased income, which reflects positively on economic growth . The study result is consistent with results of (Onakoya, Salami and Odedairo, 2013; Sama & Tah, 2016).

As shown by the value of the adjusted determinant coefficient, that 97% of the changes in economic growth are due to both petroleum consumption and electricity consumption, as evidenced by the value of F and its significance that the model is valid for measuring the causal relationship between the independent variables and the dependent variable.

Table 7. Multiple Linear Regression Results

		Dependent	Variable:	GDP
		Method:	Least Squares	
		Date: 30/10/17	Time:19:39	
		Sample: 1992	2016	
Prob.	T-Statistic	Std. Error	Coefficient	Variable
0.0009	-3.845169	1537.843	-5913.266	C
0.0000	17.25704	0.108401	1.870686	EC
0.0116	12.82996	0.153535	1.969848	BC
404.0778	F- Statistic		0.973499	R-Squared
0.0000	Prob.	(F-Statistic)	0.971090	Adjusted R-Squared

5. Conclusions

The objective of the current study is to examine the impact of energy consumption on economic growth in Jordan**.** The study used the multiple linear regression model to examine the study hypotheses. The results of the regression indicates that there is a positive and significant effect of the consumption of petroleum on economic growth, where the coefficient of petroleum consumption is 1.969848%, meaning that the increase by 1% of the petroleum consumption leads to 1.969848% increase in economic growth.

This result is consistent with the results of the study (Onakoya, Salami and Odedairo, 2013; Sama & Tah, 2016).

The results also, show that the electricity consumption has a positive and statistically effect on economic growth of Jordan since the coefficient of electricity consumption is 1.870686, i.e., an increase of 1% in electricity consumption leads to an increase in economic growth by 1.870686%,.This result is consistent with the findings of(Onakoya, Salami and Odedairo, 2013; Sama & Tah, 2016).

This is due to that the Energy is the driving force for all economic activities and to the fact that energy in its various forms, especially petroleum and electricity, is an essential resource in the economy, in which economic activity requires energy. Accordingly, economic growth is directly related to energy consumption since the increase in energy consumption increases economic growth.

The value of the adjusted R Square is 97% this means that 97% of changes in economic growth are due to both the consumption of petroleum and the consumption of electricity, As shown by the value of the F and its probability, the model is useful for measuring the causal relationship between the independent variables and the dependent variable. The results of the study are consistent with the growth hypothesis.

The implication of the study is that the results showed that there is a positively and statistically significant effect of the energy consumption represented by petroleum and electricity consumption. Therefore, if the decision makers and those who are interested in increasing the economic growth, they can increase economic growth by increasing energy consumption, especially in the productive and service sectors. The study recommends further studies on the impact of renewable energy consumption in various forms generated by solar, wind and tidal energy on the economic growth of Jordan.

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