AMERICAN UNIVERSITY OF BEIRUT

TESTING CAUSALITY BETWEEN ENERGY CONSUMPTION AND ECONOMIC GROWTH IN 15 ARAB COUNTRIES

by
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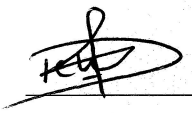

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AN ABSTRACT OF THE THESIS OF

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Economic growth is a goal for each and every country, and countries nowadays are searching for various methods to develop their economies. Energy consumption could be an appropriate instrument; yet at the same time, energy is a significant source of greenhouse gases (GHG) emissions. This raises interest on the ongoing debate about economic growth and energy consumption nexus. Arab countries including Algeria, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, and United Arab Emirates were investigated over the years 1980-2010 on annual time series data to check for the direction of causality using Granger causality tests after employing unit root tests and cointegration tests when needed. Results of this study showed that there is no causation between energy consumption and economic growth in Algeria, Egypt, Libya, Morocco, Sudan, Syria, and the United Arab Emirates. However, there is a unidirectional causality running from economic growth to energy consumption in Bahrain and Tunisia supporting the conservation hypothesis. Nevertheless, it was found that energy consumption drives economic growth in Jordan, Oman, Qatar, and Saudi Arabia in line with the growth hypothesis. Besides, in those countries authorities must be cautious about implementing energy conservation policies since they would retard growth. Nonetheless, in Kuwait and Lebanon evidence of bidirectional causality was present in favor of the feedback hypothesis.

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CHAPTER I

INTRODUCTION

Economic growth is a goal for each and every country, and countries nowadays are searching for various methods to develop their economies. Energy consumption could be an appropriate instrument; yet at the same time, energy is a significant source of greenhouse gases (GHG) emissions. Arab countries including Algeria, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, and United Arab Emirates ratified the Kyoto protocol which mandates limiting GHG emissions. It is important to note that in the mentioned countries, the last entry into force of the protocol was in Lebanon in the year 2007 (Status of Ratification of the Kyoto Protocol). As a result, Arab countries had to make much more effort in applying energy conservation policies and limiting the emission of greenhouse gases which was way harder for countries where energy consumption was found to make the economy prosper. This raises interest on the ongoing debate about economic growth and energy consumption nexus and whether the implemented policies hinder economic growth or not in the Arab world.

Causal relationship between energy consumption and economic growth can be grouped into four categories (hypotheses). The first one is the neutrality hypothesis which negates the causation between GDP and energy consumption. The second hypothesis is the conservation hypothesis which implies the existence of unidirectional causation from economic growth to energy consumption. In those two types, implementing energy conservation policy is not considered as a major drawback.

Contrary to the latter hypothesis is the growth hypothesis which states that a unidirectional causation takes place from energy consumption to economic growth. In this case, energy leads growth and is believed to act as an essential input of production complimenting the three basic factors of production: land, labor, and capital, since the last two factors can't run without energy (Eddrief-Cherfi and Kourbali, 2012). Nonetheless, it is important to mention here that energy is considered as a limiting factor to economic growth; and if austere conservation policies were applied in a country or negative shocks occurred to energy supply, this would lead to drastic effects on the country's economy. The final hypothesis is the feedback hypothesis which indicates the existence of bidirectional causality between energy consumption and GDP (Ozturk, 2010).

In attempt to see a clear overview of GDP per capita and energy per capita and assess whether there is a link between them, we grouped the chosen countries according to geographic regions: countries of the Gulf Cooperation Council also known as GCC countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates) which are considered oil-exporting countries and where forty percent of known crude oil reserves is located (Al-Iriani, 2006), Mashriq countries (Jordan, Lebanon, and Syria), and North African countries (Algeria, Egypt, Libya, Morocco, Sudan, and Tunisia). Figures 1, 2 and 3 show an overview of GDP per capita over the period 1996-2010 (except for Libya from 1999 and for Syria till 2007 due to lack of data). Figures 3, 4 and 5 show the time series trend of energy consumption per capita for the same years too. It is clear that GCC countries recorded highest GDP per capita values as well as energy consumption per capita values which could justify the current energy policies that will be stated afterwards for most countries.

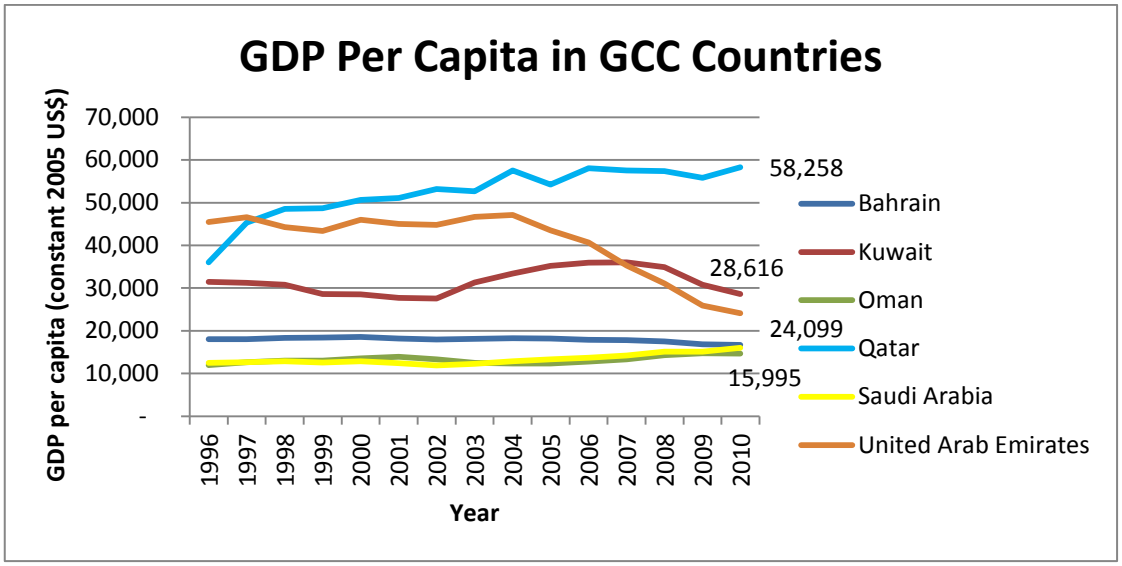

Fig.1. GDP Per Capita in GCC Countries (1996-2010)
Source: World Bank.

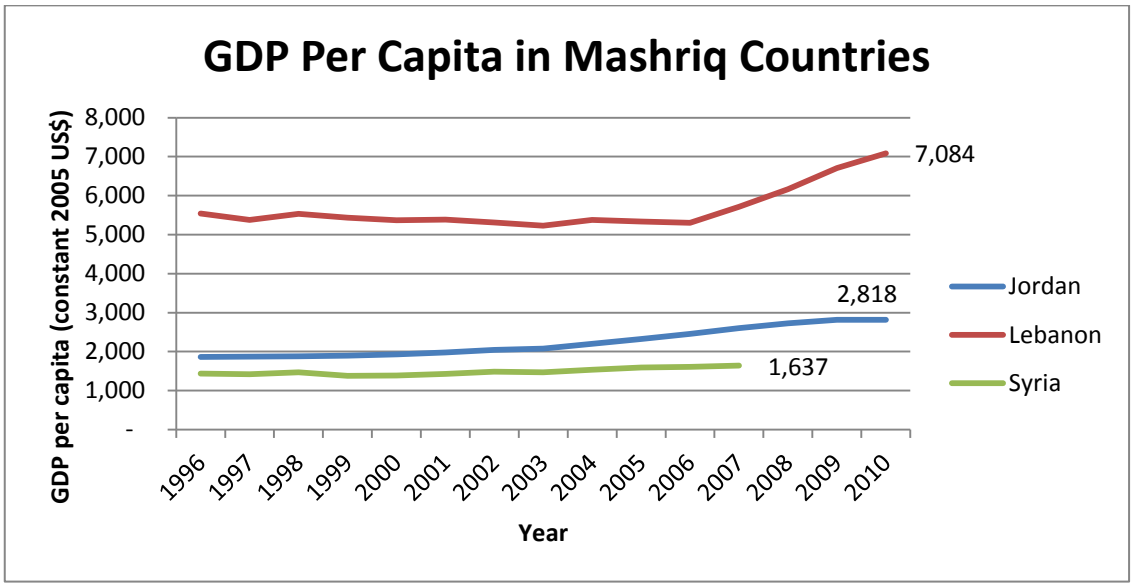

Fig.2. GDP Per Capita in Mashriq Countries (1996-2010)
Source: World Bank

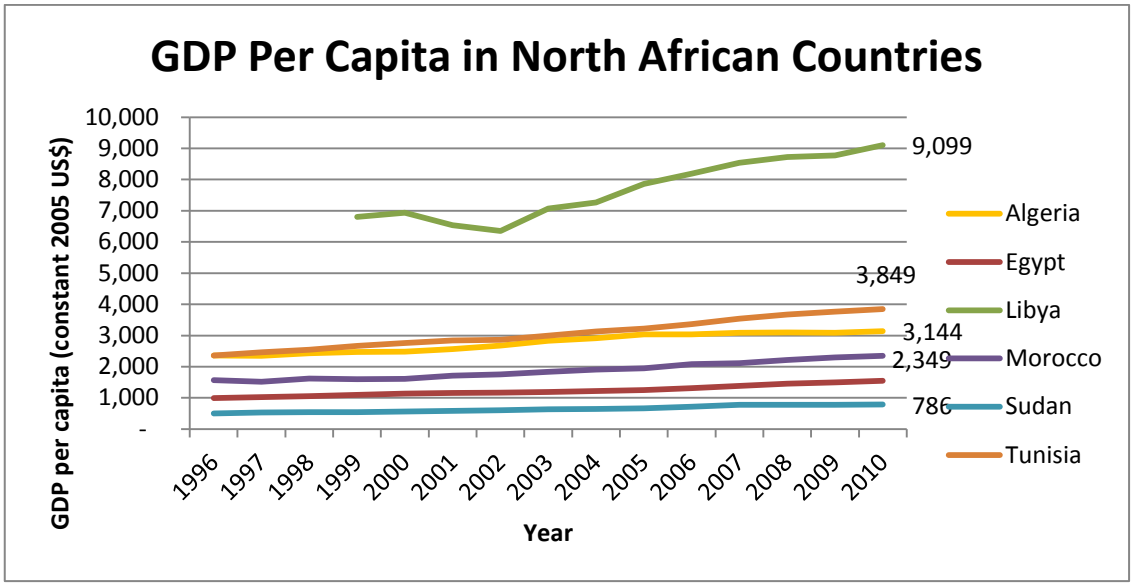

Fig.3. GDP Per Capita in NA Countries (1996-2010)
Source: World Bank.

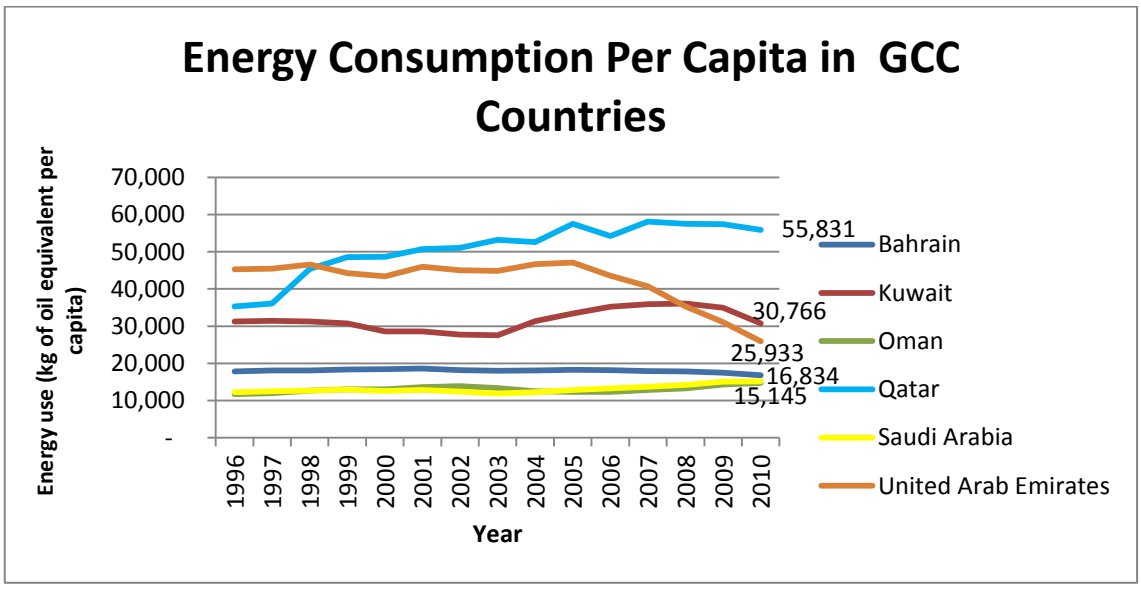

Fig.4. Energy Consumption Per Capita in GCC Countries (1996-2010)
Source: World Bank.

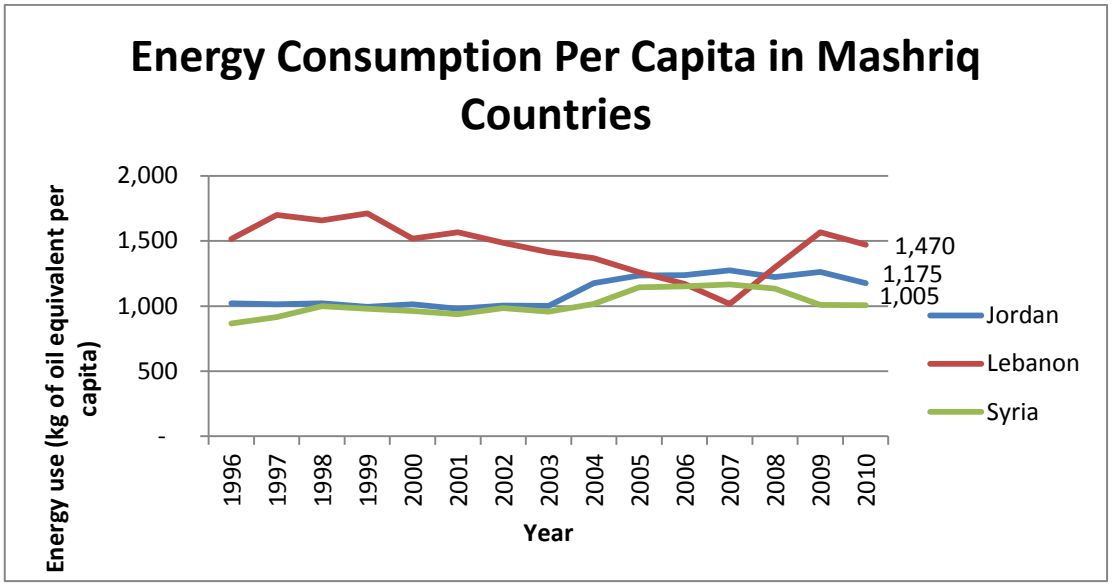

Fig.5. Energy Consumption Per Capita in Mashriq Countries (1996-2010)
Source: World Bank.

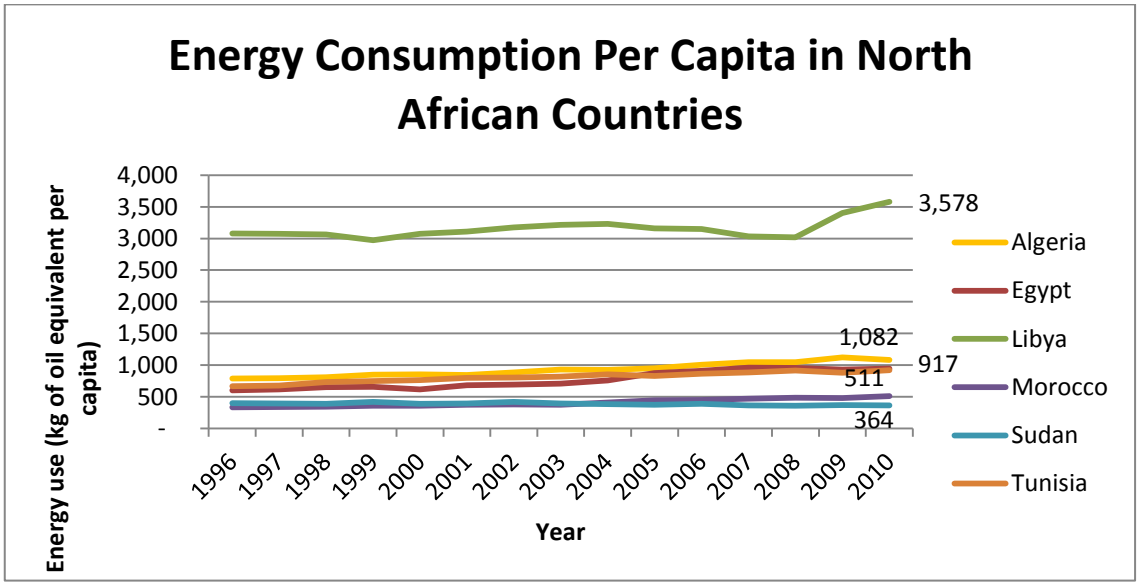

Fig.6. Energy Consumption Per Capita in North African Countries (1996-2010)
Source: World Bank.

In order to check for causality between energy consumption and economic growth, time series empirical methods for individual countries will be implemented on annual data. In what follows, chapter II of this thesis presents a literature review on energy-gdp nexus. Chapter III clarifies the methodology used. Chapter IV presents the

data and reports empirical results. Finally, chapter V provides a conclusion along with policy implications.

CHAPTER II

LITERATURE REVIEW

Many studies examined energy-gdp nexus and results differed for selected countries. Moreover, available literature on this subject shows that even for the same country conflicting results were found.

Kraft and Kraft (1978) paved the way for the study of energy consumption-growth nexus where the case of USA was analyzed for the time period 1947-1974 through using Granger causality technique. Their results yielded unidirectional relationship from economic growth to energy consumption. On the other hand, Payne (2009) analyzed the case of USA as well from the year 1949 to 2006 by employing Toda-Yamamoto causality tests and concluded that there is no relation between energy consumption and economic growth supporting the neutrality hypothesis. This shows that empirical results are still controversial and mixed. Moreover, Lee and Chien (2010) examined the nexus for G-7 countries (United States of America, United Kingdom, Germany, France, Italy, Canada, and Japan) on annual data from 1960 till 2001 except for Germany (1971 till 2001) and Canada (1965 till 2001); and by expressing the variables in natural logarithms, testing for unit roots, then applying Granger causality test which was developed by Toda and Yamamoto they inferred that economic growth doesn't cause energy consumption and vice versa in USA in line with Payne's findings. In the same study, this was also true for Germany. As for France and Japan, both supported the conservation hypothesis; so energy conservation policies are viable in them. However, the United Kingdom, Italy and Canada were found to support the growth (energy-led) hypothesis.

Nevertheless, conflicting results were found for India too. Paul and Bahattacharya (2004) applied Granger causality test combined with Engle-Granger cointegration technique for India over time series data spanning the years 1950 till 1996 and the results were in line with the feedback hypothesis. It is noteworthy to mention that the case of India was of interest because economic reforms were being undertaken since 1991 to quadruple economic growth and eradicate poverty and unemployment. Other studies have tackled the causality between economic growth and energy consumption for India but Paul and Bahattacharya's outcomes weren't confounded with them. For instance, Cheng (1999) through applying Johansen-Hsiao's form of Granger causality for energy consumption and GDP growth over the years 1952-1995 found a unidirectional causality running from economic growth to energy consumption growth; while Asafu-Adjaye (2000) by applying Engle and Granger's methodology over the time period 1973-1995 found a unidirectional Granger causality directed from energy consumption to economic growth. Differences in the results for the same country may be justified by the various methodologies used and the distinct time periods of the chosen samples.

As for Arab countries, there have been some studies on energy-gdp nexus where panel data methods as well as time series data methods on individual countries were used. Tests on individual Arab countries were done for Lebanon, Tunisia, Algeria, and Saudi Arabia. For Lebanon, the causality was investigated by Dagher and Yacoubian (2012) over the years 1980-2009. The authors employed various causality tests which are vector error correction based Granger causality, Hsiao, and Toda-Yamamoto tests which ensured the existence of bidirectional causality between energy consumption and economic growth. In this regard, Dagher and Yacoubian pointed out

that the national energy policy which calls for 5% energy conservation target must be revised urgently since it might retard growth. They also proposed fixing the shortages in electric capacity because this would have a positive impact on the economy. Omri (2013) found the same results. Other researchers, using panel data methods, found that energy consumption causes economic growth in Lebanon (Sabra, 2013).

As for Tunisia, Belloumi (2009) tested the relationship between energy consumption and economic growth over the period 1971-2004. After finding that the variables were integrated of order one, Belloumi proceeded with Johansen cointegration test followed by a vector error correction model (VECM) and Granger causality test. Empirical results proved that energy consumption can be used to boost economic growth. This finding has its disadvantages as well since energy conservation policies, which aim at decreasing GHG emissions and fighting climate change, would have distorting effects on the economy. The same causality relationship was found by Sabra (2013). However, Omri's (2013) results gave evidence of bidirectional causality in Tunisia while also using panel data methods as Sabra (2013).

Nevertheless, results on individual studies of Algeria and Jordan showed that in both countries a unidirectional causality runs from economic growth to energy consumption unlike the case of Tunisia. Eddrief-Cherfi and Kourbali (2012) investigated the case of Algeria over the years 1965-2008 by applying unit root tests, cointegration tests, and Granger causality on the logarithms of energy consumption per capita as well as GDP per capita. They deduced that economic growth is not limited by energy consumption. Nevertheless, Sabra (2013) found the opposite direction of causality and Omri (2013) found bidirectional causality between the two variables.

Differences in the results may be due to the different span of years as well as the different econometric techniques utilized.

Moreover, the case of Jordan alone was examined by Shahateet et al. (2014) over the period 1970-2011. The authors conducted Augmented Dicky-Fuller (ADF) and Phillips-Perron (PP) unit roots tests, cointegration test, and finally Granger causality test and assured that applying constraints on energy supply would have negligible or even no impact on economic growth. This fact allowed authorities to impose conservation policies more confidently especially because around 95% of Jordan's energy needs were being imported and the government had to take action to diminish the budget deficit. Yet, Sabra (2013) found that the causality runs the opposite way around and Omri's (2013) study gave evidence of bidirectional causality.

Nonetheless, for Saudi Arabia, Banafea (2014) examined the relationship of a specific type of energy consumption, which is oil consumption, with energy growth in Saudi Arabia over the years 1971-2012. He found evidence of long run unidirectional causality running from oil consumption to economic growth which indicates that imposing energy conservation policy would hinder economy's progress. In the same context, some studies investigated not only total energy consumption but the consumption of particular types of energy such as oil consumption and electricity consumption. Yang (2000) examined the nexus of Taiwan over the years 1954 till 1997. He went further and checked the causality for distinct types of energy consumption such as coal, electricity, gas, and oil consumption in addition to total energy consumption. Yang employed unit roost tests, cointegration tests, and Granger causality tests. The results yielded a bidirectional linkage between energy consumption and GDP growth. This was also true for coal and electricity consumption. However, it was found that a

unidirectional causality runs from gas consumption towards GDP growth and a unidirectional causality runs from GDP growth towards oil consumption.

Looking back at Arab countries, studies using panel data considered GCC and MENA countries. Al-Iriani (2006) examined oil-exporting countries sample consisting of the six GCC countries over the period 1971-2002. After testing the order of integration through panel unit root methods, panel cointegration was employed and the direction of causality was assessed. The outcome was in line with the conservation hypothesis in those countries, where energy obtained from the production of oil is considered cheap. Furthermore, Sabra (2013) considered a panel of the following 15 Arab countries: Algeria, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, and United Arab Emirates over the years 1980-2010. By using panel unit root test on the logarithms of GDP and energy use, cointegration, VECM, and Granger causality tests, Sabra realized that in those countries, where energy resources are abundant, energy consumption drives economic growth. Moreover, panel data study on 14 MENA countries (Algeria, Bahrain, Egypt, Iran, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, and United Arab Emirates) by Omri (2013) examined the nexus between energy consumption, economic growth and CO_2 emissions through simultaneous equations. The author's empirical results gave evidence of bidirectional causality between energy consumption and economic growth, unidirectional causality running from energy consumption to CO_2 emissions and a bidirectional causality relationship between CO_2 emissions and economic growth for the whole region. This had significant policy implications which call for the reduction of CO_2 emissions and the utilization of alternatives for energy sources which cause those emissions in order to sustain the

environment and the economy at the same time. Nonetheless, some studies approached the energy consumption-economic growth nexus by using multivariate models. In attempt to find other means that increase growth, Narayan and Smyth (2009) considered a panel of Middle Eastern countries which included Kuwait, Oman, Saudi Arabia, and Syria. They examined causality between gross domestic product, electricity consumption, and exports and deduced that 1% increase in electricity consumption causes GDP to increase by 0.04%, whereas a 1% increase in exports causes a 0.17% increase in GDP. They studied Middle Eastern countries because energy supply is considered cheap and therefore energy conservation policies weren't being implemented widely. They also gave evidence that exports, which don't harm the environment, could be a mean to expand growth.

In brief, empirical results in researches done on the energy-GDP nexus are mixed and controversial. There is no unanimity on the direction of causality for distinct countries and even for the same country. Chen et al. (2007) explained this by the use of different econometric approaches as well as different time periods and form of variables. They also justified that by the unique characteristics of each country. Therefore, one can't forecast and design policies by building up on results and experiences of other countries; however, countries must be analyzed individually and future policies must be constructed based on respective results.

CHAPTER III

METHODOLOGY

This chapter outlines briefly the methodology used in investigating the energy consumption-GDP nexus. It is noteworthy to mention that if the two variables were found to be stationary according to unit root tests, we'll proceed directly with Granger causality test. However, if one variable was stationary while the other was integrated of degree one, Granger causality will be done on the stationary variable and the first difference of the I(1) variable. Finally, if both variables were integrated of degree one then we must check if they have a long-run equilibrium relationship (i.e. cointegrated) and if they were cointegrated Toda Yamamoto test will be applied; otherwise, regular Granger causality test will be employed on their first differences.

A. Unit Root Test

Before testing for causality, one must check whether the variables are stationary or trended and specify the order of integration. A variable is said to be integrated of order n (I(n)) whenever it needs to be differenced n times in order to become stationary. Otherwise, it would be integrated of order 0 (I(0)). The augmented Dickey-Fuller (ADF) test is employed which entails a null hypothesis (H_0) stating that the variable has a unit root i.e. non-stationary, whereas the alternative (H_1) states that the variable doesn't contain a unit root i.e. stationary. In this study, we stop whenever the null is rejected due to p-value less than a determined significance level (1%, 5%, or 10%). The ADF test has three forms presented in the following equations:

$$\Delta y_t = \gamma y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \quad (1)$$

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \quad (2)$$

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \alpha_2 t + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \quad (3)$$

Where equation (3) is used whenever the variable has a constant (intercept) and a linear trend in the test regression. Equation (2) is used whenever the variable has a constant only and equation (1) is used when the variable contains neither a constant nor a linear trend. Doldado et al.'s (1990) procedure will be implemented. They proposed starting by estimating the most general model (3), checking whether it is appropriate then moving to the next one (Asteriou and Hall, 2011). Yet when differences are taken, trends would be eliminated and equation (2) would be the starting point.

Also, Phillips-Perron (PP) test will be employed to ensure the stationarity status of the variables. If it didn't agree with ADF test and if the ADF test was found to be sensitive to the number of lags chosen, then the results of PP test will be considered.

B. Cointegration

Whenever both variables are integrated of order one, long run relationship must be checked to avoid spurious regressions. If a stationary linear combination exists then our variables would be linked with a common trend and hence cointegrated. To test for cointegration, Engle and Granger's (1987) approach will be implemented. Engle-Granger (EG) test can find at most one cointegrating relationship and since we have only two variables, at most one cointegrating vector can be found. EG requires, after ensuring that our variables are integrated of the same order, the estimation of ordinary least squares (OLS) equation when Y_t is the dependent variable (equation 4) and also when X_t is the dependent variable.

$$Y_t = \beta_{1+}\beta_2 X_t + e_t \quad (4)$$

Afterwards, ADF test without a constant or a linear trend must be run on the residual series to check the order of integration. We must note that the critical values for the null of "residuals have a unit root/no cointegration" are -3.73, -3.17, and -2.91 at 1%, 5%, and 10% significance levels respectively.

C. Granger Causality

The main aim of this study is to check for causality between economic growth and energy consumption. In econometrics, causality refers to ability of a variable to predict and cause the other variable. Pairwise Granger causality test will be used when the two variables are stationary. It will also be used when one variable is stationary while the other is I(1), and when no evidence of cointegration is found between two I(1) variables. The test's null hypothesis states that one variable doesn't granger cause the other variable. It can be rejected according to chosen probability limit values. Nevertheless, when cointegration is found between our two I(1) variables, Toda and Yamamoto's (1995) technique will be used. Toda and Yamamoto (1995) allows checking for causality regardless of the order if integration of the two variables. First, Vector Autoregressive Estimates (VAR) on economic growth and energy consumption will be applied and the number of lags will be chosen according to Akaike information criterion (AIC). Toda and Yamamoto (1995) requires VAR using number of lags equal to the selected lags in addition to the order of integration of the variables. Afterwards, the VAR must be estimated through Seemingly Unrelated Regression (SUR) method. Finally, to check for causality, the coefficients of the regression will be diagnosed using Wald Coefficient test excluding the last lags added. For instance, to check if energy consumption economic, all coefficients of energy consumption must be set equal to zero

except the last n coefficients (n = order of integration of the variables and was found to be one in our case). If we could not reject the null, this means that there is no Granger causality.

CHAPTER IV

DATA AND EMPIRICAL RESULTS

A. Data

Annual time series data was gathered from the year 1980 till 2010 forming a total of 31 observations. Energy consumption was taken from the World Bank (World Development Indicators) and was measured in kilotons of oil equivalent. On the other hand, gross domestic product (constant prices) was collected from the International Monetary Fund and was expressed in billions of national currency units. Since our purpose is to observe causality of growth, natural logarithms of the variables were taken. "E" represents the log of energy use and "Y" represents the log of GDP.

B. Empirical Results

Empirical results are reported after tests explained in chapter III were applied on E and Y using Eviews on 31 observations. Results are shown according to each country separately.

1. Algeria

ADF test was applied on E and Y according to Doldado et al.'s (1990) technique. E was found to be stationary at 5% and 10% having p-value = 0.0293 < 0.05 and hence it is integrated of order 0 (Table 1 in Appendix I). As for Y, results showed that at level it has a unit root; therefore, first difference (DY) was taken. Unit root test resulted with a

p-value 0.0205<0.05 and hence the null was rejected (table 2 in Appendix I). Y is said to be integrated of order 1.

Phillips-Perron (PP) test was employed too and the results agreed with the ADF test.

Since our variables are I(0) and I(1) pairwise granger causality test can be performed. The results in Table 3 show that none of the null hypotheses can be rejected at all levels. Therefore, there is no causality between economic growth and energy consumption in Algeria.

Table 3. Granger Causality Test Results in Algeria

Pairwise Granger Causality Tests
Sample: 1980 2010
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
E does not Granger Cause DY	28	0.26933	0.7663
DY does not Granger Cause E		2.27192	0.1258

2. Bahrain

In a similar manner, we first checked the stationarity status of E and Y in Bahrain using ADF test. The results showed that E and Y are non-stationary yet their first differences are stationary (Tables 4 and 5 in Appendix I). Results of PP test agreed with the outcomes of the ADF test. Having two variables integrated of order one, long run relationship must be checked; thus, Engle-Granger (EG) test was employed. When Y was the dependent variable in OLS estimation, the residuals turned to be nonstationary, indicating that there is no cointegration. But when X was taken as the dependent variable, the residual series was found to be stationary (Table 6 in Appendix I). Because this was the only case where we had conflicting results, Johansen's

cointegration test was employed and the results indicated the existence of one cointegrating equation (Table 7 in Appendix I). This implies the presence of causality. Consequently, Toda and Yamamoto's (1995) causality test was applied. According to AIC the number of lags was 2, so we did VAR using 3 (2+1) lags and then estimated it using SUR technique. Finally, Wald Test was employed on the two resulting equations

Y = C(1)*Y(-1) + C(2)*Y(-2) + C(3)*Y(-3) + C(4)*E(-1) + C(5)*E(-2) + C(6)*E(-3) + C(7)

E = C(8)*Y(-1) + C(9)*Y(-2) + C(10)*Y(-3) + C(11)*E(-1) + C(12)*E(-2) + C(13)*E(-3) + C(14)

The test gave evidence that Y causes E, since the null was rejected (Table 9), and not the other way.

Table 8. Wald Test Results in Bahrain (Testing if E causes Y)

Wald Test:

Test Statistic	Value	df	Probability
Chi-square	0.486813	2	0.7840

Null Hypothesis: C(4)=C(5)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(4)	-0.033793	0.098911
C(5)	-0.050688	0.091481

Table 9. Wald Test Results in Bahrain (Testing if Y causes E)

Wald Test:

Test Statistic	Value	df	Probability
Chi-square	12.35054	2	0.0021

Null Hypothesis: C(8)=C(9)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(8)	0.844112	0.372256
C(9)	0.071920	0.591863

3. Egypt

For Egypt, E and Y were found to be stationary by utilizing the ADF test, yet results varied when the number of lags was changed. Therefore, we checked, informally, whether the series revert to a mean by plotting their graphs and deduced that they don't. So, Phillips-Perron test results were considered which gave evidence that E and Y are integrated of order one (Tables 10 and 11 in Appendix I).

Since E and Y are I(1), EG test was employed and results from Table 6 in the Appendix show that the null couldn't be rejected and hence there is no cointegration. Consequently, pairwise Granger causality test was run on the first differences of E and Y and the results gave evidence of the neutrality hypothesis.

Table 12. Granger Causality Test Results in Egypt

Pairwise Granger Causality Tests
Sample: 1980 2010
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
DE does not Granger Cause DY	28	0.33358	0.7198
DY does not Granger Cause DE		0.27624	0.7611

4. Jordan

While testing for unit roots we found that E doesn't have a unit root having an absolute value of t-stat 4.64 greater than the absolute value of all critical values (Table 11 in Appendix I). Yet Y was found to be non-stationary. Therefore, the first difference was taken and ADF test was done. The differenced values are stationary at 5% and 10% levels (Table 12 in Appendix I). PP test results agreed with ADF unit root test results on E and Y.

Since E is I(0) while Y is I(1), we did pairwise Granger causality test for E and the differenced value of Y. Results yielded a unidirectional causality from energy consumption to economic growth at 10% level.

Table 15. Granger Causality Test Results in Jordan

Pairwise Granger Causality Tests
Sample: 1980 2010
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
E does not Granger Cause DY	28	2.79745	0.0818
DY does not Granger Cause E		0.90201	0.4196

5. Kuwait

For Kuwait, we tested whether E has a unit root using ADF and PP test too. The results didn't agree so following the steps explained in the methodology we considered the PP test results and deduced that E is integrated of order one (Table 16 in Appendix I). However, Y was found to revert to a mean using both tests (Table 17 in Appendix I).

Since Y is stationary while E is integrated of order one, pairwise Granger causality test was employed on Y and the first difference of E and resulted in rejecting

both null hypotheses, and hence bidirectional causality is present between energy consumption and economic growth.

Table 18. Granger Causality Test Results in Kuwait

Pairwise Granger Causality Tests
Sample: 1980 2010
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
DE does not Granger Cause Y	26	5.87312	0.0037
Y does not Granger Cause DE		2.32027	0.0987

6. Lebanon

Similarly, ADF test was done on E and Y in Lebanon. E was found to be integrated of order one and this was the case while using PP test (Table 19 in Appendix I). However, ADF and PP test results didn't agree while examining Y. From ADF, Y was found to be cointegrated of order two yet, PP and the informal test showed that the first difference of Y reverts to a mean. PP unit root test results were considered (Table 20 in Appendix I). Having our variable integrated of order one, EG test was used and showed that there is no cointegration among E and Y (Table 6 in Appendix I). Therefore, pairwise Granger causality was done on the first differences of both E and Y and resulted in the rejection of both null hypotheses. So we conclude that the feedback hypothesis holds in Lebanon.

Table 21. Granger Causality Test Results in Lebanon

Pairwise Granger Causality Tests
Sample: 1980 2010
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
DE does not Granger Cause DY	26	3.25557	0.0373
DY does not Granger Cause DE		2.59796	0.0733

7. Libya

Through using ADF test on E and Y, E was found to be stationary at 10% level. PP unit root test was also employed yet showed that E is stationary at its first difference. PP results were considered since E was found stationary at the limit using ADF test (Table 22 in Appendix I).

On the other hand, Y was found to be non-stationary; thus, first difference of Y was taken. From ADF test on the first difference of Y, we saw that it is stationary at all levels (Table 23 in Appendix I). This was also the case using PP unit root test.

Afterwards, pairwise Granger causality test was undertaken; and we deduced that, at a 90% significance level, energy consumption causes economic growth. So, energy is a limiting factor in Libya.

Because E and Y are integrated of order one, EG test was utilized. Results in Table 6 of the Appendix show that we couldn't reject the null and therefore there is no cointegration. Thus, pairwise Granger causality was made on the first differences of E and Y. The outcomes show that there is no causal relationship between economic growth and energy consumption in Libya.

Table 24. Granger Causality Test Results in Libya

Pairwise Granger Causality Tests
Sample: 1980 2010
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
DE does not Granger Cause DY	28	0.90752	0.4175
DY does not Granger Cause DE		0.70567	0.5042

8. Morocco

E's ADF and PP test results gave evidence that E is integrated of order zero while Y is integrated of order one (Tables 25 and 26 in Appendix I). Granger causality test was done for E and the first difference of Y. We couldn't reject both null hypotheses which is in favor of the neutrality hypothesis.

Table 27. Granger Causality Test Results in Morocco

Pairwise Granger Causality Tests
Sample: 1980 2010
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
E does not Granger Cause DY	28	2.18723	0.1350
DY does not Granger Cause E		0.67844	0.5173

9. Oman

While checking for the stationarity status of the variables in Oman, results of ADF and PP unit root tests agreed, and both E and Y were found to be integrated of order one (Tables 28 and 29 in Appendix I).

As a result, EG cointegration test was employed and indicated that there is no cointegration (Table 6 in Appendix I). This negated the presence of long run trend

between E and Y. Therefore, granger causality test was done on the first differences of E and Y. The results support the growth hypothesis.

Table 30. Granger Causality Test Results in Oman

Pairwise Granger Causality Tests
Sample: 1980 2010
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
DE does not Granger Cause DY	28	3.64035	0.0423
DY does not Granger Cause DE		0.69810	0.5078

10. Qatar

In Qatar, according to ADF and PP test results, Y and E are integrated of order one (Tables 31 and 32 in Appendix I). Therefore, similar to the steps taken while examining the case of Bahrain, EG test gave evidence of cointegration (Table 6 in Appendix I). This means that there is causality between E and Y. To test for the direction of this causality, Toda and Yamamoto's (1995) test was utilized in a similar manner as used for Bahrain. The results yielded unidirectional causality from energy consumption to economic growth

Table 33. Wald Test Results in Qatar (Testing if E causes Y)

Wald Test:

Test Statistic	Value	Df	Probability
Chi-square	16.89405	8	0.0312

Null Hypothesis: C(10)=C(11)=C(12)=C(13)=C(14)=C(15)=
C(16)=C(17)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(10)	-0.054026	1.346182
C(11)	0.316040	0.451827
C(12)	0.455444	0.512895
C(13)	-0.263077	0.396797
C(14)	0.515635	0.588234
C(15)	0.360320	0.421521
C(16)	0.491875	0.519272
C(17)	-0.755523	0.736382

Table 34. Wald Test Results in Qatar (Testing if Y causes E)

Wald Test:

Test Statistic	Value	df	Probability
Chi-square	4.307556	8	0.8284

Null Hypothesis: C(20)=C(21)=C(22)=C(23)=C(24)=C(25)=
C(26)=C(27)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(20)	0.608107	0.987622
C(21)	-0.227546	0.409271
C(22)	-0.181403	0.228360
C(23)	0.001895	0.289645
C(24)	0.038224	0.268913
C(25)	-0.181173	0.191231
C(26)	0.161043	0.199370
C(27)	0.244045	0.511867

11. Saudi Arabia

While examining the case of Saudi Arabia, E was found to be stationary at all levels and Y was found to be stationary at 10% level using ADF test (Tables 35 and 36 in Appendix I). PP test agreed with the results on E, yet Y was found to be integrated of order one. PP test results were considered since the ADF test was sensitive to the number of lags chosen and since the informal test (plotting the graph of the series) showed that the series does not revert to a mean.

The outcomes of Granger causality test on E and the first difference of Y proved the existence of unidirectional causation running from energy consumption to economic growth.

Table 37. Granger Causality Test Results in Saudi Arabia

Pairwise Granger Causality Tests
Sample: 1980 2010
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
E does not Granger Cause DY	29	5.69643	0.0246
DY does not Granger Cause E		2.82243	0.1049

12. Sudan

While investigating Sudan's case, the ADF test on E resulted in the rejection of presence of unit root (Table 38 in Appendix I), yet for Y a unit root existed and hence the first difference was taken. The ADF test on the first difference of Y showed that it is stationary (Table 39 in Appendix I). Similar outcomes were found using PP test. Consequently, Granger causality test was made on our stationary variables. We couldn't reject any null hypothesis and this is in line with the neutrality hypothesis.

Table 40. Granger Causality Test Results in Sudan

Pairwise Granger Causality Tests
Sample: 1980 2010
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
E does not Granger Cause DY	28	0.47145	0.6300
DY does not Granger Cause E		1.58271	0.2270

13. Syria

Outcomes for energy-gdp nexus in Syria are similar to those of Sudan. E was found to be stationary at all levels but Y was stationary at its first difference not at level when ADF and PP tests were employed (Tables 41 and 42 in Appendix I). Pairwise Granger causality test indicated he absence of causality between economic growth and energy consumption in both directions.

Table 43. Granger Causality Test Results in Syria

Pairwise Granger Causality Tests
Sample: 1980 2010
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
E does not Granger Cause DY	28	0.44533	0.6460
DY does not Granger Cause E		0.29850	0.7448

14. Tunisia

For Tunisia, also ADF and PP tests according to Doldado et al.'s (1990) approach were employed. E and Y were found to be integrated of order one (Tables 44 and 45 in Appendix I).

Since both variables are I(1), EG cointegration test was applied which negated the existence of cointegrating relation between E and Y. Thus, Granger causality test

was made for the first differences of Y and E. The outcomes support the conservation hypothesis at 10% level.

Table 46. Granger Causality Test Results in Tunisia

Pairwise Granger Causality Tests
Sample: 1980 2010
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
DE does not Granger Cause DY	28	1.29623	0.2928
DY does not Granger Cause DE		2.56992	0.0983

15. United Arab Emirates

For UAE, ADF and PP tests on E gave evidence on the stationarity status of E (Table 47 in Appendix I). However, from ADF and PP test results on Y, the null hypothesis couldn't be rejected. Afterwards, ADF and PP tests on first difference were made which ensured the stationarity of DY (Table 48 in Appendix I). Subsequently, Granger causality was employed on E and DY. The results show that there is no causal relationship between energy consumption and economic growth in both directions.

Table 49. Granger Causality Test Results in UAE

Pairwise Granger Causality Tests
Sample: 1980 2010
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
E does not Granger Cause DY	28	0.69909	0.5073
DY does not Granger Cause E		0.21226	0.8103

CHAPTER V

CONCLUSION AND POLICY IMPLICATIONS

Arab countries including Algeria, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, and United Arab Emirates were investigated over the years 1980-2010 on annual time series data to check for the direction of causality using Granger causality tests after employing unit root tests and cointegration tests when needed. Results of this study weren't all in line with Sabra's (2013) outcomes on the same countries, and this may be due to the different methodologies used. Our results showed that there is no causation between energy consumption and economic growth in Algeria, Egypt, Libya, Morocco, Sudan, Syria, and the United Arab Emirates. However, there is a unidirectional causality running from economic growth to energy consumption in Bahrain and Tunisia supporting the conservation hypothesis. Nevertheless, it was found that energy consumption drives economic growth in Jordan, Oman, Qatar, and Saudi Arabia in line with the growth hypothesis. Results on Saudi Arabia were consistent with Narayan and Smyth's (2009) findings. Besides, in those countries authorities must be cautious about implementing energy conservation policies since they would retard growth. Nonetheless, in Kuwait and Lebanon evidence of bidirectional causality was present in favor of the feedback hypothesis, which agrees with Dagher and Yacoubian's (2012) outcomes.

We must note that for Saudi Arabia, Kuwait and Qatar, who are members of the Organization of the Petroleum Exporting Countries (OPEC) and the Organization of

Arab Petroleum Exporting Countries (OAPEC), the growth of the economy is affected by energy consumption (OAPEC). Moreover, energy leads growth in other countries which are not members of OPEC and OAPEC such as Jordan, Lebanon and Oman. Energy policies vary in those countries. For example, in Jordan, the current Energy Efficiency Strategy requires energy mixing and targets 7% of the energy to be extracted from renewable sources by 2015 and 10% by the year 2020. Their law also encourages the use of renewable energy through exempting all equipment and production inputs of renewable energy from taxes (IEA). In the same context, Lebanon is supporting energy efficiency initiatives and investments. The National Energy Efficiency and Renewable Energy Action, which was initiated by Central Bank of Lebanon in association with UNDP, EU, and the Ministries of Finance and Energy and Water, allows the private sector to apply for loans which are subsidized for working on renewable energy and energy efficiency projects. The loans only ask for 0.6% interest rate and have a repayment period which can reach up to 14 years (LCEC). As for Oman, the price of energy in subsidized mainly. This reduces the incentive for making energy efficiency a priority. However, actions must be taken to make use of abundant renewable energy sources such as the solar energy. This is because in 2008, for instance, a study by Oman found out that their solar energy potential meets all domestic electricity needs and is sufficient to provide electricity for the purpose of exports as well (REEEP Policy Database). Nevertheless, the Qatar National Development Strategy 2011-2016 and Qatar's Vision 2030's goal is to reduce energy intensity of electricity consumption and cut power generation by 7% by 2016 through seasonal shutdowns and standardization (2013 Doha Carbon and Energy Forum). This policy could be linked to Figure 4, presented earlier, which showed that Qatar had the highest value in energy consumption

per capita compared to other Arab countries. However, this strategy must be reconsidered since it might distort growth knowing that energy consumption causes economic growth in Qatar. Moreover, Saudi Arabia, with the support of UNDP, aims at reducing the demand for energy consumption for the following 20 years (UNDP, 2014). This could be justified by the high energy consumption per capita relative to other countries as well. Yet this target must also be revised due to the presence of unidirectional causality running from energy consumption to economic growth in Saudi Arabia.

Therefore, in order to sustain the economy and the environment, countries must rapidly invest in infrastructures where energy could be produced from renewable sources like hydroelectricity, solar, and wind power (Halicioglu, 2011).

APPENDIX I

TABLES

Table 1. ADF Unit Root Test Results for Energy Consumption in Algeria

Null Hypothesis: E has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-3.820724	0.0293
Test critical values:	1% level	-4.296729	
	5% level	-3.568379	
	10% level	-3.218382	

Table 2. ADF Unit Root Test Results for Economic Growth in Algeria

Null Hypothesis: DY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-3.372059	0.0205
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 4. ADF Unit Root Test Results for Energy Consumption in Bahrain

Null Hypothesis: DE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-6.033970	0.0000
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 5. ADF Unit Root Test Results for Economic Growth in Bahrain

Null Hypothesis: DY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-3.687465	0.0098
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 6. Engle-Granger Cointegration Test Results

Null Hypothesis: Residual series has a unit root/ no cointegration			
Critical values by EG: -3.73 (1% level) -3.17 (5% level) -2.91 (10% level)			
Country	ADF test statistic on residual series of $Y_t = \beta_{1+}\beta_2 E_t + u_t$	ADF test statistic on residual series of $E_t = \beta_{1+}\beta_2 Y_t + \varepsilon_t$	Conclusion
Bahrain	-2.372812	-5.205090***	-
Egypt	-2.189334	-2.269236	No cointegration
Lebanon	-2.308028	-2.489472	No cointegration
Libya	-1.335324	-2.676449	No cointegration
Oman	-2.193380	-1.998191	No cointegration
Qatar	-3.120394*	-5.094767***	Cointegration
Tunisia	-1.778796	-1.895252	No cointegration

Table 7. Johansen Cointegration Test on Y and E in Bahrain

Sample (adjusted): 1982 2010
Included observations: 29 after adjustments
Trend assumption: Linear deterministic trend
Series: Y E
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.537691	23.07315	15.49471	0.0030
At most 1	0.023815	0.699000	3.841466	0.4031

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.537691	22.37415	14.26460	0.0021
At most 1	0.023815	0.699000	3.841466	0.4031

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 10. PP Unit Root Test Results for Energy Consumption in Egypt

Null Hypothesis: DE has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.
Phillips-Perron test statistic		-2.724644	0.0821
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 11. PP Unit Root Test Results for Economic Growth in Egypt

Null Hypothesis: DY has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.
Phillips-Perron test statistic		-2.800270	0.0706
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 13. ADF Unit Root Test Results for Energy Consumption in Jordan

Null Hypothesis: E has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-4.646172	0.0044
Test critical values:	1% level	-4.296729	
	5% level	-3.568379	
	10% level	-3.218382	

Table 14. ADF Unit Root Test Results for Economic Growth in Jordan

Null Hypothesis: D(Y) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 7 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-4.384509	0.0112
Test critical values:	1% level	-4.440739	
	5% level	-3.632896	
	10% level	-3.254671	

Table 16. PP Unit Root Test Results for Energy Consumption in Kuwait

Null Hypothesis: DE has a unit root
Exogenous: Constant
Bandwidth: 28 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.
Phillips-Perron test statistic		-9.486248	0.0000
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 17. ADF Unit Root Test Results for Economic Growth in Kuwait

Null Hypothesis: Y has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-3.499720	0.0582
Test critical values:	1% level	-4.309824	
	5% level	-3.574244	
	10% level	-3.221728	

Table 19. ADF Unit Root Test Results for Energy Consumption in Lebanon

Null Hypothesis: DE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-4.765694	0.0007
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 20. PP Unit Root Test Results for Economic Growth in Lebanon

Null Hypothesis: D(Y) has a unit root
Exogenous: Constant
Bandwidth: 10 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.
Phillips-Perron test statistic		-4.127643	0.0033
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 22. PP Unit Root Test Results for Energy Consumption in Libya

Null Hypothesis: D(E) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.
Phillips-Perron test statistic		-5.043480	0.0003
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 23. ADF Unit Root Test Results for Economic Growth in Libya

Null Hypothesis: DY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-5.169095	0.0002
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 25. ADF Unit Root Test Results for Energy Consumption in Morocco

Null Hypothesis: E has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-3.525002	0.0547
Test critical values:	1% level	-4.296729	
	5% level	-3.568379	
	10% level	-3.218382	

Table 26. ADF Unit Root Test Results for Economic Growth in Morocco

Null Hypothesis: DY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-11.50915	0.0000
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 28. ADF Unit Root Test Results for Energy Consumption in Oman

Null Hypothesis: DE has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-3.699082	0.0098
Test critical values:	1% level	-3.689194	
	5% level	-2.971853	
	10% level	-2.625121	

Table 29. ADF Unit Root Test Results for Economic Growth in Oman

Null Hypothesis: DY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-3.242592	0.0275
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 31. ADF Unit Root Test Results for Energy Consumption in Qatar

Null Hypothesis: DE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-6.015413	0.0000
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 32. ADF Unit Root Test Results for Economic Growth in Qatar

Null Hypothesis: DY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.963647	0.0050
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 35. ADF Unit Root Test Results for Energy Consumption in Saudi Arabia

Null Hypothesis: E has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-4.542371	0.0056
Test critical values:	1% level	-4.296729	
	5% level	-3.568379	
	10% level	-3.218382	

Table 36. PP Unit Root Test Results for Economic Growth in Saudi Arabia

Null Hypothesis: D(Y) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.
Phillips-Perron test statistic		-3.523114	0.0145
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 38. ADF Unit Root Test Results for Energy Consumption in Sudan

Null Hypothesis: E has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-4.312114	0.0096
Test critical values:	1% level	-4.296729	
	5% level	-3.568379	
	10% level	-3.218382	

Table 39. ADF Unit Root Test Results for Economic Growth in Sudan

Null Hypothesis: DY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-3.392506	0.0196
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 41. ADF Unit Root Test Results for Energy Consumption in Syria

Null Hypothesis: E has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-5.113257	0.0019
Test critical values:	1% level	-4.374307	
	5% level	-3.603202	
	10% level	-3.238054	

Table 42. ADF Unit Root Test Results for Economic Growth in Syria

Null Hypothesis: DY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-5.858326	0.0000
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 44. ADF Unit Root Test Results for Energy Consumption in Tunisia

Null Hypothesis: DE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-9.290492	0.0000
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 45. ADF Unit Root Test Results for Economic Growth in Tunisia

Null Hypothesis: DY has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-6.687056	0.0000
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

Table 47. ADF Unit Root Test Results for Energy Consumption in UAE

Null Hypothesis: E has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-3.911706	0.0261
Test critical values:	1% level	-4.356068	
	5% level	-3.595026	
	10% level	-3.233456	

Table 48. ADF Unit Root Test Results for Economic Growth in UAE

Null Hypothesis: DY has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=7)

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-3.947277	0.0003
Test critical values:	1% level	-2.647120	
	5% level	-1.952910	
	10% level	-1.610011	

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