The Impact of Renewable Energy Consumption on GDP Growth in the Mediterranean Countries

تأثير استهلاك الطاقة المتجددة على النمو الاقتصادي في الدول المطلة على البحر المتوسط

Prepared By:

Riwa Younis

Committee:

Dr. Tareq Sadeq (supervisor)

Dr. Fathi Srouji

Dr. Shaker Sartawi

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Dedication

I dedicate this work firstly to the sake of Allah. A special feeling of gratitude to my loving parents, whose words of encouragement and pushing for tenacity were ringing in my ears. I also dedicate this work to my precious brothers and sisters .

I dedicate this work and give special thanks to my husband Mohanad and my wonderful sons Izz-Aldeen and Zain-Aldeen for being there for me throughout the entire Master program. You have been my best cheerleaders.

Finally, all the appreciation and gratitude for my mother and father in law who supported me in every way to complete this program.

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Abstract

of

The Impact of Renewable Energy Consumption on GDP Growth in the Mediterranean Countries

by

Riwaa Yousif Younis

The purpose of this study is to investigate the short run and long run relationship and causality direction between renewable energy consumption share of total energy consumption (REC) and gross domestic production per unit of energy use (GDP/UEU) in 10 Mediterranean countries divided into two clusters: The first contains five countries lying in the north of the Mediterranean sea (NMC) (France, Spain, Italy, Greece and Turkey); while the second contains four countries lying in the south of it (Algeria, Tunisia, Egypt, Morocco) beside Israel, for the period between (1990-2015). To investigate the connection, this study uses the panel autoregressive distributed lag (ARDL) testing model of cointegration and error-correction model (ECM) in order to measure the short run variations, also a new approach designed by Dumitrescu and Hurlin (2012) is applied to test the Granger non-causality relation in panel data. The REC has a positive significant effect in the long run and no impact in the short run on GDP/UEU growth for the (NMC). In cluster2, REC has a negative significant effect in the long run and no impact in the short run on GDP/UEU growth of five countries. Besides, the empirical results support the existence of a bidirectional causal relationship between the two variables in both clusters, which means the feedback hypothesis is approved.

الملخص

تهدف هذه الدراسة إلى البحث في طبيعة العلاقة طويلة وقصيرة المدى واتجاه السببية بين حصة استهلاك الطاقة المتجددة من إجمالي استهلاك الطاقة (REC) والناتج المحلي الإجمالي لكل وحدة استهلاك من الطاقة (GDP/UEU) في عشرة دول تطل على البحر المتوسط مقسمة إلى مجموعتين: الاولى تسمّى دول شمال البحر المتوسط (NMC) والتي تضم خمسة دول هي (فرنسا و إسبانيا و إيطاليا و اليونان وتركيا)، أما الثانية فهي دول جنوب البحر المتوسط (SMC) وتضم (الجزائر و تونس و مصر والمغرب) بالإضافة لإسرائيل وذلك في الفترة الواقعة ما بين (1990-2015)، ومن خلال استخدام نموذج الانحدار الذاتي للإبطاء الزمني الموزع (ARDL) و نموذج تصحيح الخطأ (ECM) من أجل قياس التغيرات على المدى القصير و تطبيق نموذج دوميتريسكو و هورلين الذي تم تصميمه في عام 2012 لاختبار علاقة جرانجر غير السببية في البيانات الطولية فقد تبين أن هناك تأثير إيجابي هام على المدى الطويل لاستهلاك الطاقة المتجددة على نمو الناتج المحلي الاجمالي لكل وحدة استهلاك من الطاقة في المجموعة الاولى و وجود تأثير سلبي كبير في المجموعة الثانية، بينما لا يوجد له اي تأثير على المدى القصير في كلا المجموعتين. إضافة إلى ذلك ، تدعم النتائج التجريبية وجود علاقة سببية ثنائية الاتجاه بين المتغيرين في كلا المجموعتين ؛ مما يعني أن النتيجة توافق فرضية التغذية الراجعة.

.

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List of Abbriviations

Renewable Energy Consumption Share of Total Energy Consumption	**(REC)**
Gross Domestic Production / Unit of Energy Use	**(GDP/UEU)**
Gross Fixed Capital Formation	**(GFCF)**
Labor Force	**(LF)**
International Energy Agenecy	**(IEA)**
Union for Meditteranian Countries	**(UFM)**
North Mediterranean Countries	**(NMC)**
South Mediterranean Countries	**(SMC)**
Akaike Information Criterion	**(AIC)**
Final Prediction Error	**(FPE)**
Pool Mean Group	**(PMG)**
Mean Group	**(MG)**
Dynamic Fixed Effects	**(DFE)**

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Chapter 1

Introduction

Chapter 1

INTRODUCTION

1.1 Preamble

Energy is considered an important input in the process of producing goods and services for most of the industrial countries and in boosting economic growth in the era of dynamic events and globalization. Since 2014, the drop in oil prices led many economists to question about the future of renewables and clean energy investments all around the world. As a result, primary energy demand increased and became a topic to be discussed in terms of its effective impact on the sustainability of economic growth in the Mediterranean region. At the same time, vigorous efforts were taken to adopt sustainable and efficient forms of renewable energy production to handle with the increase in demand for energy and guarantee the existence of sustainable energy sources in the region. The (NMC) have applied many procedures for reducing energy demand along with adopting energy mix policies between renewable and non-renewable energy resources as part of their alteration process in energy system. In contrast, the (SMC) have implemented un satisfactory procedures in improving energy efficiency and utilizing renewable energy effectively although their energy demand witnessed 6% growth since 2010 (MEDENER, 2014).

According to the diversity of renewable energy resources, the Mediterranean region gained great benefits in this sector. However, the North- South renewable energy use is obviously unequal. In 2015, (REC) in the selected (NMC), in this study; was approximately double of the selected (SMC) besides Israel, 76.79% and 33.33%, respectively.[1]

The type of causality relationship between REC and economic growth determines the optimal energy policy that should be taken in Mediterranean countries. Four hypotheses were tested in empirical studies and clarified the causality types between the preceding variables. Firstly, growth hypothesis was studied by Naseri, Motamedi and Ahmadian (2016), Khobai and Le

[1] Information calculated from data used in this study.

Roux (2018), Adhikari and Chen (2012) and Marinaș et.al. (2018) by using different techniques, they found a unidirectional causality running from REC to economic growth only. Second, conservation hypothesis was investigated by Sadorsky (2009), Mahmoodi and Mahmoodi (2011), Šimelytė and Dudzevičiūte (2017) and Mahmoodi (2017). They found a unidirectional causality running from economic growth to REC, but not the opposite. Further, Sebri and Ben-Salha (2014), Sifuba (2018), Apergis and Payne (2011) and Saidi, El-Montasser and Ajmi (2018), results supported the feedback hypothesis which indicates a bi-directional causal relationship between the two variables. Finally, neutrality hypothesis was examined by Shahateet (2014), Ziramba (2013) and Menegaki (2011); they showed no correlation between REC and economic growth.

1.2 Purpose

Along with the above controversy, clearly, the evidence between energy consumption and GDP growth is indecisive and the effect of REC on GDP growth is not clear. The purpose of this study is to investigate the causality linkage between REC and GDP growth and to analyse the impact of REC, controlling other factors, on GDP growth through observing how GDP and REC changed in the Mediterranean countries selected over the period of (1990 -2015). As countries around the world have developed remarkably and significantly during the 20th century, the cost of that great progress was a tremendous diminishing in energy sources as demand for energy was significantly increasing. This study has worked in order to check the effect of using renewable energy sources on GDP/UEU growth in 10 Mediterranean countries divided into two clusters : cluster one contains five countries (NMC) (France, Spain, Greece, Turkey and Italy); while the other cluster includes four countries (SMC) (Algeria, Egypt, Morocco, and Tunisia) beside Israel. In this way, we could notice which group of countries in the region benefited the most from the common available renewables such as (geothermal, wind, solar, hydropower, etc.) and if policies adopted in the cluster that has a positive effect

on GDP/UEU could be generalized on the other one. The representative sample for both sides of the Mediterranean region is chosen based on two reasons. First, as strategies and energy efficiency[2] policies have been implemented in some countries and their development has allowed achieving a detailed monitoring system of the energy performance to assess the impact of the policies, to understand the energy demand trends and to measure progress towards energy efficiency. However, the countries in the other cluster took timid steps in this approach. Moreover, geographical location (southern Mediterranean), cooperation and membership of countries selected to several unions within the Mediterranean countries, the presence of common renewable resources among the selected countries and being highly energy consuming countries are considered reasons for selecting these countries in this cluster. Secondly, there was a lack of data for many countries in the region over the selected period which made it difficult to choose a larger sample.

1.3 Importance

The importance of this study appears in covering the gap in the studies concerning the impact of renewable energy consumption in the Mediterranean region on economic growth. Unlike other studies that focused on analyzing its effect in each country in the region separately, we clustered ten countries into two groups to study how renewable energy consumption in the (NMC) differs from that in (SMC) and its impact on the policies followed in this sector. In spite of the differences in the economic structures in each cluster and the availability of data over the selected study period, their selection is based on the homogenous approach in dealing with renewable energy sector. The selected countries agreed on increasing the share of REC by setting various targets in their strategies to be achieved by 2020 and 2030, so suggesting

[2]Energy efficiency means less energy is used to complete a task avoiding energy waste; it leads to increase energy productivity, to decrease energy imports and to lower the cost of energy for users .It is achieved through investing in technologies generating renewable energy.

some recommendations will help decision-makers in order to facilitate the use of renewable energy in boosting the economy from the empirical results obtained.

Our study covers the period between 1990 and 2015. A unit root developed by Im et al. (2003) is performed, Autoregressive distributed lag (ARDL) cointegration test developed by Pesaran et al.(2001) and Granger causality analysis developed by Dumitrescu and Hurlin (2012) are used to investigate the impact of REC on GDP/UEU growth over the selected sample in the short and long run. The results shows how effectively renewable energy can be utilized to set the right policies for keeping growth at the desired level by governments in Mediterranean region.

1.4 Plan

The study is convenient with the predetermined objective and literature review already used. In section 2, the study reviews the results of other researches in this field and shows the four hypotheses on the potential relation among REC and economic growth. Section 3 mentions how renewable energy sector is considered important on both Mediterranean region clusters by presenting the efforts taken to cooperate between international governments to build common policies and strategies to utilize from this sector; and on a country–level by focusing on local initiatives and policies that were taken to enhance renewable consumption. In section 4, theoretical framework is discussed. Section 5 combines data and econometric approach. In section 6, the results and their explanation are presented. The last section amalgamates final conclusions and some policy implication.

Chapter 2

LITERATURE REVIEW

Chapter 2

LITERATURE REVIEW

2.1 Hypotheses Definition

Many papers tried to deep in the nature of the relationship between renewable energy consumption and economic growth. Consequently, policies in action that governments should execute and investment decisions energy companies would take depend on the type of the resulted relationship under study. However, before we think how energy use would affect any economy, a base of four hypotheses will draw the start point of any analysis. First, the growth hypothesis presumes the presence of a unidirectional causality from REC to economic growth. It assumes that energy consumption is a necessary factor in production process, so it is possible to have a negative impact on GDP growth when energy saving policy is applied. In contrast, energy use will play an important role in boosting economic growth by increasing its usage in the production process along with labor and capital factors. Secondly, the feedback hypothesis supports a joint effect between the two variables in decreasing or increasing cases, more clearly a bidirectional causality existence means that both variables are depending on each other and adopting an energy conservation policy may cause contraction effects. The third one is Conservation hypothesis which proposes that a change in energy consumption has no effect on GDP growth, hence energy policies will have no effect on growth; while, any change in GDP growth will necessarily affect energy consumption positively or negatively. Finally, the neutrality hypothesis assumes there is no relation between the two variables which leads governments to apply different energy policies with zero effect on GDP growth.

2.1.1 Growth Hypothesis

In the following context, a great number of researchers using different models have supported the growth hypothesis in searching about the existence of a causal link between REC and GDP growth (GDP). Inglesi-Lotz (2016) studied the relationship between REC and GDP in 34 OECD countries over the period (1990– 2010). Cobb-Douglas function is used and a positive long-run equilibrium existed between renewable energy and GDP based on the results of the Pedroni cointegration test. Thus, OECD countries should adopt mechanisms to enhance renewable energy usage which will affect their GDP positively. Naseri, Motamedi and Ahmadian (2016) studied the relationship between REC and GDP in OECD countries using data available in the interval (1990-2012). The results showed that increasing renewable energy use will enhance GDP growth using Johansen Cointegration test and the ARDL model. Further, Khobai and Le Roux (2018) investigated the causality relationship between REC and GDP in South Africa. The Autoregressive distributed lag (ARDL) model, Vector Error Correction Model (VECM) and other techniques were used in testing the quarterly data used over the period (1990 – 2014). In the long run, results proved a presence of unidirectional causality flowing from REC to GDP growth. Adhikari and Chen (2012) investigated the linkage between energy consumption and GDP growth in the long run in 80 developing countries over the period (1990- 2009); through applying a unit root test, cointegration test and dynamic ordinary least squares (DOLS) for panel data. Countries were divided into three income groups, upper middle, lower middle and low income countries. Researchers proposed that energy consumption and GDP growth are co-integrated in long run for each group. In addition, they found that REC causes GDP in upper middle and lower middle income countries in the long-run. However, the GDP growth affects energy consumption in low income countries supporting conservation hypothesis. Various results were obtained in such one study that supports more than one

hypothesis, as Marinaș et.al. (2018) in ten Central and Eastern Europe (CEE) members investigated the association between GDP growth and REC over the period (1990–2014) using ARDL approach. In the short run, a unidirectional causal relationship from energy consumption and GDP growth was found in Hungary, Lithuania and Slovenia; while, no relation was found in Romania and Bulgaria. On the other side, a bi-directional causality was confirmed for all the analyzed countries in the long run, supported the feedback hypothesis. Brini, Amara and Jemmali (2017) examined the correlation and causality direction between REC and GDP growth in Tunisia in the long-run and the short-run. They included international trade and oil price factors in their model. Data over the period (1980–2011) was tested using the ARDL approach and Granger causality test. A unidirectional long-run causality with a negative effect was running from REC to GDP.

2.1.2 Conservation Hypothesis

The conservation assumption is promoted by other studies. The study of Sadorsky (2009) studied the effect of renewable energy on GDP for the G7 economies over the period (1980-2005). Panel cointegration estimates as Pedroni (2001) and FMOLS and DOLS models along with error correction model (ECM) approach of Engle and Granger (1987) proposed that increases in real GDP per capita drives per capita REC in the long run. Mahmoodi and Mahmoodi (2011) examined data for seven Asian developing countries from 1985 to 2007 to capture the relationship between REC and GDP growth. The results revealed that only GDP growth affects REC in 4 countries: India, Iran, Pakistan, and Syrian Arab Republic. While, a bi-directional causality between variables was supported in Bangladesh and Jordan confirming (feedback assumption), but for Sri Lanka no evidence of causality were existed supporting (Neutrality assumption). Authors applied ARDL- bound test and Toda and Yamamo (1995) granger causality test to reach the previous results. Another study involved 28 European Union countries with data covering the period (1990 – 2012). Šimelytė and Dudzevičiūt

(2017) considered renewable energy as a factor of production that affects output; they used Cobb-Douglas production function and studied the links between REC, GDP growth, trade, and LF. Their result was manifold, as the analysis confirmed the conservation hypothesis in 6 countries. While, the neutrality hypothesis was proved in 2 countries. Meanwhile, the growth hypothesis has been confirmed in 12 countries out of 28 according to techniques have been used. In a study for checking the relationship between GDP Growth, Renewable Energy, and CO2 Emissions, Mahmoodi (2017) employed Pedroni and Kao co-integration test and vector error correction model (VECM) causality for a panel data over the period (2000–2014) concerning 11 developing countries. The author found a long-run relationship beside a unidirectional causality from GDP to REC. Salim, Hassan & Shafiei (2014) used data over the period (1980–2011) and examined the dynamic relationship between REC & GDP growth. Based on the neoclassical Cobb–Douglas and using panel data techniques, a unidirectional relationship amongst GDP and REC existed.

2.1.3 Feedback Hypothesis

Furthermore, a number of studies supported the feedback hypothesis. Amri (2017) based on the Cobb-Douglas production function exploited a dynamic simultaneous-equation panel data approach over the period (1990 - 2012); in order to investigate the connection between GDP growth, renewable sort of energy, and trade. The author analyzed this relationship by separating 72 countries into three groups as per the level of development: whole, developing, high-income developing, upper middle-income developing, lower middle-income developing, lower-income developing, developed, major developed, and other developed countries. The outcomes demonstrated that both variables exert a positive effect on each other; although, they were more notable in developed countries in comparison to developing ones. The effect was higher in major developed countries group than in other developed countries and in upper-income countries than in lower-income countries. In a study

of some MENA countries (Algeria, Bahrain, Egypt Arab Rep, Iraq, Iran, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, Tunisia, and United Arab Emirates), Saidi, El -Montasser and Ajmi (2018) examined if there is a cointegration between REC and GDP by taking into account five variables: corruption, bureaucracy quality, democracy accountability, law and order and ethnic tension. By applying the necessary tests as Pedroni (2001), Westerlund (2007) and Westerlund and Edgerton (2008), also using Engle and Granger (1987) technique including vector error correction model (VECM) on the panel data over the period (1986 – 2015), they found a mutual positive significant impact between GDP and REC leading to a bidirectional causality relationship. It implicates that renewable energy have to be promoted by governments. Esseghir and Khouni (2014) depended on a Neo-classical production model and ECM model to test the relationship between energy consumption and GDP growth in 38 UFM countries over the period (1980 – 2010) by sorting them into two groups: developed and developing countries. A positive bidirectional causal relationship resulted among the two variables in both groups and for the whole panel. The result supports improving renewable energy utilization. Sebri and Ben-Salha (2014) investigated the bond amongst GDP growth, REC, carbon dioxide emissions and trade openness in the BRICS countries. By using the ARDL bounds technique study along with the vector error correction model (VECM) model over a period (1970 -2010). The authors suggested that there exists a long run relationship between GDP growth and REC. In addition, a bidirectional causality links between REC and GDP growth existed in the short run. BRICS countries have been investigated also by Sifuba (2018), whose study concerned about the causality relationship between GDP growth and REC (REC), non-REC over the period of (1990-2014). The researcher applied unit root tests, cointegration tests, and Granger-causality tests over the panel data. As a result, a long-run relationship between the two variables existed beside a bidirectional relationship between REC and GDP in both the short run and long run.

In addition, a study for Apergis and Payne (2011) aimed to determine the relationship between REC and GDP in six Central American countries for the period (1980 –2016). The researchers used Pedroni (1999, 2004) panel co-integration model and panel error correction model. Beside, to define the equilibrium relationship among the variables in the long-run, the fully modified OLS (FMOLS) model for heterogeneous co-integrated panels is estimated. The results suggested GDP, REC, LF and GFCF are co-integrated. Moreover, a feedback relationship was observed between REC and GDP both in the long run and short run. Kahia, Aïssa and Lanouar (2017) examined the energy use – GDP growth nexus in eleven MENA Net Oil Importing Countries (NOICs) over the period (1980–2012). Considering production factors involved in Cobb-Douglas production function, such as renewable energy use, non-renewable energy use, real GFCF and LF that affect level of GDP; they approved the co-integration status between the mentioned factors and GDP. Furthermore, feedback hypothesis is confirmed using panel (ECM) model which suggests that renewable and non-renewable energy use affect and cause GDP and vice versa.

2.1.4 Neutrality Hypothesis

As for the Neutrality hypothesis, Shahateet (2014) examined the nexus between energy consumption and GDP growth in 17 Arab countries: Algeria, Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, United Arab Emirates and Yemen. The author applied Augmented Dickey Fuller (ADF) unit root test and Johansen cointegration test along with an Auto Regressive Distributed Lag (ARDL) model to test panel data over the period (1980-2011). Empirical findings support neutrality hypothesis in all sampled Arab countries except for Kuwait in which feedback hypothesis is confirmed leading GDP output to be adversely affected when energy conservation policy is implied and raising the level of energy consumption when GDP output increases. Ziramba (2013) selected three African countries (Algeria, Egypt and South Africa) to define the causal

linkage between GDP growth and hydroelectricity consumption in over the interval (1980 – 2009). Engle and Granger (1987) approach was used to examine co-integration relationship between the variables in the long run. The findings resulted from the Toda and Yamamoto technique Granger non-causality test proposed the existence of neutrality hypothesis in Egypt. Besides, bidirectional causality between the determinants was confirmed in Algeria supporting the feedback hypothesis; while, in South Africa the conservation hypothesis was confirmed. Menegaki (2011) chose data of 27 European countries over the period (1997-2007). He employed random effect model for testing equilibrium relationship in the long run and (ECM) framework on 27 European over the period (1997-2007). Results suggested that no linkage between renewable energy and GDP growth even in the short-term or long-term supporting neutrality hypothesis.

Comparing to previous literature, our contribution is mainly to consider renewable energy in Cobb-Douglas production function. Unlike many previous studies concerned in the effect of energy on economic growth in the Mediterranean region, we propose to analyze the causal relationship between REC and GDP growth by choosing two clusters of five Mediterranean countries each.

Chapter3

Context description

Chapter3

Context description

3.1 Mediterranean region -level concern

Many countries considered Renewable energy sources an important topic of interest in the last decades due to the increase in energy demand and Industrial revolution. Different bodies were interested in the energy status of the Mediterranean countries during the past decades. For example, The international energy agency (IEA) and World Energy Statistics aimed to promote diverse, efficient and reliable fuels and energy sources that will free markets, to boost GDP growth, to decrease energy shortage for achieving GDP development, to facilitate collaborating with many countries especially major developing ones and to get suggestions in dealing with common energy and environmental problems; along with other objectives in many countries. IEA examined all renewable energy issues, the entrance to this sector, ways of managing the demand on its resources and much more. Through its work, IEA supported policies and mechanisms to improve credible, inexpensive and sustainable energy in its member countries and others. Dr. Birol. F, Executive Director in IEA mentioned in Renewables 2018 forecasts that renewables share in facing the growing international demand for energy is expected to reach 12.4% in 2023.

Consistent efforts and various policies were implemented in the Mediterranean region by different parties. The Union for Mediterranean countries (UFM) established in 2008 was a good podium in assisting and encouraging dialogue and teamwork among countries in the region .Different projects in energy filed were accomplished with the purpose of addressing challenges of climate and environmental changes and energy availability in the region, at the same time proceeding towards more effective and sustainable energy framework.

Mediterranean region is fertile in renewable energy sources, such as wind, sun and water; therefore, the potential shall increase to promote shifting towards more sustainable, low carbon energy systems. Consequently, several completed or outstanding researches have been made on key issues in energy sector in the region such as grid connections[3], Schemes and methodologies for operation of interconnected systems[4], various regulations for the stimulation of infrastructure investments[5] , Schemes for sharing systems services and RES integration[6]and smart grids[7] to highlight potentials that exist in the region. Besides, the Mitigation Enabling Energy Transition in the Mediterranean Region (MEETMED) project was presented. MEETMED[8] is a 2-year project, aimed to foster the energy transition at country level throughout all Southern Eastern Mediterranean countries (SEM) under the European Neighborhood Instrument (ENI). It intended to assess energy efficiency and renewable energy sources strategies and policies, attract responsible and sustainable investment and support the Union for Mediterranean (UFM) Renewable Energy and Energy Efficiency Platforms[9]. Another project, CLIMA-MED[10]with a budget of € 6,9 Millions included 8 countries to enhance energy protection and its capability during their moving to economies characterized with low carbon emissions and more cleaner environment.

[3] Available on Med-TSO cite :https://www.med-tso.com/publications2.aspx.
[4] Available on Med-TSO cite :https://www.med-tso.com/publications2.aspx.
[5] Available on Med-TSO cite :https://www.med-tso.com/mediterranean2.aspx?f=
[6] Available on Med-TSO cite :https://www.med-tso.com/publications/Deliverable_3.2__Schemes_for_sharing_systems_services_and_RES_integration_v_1.pdf
[7] Implemented by MEDREG; MEDREG refers to Mediterranean Energy Regulators Association ,itcombines 25 energy organizers from the European Union, the Balkans and North Africa countries .Cite :http://www.medreg-regulators.org/
[8] Available on: https://meetmed.org/about/ .
[9]Available on: https://ufmsecretariat.org/ufm-energy-platforms/ .
[10] The project objective is part of "Energy security and Climate action in the Southern Neighbourhood 2017-2018" programme. In 2017 European Commission has adopted it. https://ufmsecretariat.org/project/clima-med/ .

3.2 Country-level concern

On the Country- level, many countries in the Mediterranean region took some local actions, designed policies and targets through their ministries and competent bodies of energy. Countries in North Mediterranean region have common support schemes and policies in promoting for renewable energy use in different sectors such as electricity, heating and cooling and transport.

In France, government promoted electricity generation from renewable sources through different mechanisms as **a feed-in tariff (FIT):** a policy tool set for speeding up investment in technologies of renewable energy. By considering the costs incurred by energy production companies to generate energy by using different technologies, French government offered long-run contracts to renewable energy producers instead of paying the same amount for energy regardless the technology used to generate it. For example, wind and solar power are paid a lower per-KWh value, whereas energy generated by tidal power[11] technologies are offered a higher price, as costs incurred to obtain this form of energy are higher. Hence, energy producers are encouraged to focus on exploitation one technology over another. Furthermore, France allowed some renewable energy producers to benefit from a premium tariff over the sale price they earn in the electricity market when generating it from other energy sources as fuels, in order to cover the costs of their installations and ensure their profitability (so-called "compensation mechanism").Tenders for constructing renewable energy plants were announced according to the (Programmation Pluriannuelle des Investissements PPI)[12] investment plan for achieving the predetermined capacity of energy. Additionally, income tax credit (**créditd'impôt**) deduction was provided to individuals for their investments in renewable energy plants and a VAT deduction for those who installed

[11]**Tidal power: a type of** hydropower that transforms tides power into electricity.
[12] Available on: https://www.emploi-environnement.com/ .

photovoltaic installations on private buildings. In heating and cooling sector, many energy subsidies included several measures aimed to reduce per KWH price generated from renewable sources for consumers or increasing it for producers above the market price of KWH of electricity generated from primary energy, tax exemptions measures, restrictions and limitations on trade and market access that will secure supply of energy and reduce importing it. Besides, promoting investments for constructing renewable energy plants was implemented through granting zero -interest loans. While, in transport sector, importers and producers of primary energy sources as fuels and gas were obligated to a quota system to ensure that renewable energy sources made up a particular percentage of annual energy sales in the economy.

In Spain, the government encouraged electricity generation from natural non-depleted sources through different instruments like the Specific remuneration regime (2017)[13]that aimed to provide specific remunerations for new renewable energy plants established through calling for tenders. Until October 2018, a new regulation includes contribution mechanism was performed to determine charges on the current and new plants constructed for RES consumedon an individual level. According to it, RES consumed on an individual level are free from any charges and proceedings have been simplified for their consumption. In addition, a quota system for bio fuels was performed. Furthermore, training policies and giving certifications for installing solar panels were conducted. Buildings having big RES -thermal plants were also subsidized financially. Moreover, in the scope of supporting sectors as transport,heating and cooling and electricity that depends on RES, Spanish government published a new research, development and deployment plan to be achieved over the period(2017- 2020).

[13] Available on :https://sede.cnmc.gob.es/tramites/energia/regimen-retributivo-especifico-circular-12017

In Italy, in their proceeding efforts to support renewable energy sector, the Economic Development Ministry accepted an intended plans suggested by Renewable Energy Ministerial Decree ("Decreto FER 2018-2020").Italian government obliged grid operators to give priority access to renewable energy plants and to give primary delivery to electricity produced from RES. At the same time, currently a quota systems supported bio fuels. Also, for improving installations in RES-heating and cooling sector a price mechanism was developed. Italian government regulated training programmes for RES-plant installers. In addition, according to the legislative provision DM 37/08, a compliance certificate for some standards is required from each installer of RES- plants. Within the intended plan, additional fees were imposed on consuming natural gas. In addition, zero-interest loans were offered for encouraging investment in RES plants.

In Greece, since 2017 RES- electricity production was supported through a feed-in premium 14(FIP). A net metering scheme which is a policy designed to raise private investment in renewable energy by allowing consumers who generate some or all of their own electricity to use that electricity anytime, instead of when it is generated. Tax regulation mechanism and subsidies foreseen in the Development Law IN 2016, as well as an income tax relief and a quota system renewable energy use in transport were regulated. Greece took a number of measures as designing national programmes aimed to promote energy efficiency by using RES in buildings and to provide financial support for the improvement of research and development.

Turkey is a nominee country for EU, so its measures and policies are projected to be consistent with the EU legislations. Their mission is decreasing imports of energy and reducing greenhouse gas emissions by encouraging RES-electricity production in EU. Tools to

[14]FIP: RES- electricity production is sold in the market on the spot then producers are given a premium on top of the market price.

promote that aim were adopted such as feed-in tariff and a tender support scheme in defined Renewable Energy Zones (YEKA-zones)15.Law No.(5346) in published (2005) included several incentives for RES-electricity production. One of them is: facilitating of land possession and feed-in-tariffs. In 2001, Law (No. 4628)was the first tool towardsmotivating RES-electricity production. In the context of this law, exemption from licensing requirements and constructing a company were provided for individual and corporations built facilities to generate RES-electricity production having maximum installed capacity of 500 kW.

During the last two decades, a comprehensive review for regulations and measures adopted in the Mediterranean region showed that the most common renewable energy support mechanisms as feed-in tariffs (FITs) were adopted in some MED-11 countries[16] (e.g. Israel) ,but not in other countries up till now (e.g. Morocco, Algeria).This scheme was under consideration in all MED-11 by the governments beside simplified authorization procedures or tax exemptions were under process. However, in Algeria there was no clear national frame in the desired schemes for supporting renewable energy such as: Tax regulations, fiscal incentives and FIPs. In particular cases, renewables sector was given no priority access and management because of the deficiencies in regulations adopted by some countries as in Morocco or in Israel. At the meanwhile, Tunisia provided access to electricity grid for renewable energy auto producers.

Many MENA governments adopted renewable energy targets in their agendas following other advanced countries trend. Egypt announced that renewables will contribute by 20% of electricity production by 2020; while, Tunisia will achieve 30% by 2030, Algeria 27% by 2030 and 42% of electricity installed capacity aimed to be reached by Morocco in 2020. These

[15]YEKA-zones :The General Directorate of Renewable Energy conducts tenders in Renewable Energy Zones

[16] MED-11 countries: (Algeria, Egypt, Israel, Jordan, Lebanon, Libya, Morocco, Palestinian Autonomy, Syria, Tunisia and Turkey)

targets seemed to be ambitious. Tough and clear roadmaps need to be followed to achieve the preset targets. In 2009, Morocco and Tunisia launched their projects in renewables sector, called “Solar Plans,”; later on , in 2011 Algeria started a “Renewable Energy Development Plan,” and the “Egyptian Solar Energy Plan” was promulgated in 2012 (IEA/IRENA, 2015). It is worth mentioning that, the achieved accomplishments in renewable energy sector in MENA countries lacks the necessary evaluation, review and monitoring process beside that when targets are mismatched no sanctions are imposed on those countries to address their compliance.

In general, manufacturers of renewable energy ingredients were encouraged in many MENA countries by the implementation of national supporting plan to facilitate their production of components necessary to create solar and wind plants. An industrial policy was adopted in Algeria to encourage manufacturing the elements and components needed for installing solar panels using (FITs) scheme (CDER, 2014). The participation of the private sector was a mechanism applied in the deployment process of RE sector. Besides, a purchase agreement for energy made with the private sector in Egypt permitted investors to construct, own and operate RE stations and sell the produced electricity to distribution companies within a specific period and under a defined price. However, the national electricity companies (monopolists of electricity sector) in most MENA countries rely on generating power basically from fuels (oil and gas). Hence, a resistance always existed against manufacturing instruments and components for renewables. In Tunisia, for instance, a proposed law to enhance private sector involvement in RE sector had strongly resisted by the national electricity utility (L’Economiste Maghrebin, 2014). Electricity market monopolists are the main barrier for not achieving the predetermined targets for renewable energy use, but in order to overcome this barrier, MENA countries can liberalize their electricity market by enacting new regulations for renewable energies.

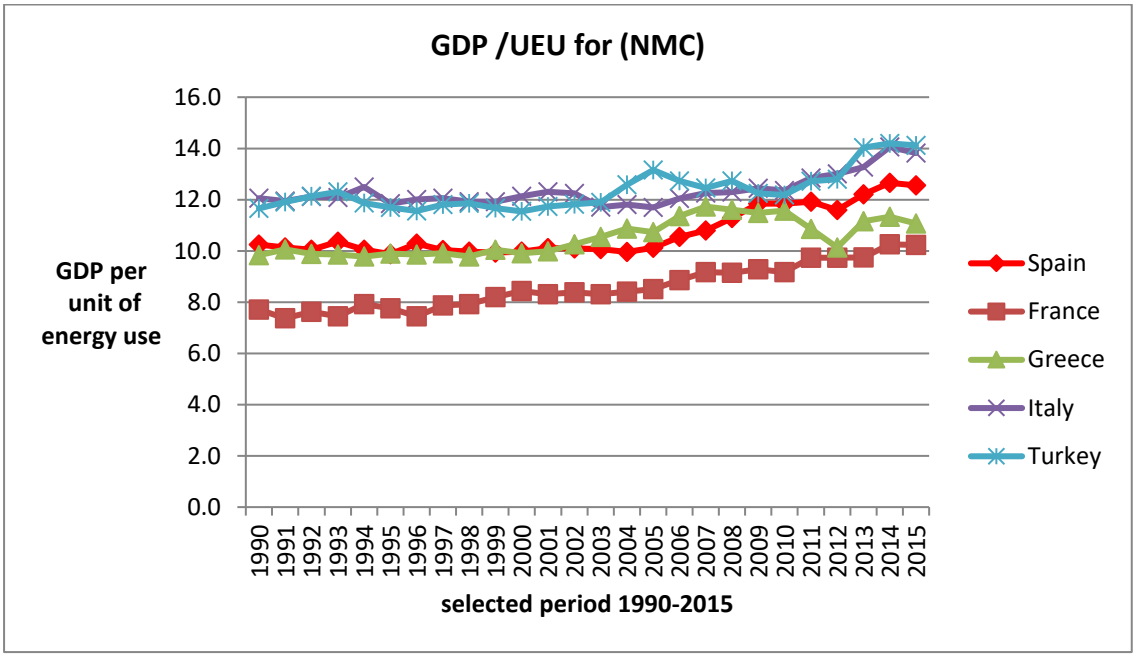
3.3 REC VS. GDP /UEU

Data was collected from World Bank site for analysis and finding the nature of the nexus, if existed, between GDP/UEU and REC for some representative countries in the Mediterranean Region. It has been divided into North –South countries depending on the great attention to the issue of renewable energy and related policies; in order to ensure the positive impact in achieving sustainable development.

Chart 1 and Chart 2; show how GDP/UEU and REC for (NMC) change at same time in the long run, respectively. As we can see, the GDP/UEU for the selected (NMC) is following almost the same pattern of REC over time except for Turkey. For Turkey, its GDP/UEU is increasing while renewable energy percentage of the total energy consumption is decreasing, this could be explained from the perspective of the conservation hypothesis mentioned previously.

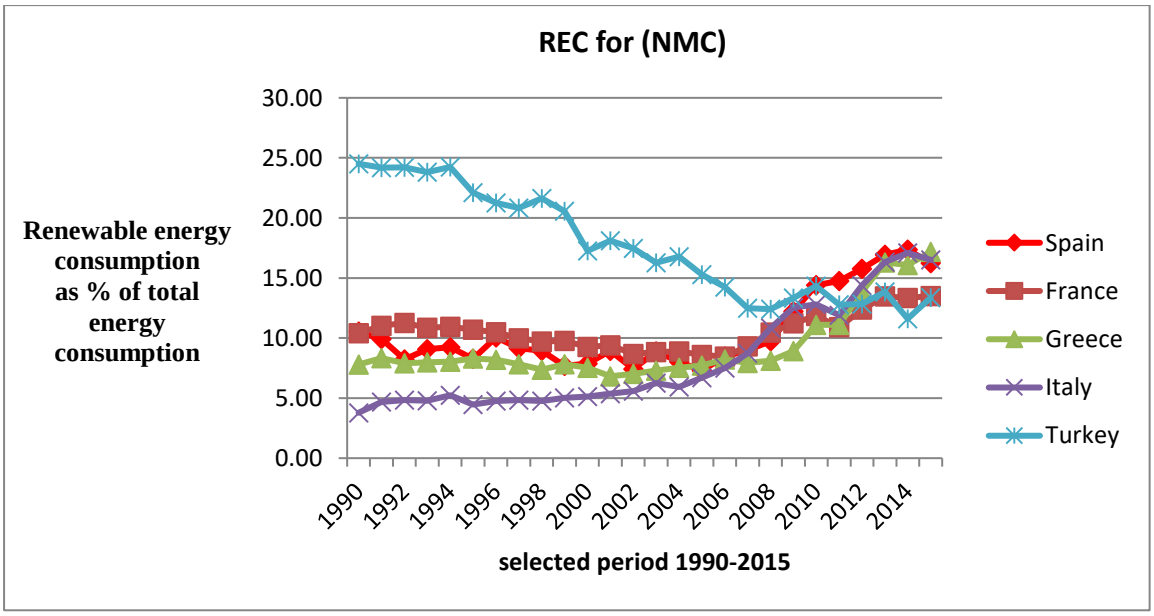
However, from the data selected we calculated the average growth rate for GDP/UEU and REC over the period (1990-2015). Cluster 1, presented 19.99% and 34.64%, respectively. It seems that for the whole cluster, the two variables are moving together in the long term which indicates a presence of some relationship between REC and growth in GDP per unit of energy use positively.

Chart 1



Source : World Bank data. Available on : https: //data.worldbank.org/indicator/EG.GDP.PUSE.KO.PP.KD.

Chart2



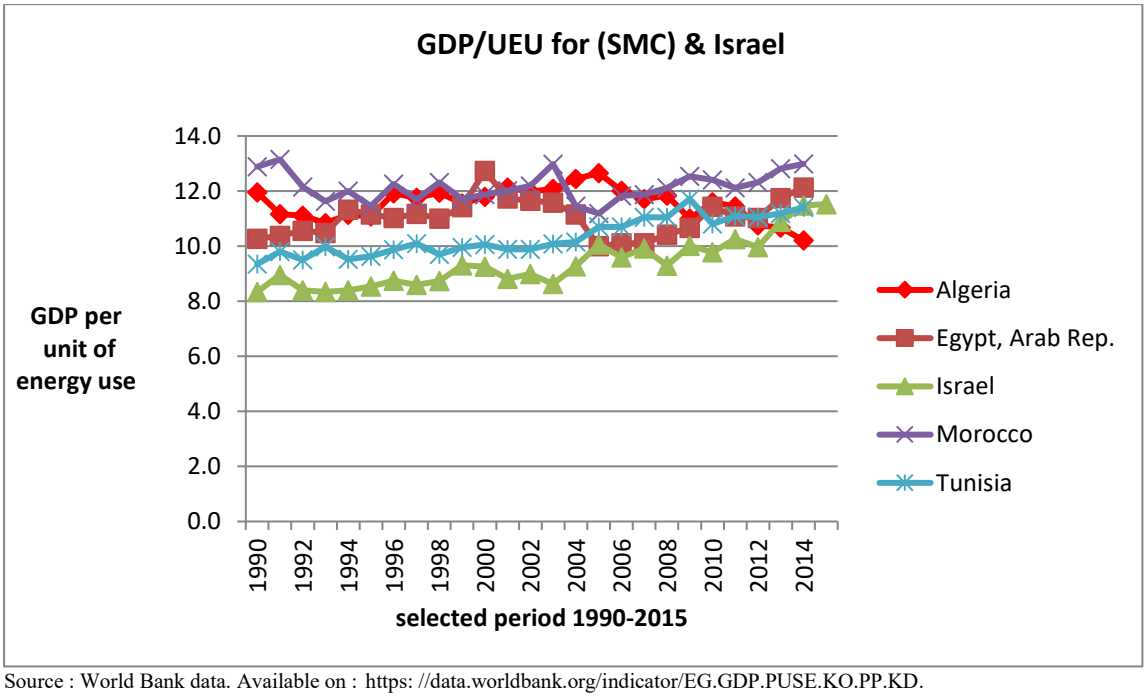
Source : World Bank data. Available on : https://data.worldbank.org/indicator/EG.FEC.RNEW.ZS

While Chart3 and Chart4 exhibit how GDP /UEU for and REC for (SMC) change at same time in the long run, respectively. It seems that, the change in GDP/UEU for the selected (NMC) over time is following a pattern that is quite different from the change in REC for all

countries. Apparently, the decrease in REC percentage of the total energy consumption over time, did not affect the path of GDP/UEU for all the countries which exhibits a slight increase in the long run. This could also be explained from the perspective of the conservation hypothesis mentioned previously.

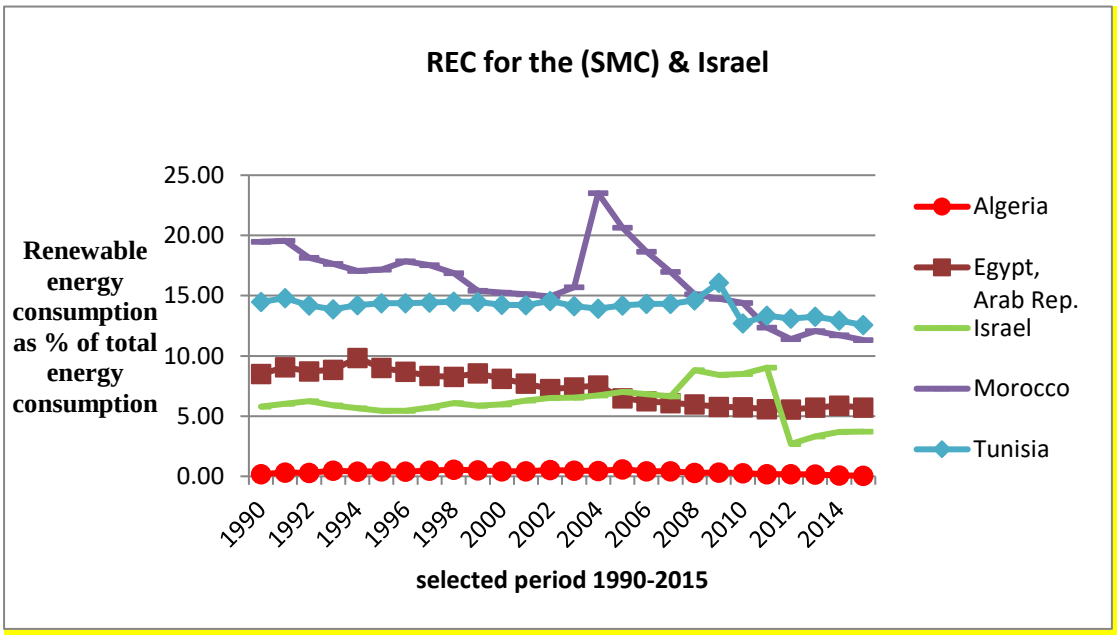
Again, from the data selected we calculated the average growth rate for GDP per unit of energy use and REC over the period (1990-2015). Cluster 2, presented 10.25% and -31.14%, respectively. It seems that for the whole cluster, the two variables are moving in a different direction in the long term which indicates that an increase in REC may affect growth in GDP/UEU negatively.

Chart3



Source : World Bank data. Available on : https: //data.worldbank.org/indicator/EG.GDP.PUSE.KO.PP.KD.

Chart4



Source : World Bank data. Available on : https://data.worldbank.org/indicator/EG.FEC.RNEW.ZS

As we can note at table 1 below, the average GDP/UEU for countries belonging in cluster1 is 1.0325 $ per kg of oil equivalent; in the second cluster there is an average of 1.0345 $. The average REC of the first cluster is 11.238%, while countries in the second cluster consume an average of 8.809 %. It is remarkable that the countries of the second cluster have a greater deviation comparing to the first cluster. Beside that, the results in appendix 1 show that GDP/UEU and REC are correlated by 28% in cluster 1 , while they are correlated by 10% in cluster 2.

Table1. Clusters According to GDP/UEU and REC

		GDP/UEU		REC	
		Mean	Std.Deviation	Mean	Std.Deviation
Cluster	1	1.0325	0.06689	11.238	4.8012
	2	1.0345	0.0484	8.809	5.9636

Chapter 4

Theoretical Frame work

Chapter 4
Theoretical Frame work

Many economists believed in the role of energy for economic development Georgescu - Roegen (1979a), Stern (1997, 1999), (Hall et al. 2001), Stern and Cleveland (2004) and Lee and Chang (2008). Modern Economists considered energy an important input in the production process unlike the advocates of Classical Model, Harrod-Domar Theory, Neo – classical theory, new growth theory.

Briefly, each theory pillars will be mentioned in this section. The Classical Model developed by Ricardo and Malthus assumed there will be no technological change and increasing inputs (labor) could lead to diminishing returns. Malthus suggested that any improvement in technology will not increase food output, so he under-estimated the ability of technology advance to affect output. Harrod-Domar growth model has extended the full employment and income theory developed by Keynes which is concerned about the short term changes to involve changes in the long term. They have provided a model in that:

a) Capital accumulation is considered a major element in boosting any economic growth.

b) Considers that labor and capital are complementary to each other not substitutes.

Their production function is: $Y = K_k$, (k>0)

The Neo-classical theory presumes that specific factors as capital stock, labor, and technological improvements are determining the economic growth across time. In addition, it considers that labor and capital are substitutes to each other.

The production function: Y = F (K, L, T).

New growth theory: The new growth theory models considered knowledge or information as fairly endogenous factor such as research and development (R&D), unlike preceding models.

Unlike neoclassical theories of growth which assumed marginal capital productivity is diminishing, Hulten (2000) proposed that the new assumption is being constant not diminishing. According to the new growth theory, capital factor involves investments in knowledge, human capital and R&D activities.

Production process includes two types of inputs: Primary and Intermediate inputs. Primary inputs such as capital, labor and land are not directly consumed in production process; while intermediate inputs as materials and fuels (energy) are needed and consumed totally during the process (Stern, 1999a). From that, previous growth theories focused mainly on the primary inputs and gave insignificant role for energy. For instance, Neo-classical Solow's growth model (1956) presumes GDP growth happens mainly as a result of exogenous technological changes which affect the rate of return to capital. Moreover, sustainability[17] in his view is always affordable and technically feasible when renewable and non-renewable resources are available and the ease of substitution among inputs of production exists, so they focused at most on the institutional requirements. The structure of market and property rights and value systems concerning about future generations' welfare are examples of institutional requirements.

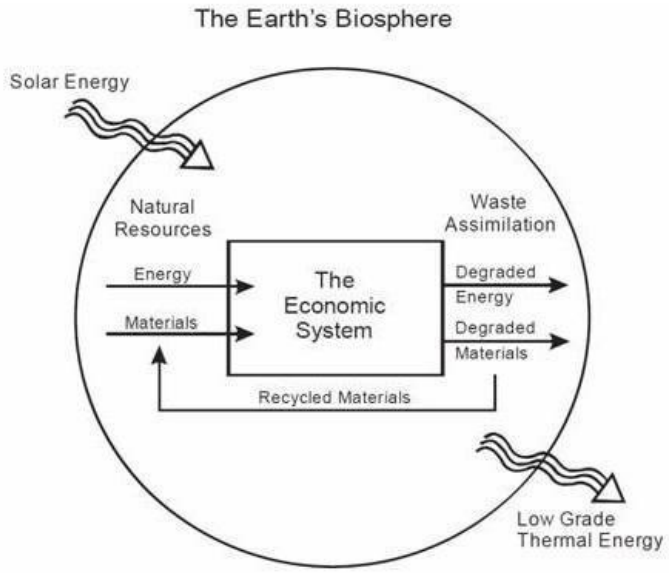
A few decades ago, based on the principle of entropy: Georgescu-Roegen (1979b) argued that the relevance of thermo dynamics to economics showed that energy cannot be created or destroyed in the economic process but it is being transformed. Production and 'consumption' are verbal terms manage this process in economics. Followers of Georgescu-Roegen believed that economic sphere is part of the natural world and not separated from it, yet they are quite depending on each other.

However, Ecological economists took into account the scarcity of resources that will restrict economic growth if limits existed in substitution between inputs and in technological progress.

[17] Sustainability is: (non-declining social welfare)

They argued the way neoclassical theory considered natural capital and human-made capital (labor and technology) as substitutes and ignoring nature role in creating wealth as energy. Ecological approach is distinguishable from main stream models by its emphasis that economy is a part of the environmental system and a continual interaction exists that must be taken into consideration in economic models. Hence, this system contains several components such as: energy and human economy.

The chart below shows us a circular flow of income diagram which exhibits the way solar energy entrance keeps natural inputs and environmental services that later will be used as units of production. Ecosphere involves economic System as a subsystem.



By: W. Rees

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Moreover, based on biophysical approach, Ecological economists incorporated energy as a key input in the production process expanding the traditional solo-swan growth model. Ecological model asserts that a flow of materials and energy will be needed at all stages of production by other factors –human and manufactured capital. Pokrovski (2003) treated energy as labor an essential production factor, so it acquires all the characteristics of any other

production factor .Though, if more of other production factors as manufactured capital is needed, more of energy will be needed to provide it, so ecologists suppose energy is a necessary input to produce output and other inputs, simultaneously. Thompson (2006) assumed that additional jobs which convert raw materials to capital are created when using further quantity of energy. Some economists (Georgescu- Roegen, 1979a; Cleveland et al., 1984; Kaufmann, 1992; Stern, 1997b) argued that conventional production functions assumed energy and capital are substitutes which is not true and ignoring the interdependence between them. Thus, energy will be considered "non-essential" if elasticity of substitution is greater than one. However, if it is less than or equal to one, then energy will be "essential." Given other inputs in production are positive, if energy input is zero then output will be equal to zero, but if it is positive output surely will be positive. Cobb-Douglas function satisfies the fundamental condition which at least considers that a mix of energy and materials are required in goods and services production (Stern and Cleveland, 2004).

This section illustrates our model based on the exogenous-growth theory, commonly called the conventional neoclassical aggregate production (Solow-Swan) function, that was pioneered by Solow (1956) which illustrates the correlation between production factors (capital and labor) and real GDP. Because we consider energy is a crucial factor of production, we utilize the following adjusted neo-classical Cobb-Douglas production function used by Lee and Chang (2008); Amri (2017); Inglesi-Lotz(2016) and Naseri et al. (2016) determine energy as a factor of production as it has a great impact on output :

$$Y = f(K, L, EC)$$ Where, Y is total output or real GDP, K, L and EC represent real capital stock, labor force and energy consumption inputs, respectively.

Chapter 5

Methodology and Data

Chapter 5

Methodology and Data

5.1 Data

In this study, our data includes GDP expressed in Purchasing Power Parity (PPP)[18] in constant prices of 2011 (international $) per kilogram of oil equivalent[19] of energy use, REC expressed as renewable energy share in total final energy consumption (%), total labor force and Gross fixed capital formation expressed in current U.S. dollars. Annual balanced data from 1990 to 2015 for two panels of 10 selected Mediterranean countries were obtained from the World Bank data, International Energy Agency (IEA) statistics, OECD National Accounts data files, International Labor Organization and ILOSTAT database. We transformed variables to a logarithmic form, with the aim of interpreting the resulted coefficients from panel regressions as elasticities.

5.2 Econometric Technique

This subsection presents the general panel data econometric tools that have been selected. First, we grouped the selected 10 Mediterranean countries into two clusters. The first one includes the (NMC) (Spain, France, Italy, Greece and Turkey); while the second one contains the (SMC) (Algeria, Morocco, Tunisia and Egypt) besides Israel, as in Table 2. The following techniques and models were implemented on both clusters.

[18]World Bank defines PPP as" the converted gross domestic product into 2011 constant international dollars by using PPP rates".

[19]Kilogram(s) of oil equivalent (kgoe): by custom, how much energy can extracted from one kilogram of crude oil.

Table2. Countries as Divided into Two Clusters

	Cluster distribution			
	number of countries		countries are	% of combined
Cluster	**1**	**5**	**Spain, Greece, Italy Turkey, France.**	**50%**
	2	**5**	**Algeria, Morocco, Tunisia Egypt, Israel.**	**50%**

In the empirical analysis, we'll examine the properties of the variables mentioned in the previous section to evade the likelihood of spurious regression. At first step, we realized the integration properties of the panel. We performed the (Im et al., 2003) (IPS) –unit root test to provide an analysis of sensitivity and robustness. It treated unit root existence, by assuming the null hypothesis as the variable is non-stationary while the alternative hypothesis is when variable is stationary or there is no unit root.

Next, we'll test if the variables are co-integrated in the long run by using two approaches: Pedroni (1999, 2004) and Kao (1999). Pedroni and Kao tests are based on the cointegration test of Engle-Granger (1987) two-step method. The latter cointegration test is based on examining the residuals resulted from carrying out a simple OLS regression using I(1) variables. Residuals should be I (0) when variables are co-integrated. Pedroni and Kao expanded the Engle-Granger scope to specially involve tests for panel data. Hence, if the GDP/UEU, LF, REC and GFCF are co-integrated, then equilibrium relationship in the long-term exists.

Later, after testing the co-integration status between variables, Panel Autoregressive Distributed Lag (ARDL) technique has been used to detect the long-term and short-term elasticities, the short-run deviations from the long-run equilibrium path and at what speed these deviations have adjusted towards the long-run equilibrium path each year. To perform panel ARDL model first it is essential to find out the optimum lag length. It can be determined by using VAR lag order selection criteria, presented in Appendix 2.

In order to determine the effect of variables under consideration, error correction models (ECM) where conducted with focusing on the special characteristic of pooled mean group (PMG) model over the other estimations that is based on error correction, Mean group (MG) and Dynamic Fixed Effects (DFE). The (PMG) model has been inserted in the panel ARDL structure by Pesaran et al. (1999) [20]. In our study, homogeneity in cluster 1 may be a result of the countries' desire to promote heavy intensive use of renewable energy resources, in addition to the cooperation efforts were represented by unions' formation between the EU countries in the last two decades. However, in cluster 2,the general attention for this sector is still languid as a baby steps in shifting towards more sustainable energy systems. Furthermore, it may result from the consistent of the selected countries with the objectives set by their governments by 2020 or 2030 strategies that aim to reduce consuming primary energy and realizing a steady share of renewable energy in the total energy consumption. Therefore, raising energy efficiency in renewable energy sector should decrease energy demand on traditional energy sources in the economy and defines some methods to reduce the reliance on them solutions in the long term. In general, PMG estimator takes into account that economies of countries are different in the short term; while, it presumes the existence of similar effects in the long term. Thus, if the dependent variable and the other regressors in a model are co-integrated in the long term, then PMG estimation method can be applied. If this hypothesis assured, the estimation of coefficients can be obtained in the long run based on the ARDL model.

The main objective of our study is examining the four hypotheses that clarify the relationship between GDP/UEU growth and REC in a case of two clusters with comparable strategies and policies have been carried out to enhance using renewable energy resources in the few past decades, in spite of the dissimilarities between economies. Consequently, we intend to figure

20 The pooled mean group approach (PMG)assumes homogeneity of the individual co-integrating vector across countries

out the type of relationship between the two variables on the short term, in order to understand the particular dynamics and forces that stimulate growth in the selected economies. Besides, we mainly intended to find the linkage on the long term, by considering the membership to several unions within the Mediterranean region. In this context, the panel Auto-regressive Distributed Lag (ARDL) model is selected to investigate the long term and short term cointegration correlations among the variables (GDP & REC) and we extract the ECM (error correction version) of the panel characteristics to identify the short-term dynamics, and to use it all variables must be co-integrated from the same level of integrations. The selection of this model among others as it is convenient to homogenous economies suggesting a perception on the transmission process to a new energy system for each cluster, by assessing the short run relationship, plus its effect on the economic development through assessing the long run relationship. ARDL model has other features concerning the accuracy of econometric assessment. First, ARDL model can be applied according to Pesaran & Pesaran (1997) irrespective if the variables are $I(0)$ or $I(1)$ or a mix of both, stationary or non-stationary, so we avoid before checking for the co-integration any problems existed in the unit root test, as equation (1) shows:

$$Y_{it} = \alpha_{it} + \beta'_{it} X_{it} + \varepsilon_{it} \dots\dots\dots eq(1)$$

In Equation (1), i = 1, . . . , n is the country index, t = 1, . . . , T is the time index and ε_{it} a random disturbance term. Besides, ARDL cannot be used even though one variable has a higher degree of integration, for instance $I(2)$. In equation (2), panel ARDL with various variables can include various lags, which are inapplicable using the other cointegration tests .Indeed; some assumptions are usually made about the parameters, the errors and the exogeneity of the regressors.

$$Y_{it} = \alpha_{it} + \sum_{i=1}^{k} \delta_{ij} Y_{j,t-i} + \sum_{i=0}^{q} \beta'_{it} X_{j,t-i} + \varepsilon_{it} \dots..\text{eq (2)}$$

Moreover, an error correction model (ECM) can be obtained according to ARDL model, which combines the dynamics and variations in the short run and the equilibrium status in the long run. The selection of the optimal ARDL model includes correcting the residual serial correlation automatically and addressing the endogeneity problem (Pesaran &Shin, 1999). In the literature, it has been recommended to use this model based on the interval length selected and the cross sections number tested. Therefore, ARDL is used once the number of years considered are greater than cross sections number.

According to Pesaran et al. (2001), to test the possible correlation between the variables mentioned in Cobb-Douglas function during the stated period, a log-linear specification was used (eq (3)). The applied log-linear specification was of the following form:

$$\ln GDP_{(t)} = \alpha_0 + \alpha_1 \ln GFCF_{(t)} + \alpha_2 \ln LF_{(t)} + \alpha_3 REC_{(t)} + u_t \dots eq(3)$$

The relationship between GDP growth and REC can be presented in the panel ARDL form. As following in Equation (4), the production function of panel ARDL that ought to be analyzed is presented as the following:

$$\begin{aligned}\Delta lnGDP_{it} = {} & \beta_1 + \sum_{i=1}^{k} \alpha_{ij} \Delta lnGDP_{j,t-i} + \sum_{i=0}^{k} \beta_{ij} \Delta lnGFCF_{j,t-i} + \sum_{i=0}^{k} \gamma_{ij} \Delta lnLF_{j,t-i} \\ & + \sum_{i=0}^{k} \alpha_{ij} \Delta REC_{j,t-i} + \theta_1 lnGDP_{j,t-1} + \theta_2 lnGFCF_{j,t-1} + \theta_3 lnLF_{j,t-1} \\ & + \theta_4 REC_{j,t-1} + \varepsilon_{it} \dots \dots \dots \dots \dots eq(4)\end{aligned}$$

Variables previously explained in data section. Furthermore, t is time, i refers to the studied country, Δ is the 1st variation factor, and k is the ideal lag length. To investigate the long-term cointegration correlation between the determinants, the below assumptions are formed:

$H_0: \theta_1 = \theta_2 = \theta_3 = \theta_4 = 0$ (There is no cointegration).

$H_0: \theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq 0$ (There is cointegration).

The no cointegration assumption can be investigated and compared with the assumption of cointegration applying the F test. Two groups of main rates were computed; I(0) identified

with lower restriction, and I(1) identified with higher restriction. If the F statistics surpass the I(1), we reject the null assumption and a cointegration correlation is concluded. If they result below the I(0), we cannot disapprove the null assumption, and if they result between the I(0) and I(1), a derivation cannot be generated properly. Generally, if a long term correlation among the variables is approved, in the below long run and short run in Equations (5) and (6), the models will be estimated simultaneously:

$$lnGDP_{it} = \beta_2 + \sum_{i=1}^{k} \alpha_{i2}\, lnGDP_{j,t-i} + \sum_{i=0}^{k} \beta_{i2}\, lnGFCF_{j,t-i} + \sum_{i=0}^{k} \delta_{i2}\, lnLF_{j,t-i} + \sum_{i=0}^{k} \gamma_{i2} REC_{j,t-i} + \varepsilon_{it2} \dots\dots\dots eq(5)$$

$$\Delta lnGDP_{it} = \beta_3 + \sum_{i=1}^{k} \alpha_{i3}\, \Delta lnGDP_{j,t-i} + \sum_{i=0}^{k} \beta_{i3}\, \Delta lnGFCF_{j,t-i} + \sum_{i=0}^{k} \gamma_{i3}\, \Delta lnLF_{j,t-i} + \sum_{i=0}^{k} \alpha_{i3}\, \Delta REC_{j,t-i} + \vartheta ECT_{j,t-i} + \varepsilon_{it3} \dots\dots\dots eq(6)$$

Where, ECT is the error correction term and the ϑ is the coefficient that can validate the quickness of changes of the variables for reaching to equilibrium. In addition, the coefficient gives input regarding the long-term correlation between the variables as shown in Equation (7).

$$ECT_{j,t} = lnGDP_{it} - \beta_2 - \sum_{i=1}^{k} \alpha_{i2} lnGDP_{j,t-i} - \sum_{i=0}^{k} \beta_{i2} lnGFCF_{j,t-i} - \sum_{i=0}^{k} \delta_{i2} lnLF_{j,t-i} - \sum_{i=0}^{k} \gamma_{i2}\, REC_{j,t-i} \dots\dots eq(7)$$

In the last step, as the ARDL method detects the long term cointegration relationships, it does not point out causality relationship between variables. Thus, an extension designed by Dumitrescu and Hurlin (2012) to test the Granger causality in panel data was implemented. The following regression writes as follows:

$$Y_{i,t} = \alpha_i + \sum_{k=1}^{K} \beta_{ik}\, y_{i,t-k} + \sum_{k=1}^{K} \gamma_{ik}\, x_{i,t-k} + \varepsilon_{i,t} \ldots\ldots eq\ (8)$$

Where $x_{i,t}$ and $y_{i,t}$ are the observations of two stationary variables for individual i in period t. Coefficients will differ across individuals ((i) subscripts related to coefficients), but they are supposed to be unchanged across time. K represents the order of lag which presumed to be the same for all individuals and the panel must be balanced.

For determining the presence of causality direction the procedure is to check if past values of x affect significantly the values of y. Therefore, the null hypothesis will be as following:

$$H_0 : \beta_{i1} = ... = \beta_{ik} = 0 \ \forall\ i = 1, ..., N$$

The test of Dumitrescu and Hurlin presumes the existence of causality for some individuals but not essentially for all. Thus, the alternative hypothesis will be:

$$H_1 : \beta_{i1} = ... = \beta_{ik} = 0 \quad \forall\ i = 1, ..., N1$$

$$\beta_{i1} \neq \text{ or } \beta_{ik} \neq 0 \ \forall\ i = N1 + 1, ..., N$$

Where $N_1 \in [0, N - 1]$ is unknown. If $N_1 = 0$, the causality relationship exists for each individual in the panel. It is very necessary to have N_1 smaller than N; otherwise all individuals will have no causality and H_0 would not be rejected.

Chapter 6

Empirical Analysis

Chapter 6

Empirical Analysis

In this chapter, the study displays the outcomes of panel ARDL model application. Thus, first we checked the stationarity of variables in two panel data series to examine if ARDL model is valid to use or not. Later, the existence of cointegration relationship between GDP/UEU growth and REC is tested. Posteriorly, depending on minimum of (AIC) and (FPE), we got the optimum lags number of the ARDL model. Since cointegration relationship is confirmed, error correction models become possible to be tested to obtain the long-term and short-term relationships between variables. Lastly, the four hypotheses that clarify the relationship between GDP/UEU growth and REC are tested using the Granger causality test designed by Dumitrescu and Hurlin (2012). STATA software is used in estimating the results of the ARDL model.

6.1. Panel Unit root test:

Gujarati and Porter (2004) defined an assumption for long time series data used in OLS approach, it states: “data must be fixed in repeated sampling”. More clearly, it means that stationarity of variables is a necessary condition to apply the OLS model. Table 2 below shows panel unit root test “Im, Pesaran and Shin (IPS)”, IPS (Im et al., 2003), as applied by Inglesi-Lotz (2016), Adhikari & Chen (2012), Marinas et al (2018) and Apergis and Payne (2011).

Table 3, shows that LnGDP/UEU, LnGFCF, LnLF and REC are non-stationary at their level form for cluster1 countries (NMC) because the respective P-values are greater than 5% so that we cannot reject the null hypothesis of the unit root existence. However, if we take the first difference of all the variables respectively then they become stationary because the respective

P-values are less than 5% now so that we can reject the null hypothesis of a unit root presence. On the other hand, for cluster2 countries, we can also say that variables LnGFCF and REC are non-stationary while others (LnGDP/UEU and REC) are stationary at their level. Since we have mixed-order of integration for variables, this suggests applying panel ARDL co-integration based model in order to test for the presence of a long-term equilibrium relation between the variables.

Table (3): Panel Unit Root Test– Im, Pesaran and Shin (IPS) Results for the Clustering Countries in 1990-2015

Region	Variables	Level		1ST Difference		I( )
		Constant	Constant & trend	Constant	Constant & trend	
Cluster 1	Ln(GDP/ UEU)	3.2135 (0.9993)	-0.016 (0.4936)	-9.8249*** (0.0000)	-9.3010*** (0.0000)	I(1)
	Ln(GFCF)	1.5941 (0.9445)	3.0073 (0.9987)	-5.3703*** (0.0000)	-4.0586*** (0.0000)	I(1)
	Ln(LF)	2.3235 (0.9899)	3.6461 (0.9999)	-5.8909*** (0.0000)	-7.2312*** (0.0000)	I(1)
	REC	4.7163 (1.0000)	3.1489 (0.9992)	-6.9969*** (0.0000)	-7.4113*** (0.0000)	I(1)
Cluster 2	Ln(GDP/ UEU)	-1.6616** (0.0483)	-1.8618** (0.0313)	-11.2176*** (0.0000)	-10.4521*** (0.0000)	I(0)
	Ln(GFCF)	1.7592 (0.9607)	0.9403 (0.8265)	-4.3679*** (0.0000)	-2.9497*** (0.0016)	I(1)
	Ln(LF)	-5.0537*** (0.0000)	-0.7474 (0.2274)	-5.4925 *** (0.0000)	-7.5548*** (0.0000)	I(0)
	REC	-0.0832 (0.4668)	-1.2037 (0.1144)	-11.5068*** (0.0000)	-11.1749*** (0.0000)	I(1)

Note: The values in parentheses, (), are the corresponding probability value. ***, **, and * represent the significance at levels 1, 5 and 10%.

6.2. Panel Co-integration Tests:

Next, testing the co-integration status of variables will be performed by using Pedroni's test (1999, 2001, and 2004). Adhikari & Chen (2012), Marinas et al (2018), Apergis and Payne (2011), Mahmoodi (2017) applied the test in their studies ; in order to confirm the belief of

Coiteux and Olivier (2000) in the higher -power results obtained from panel co-integration tests comparing to those traditional ones. Thus, Co-integrations for constant and constant plus time trend are executed and results of co-integrations analyses summarized in Table 4.

For cluster 1 countries, as all the variables are I(1) in nature we can check whether they are co-integrated or not, that means whether there is long-term equilibrium bond among the variables or not. If they are co-integrated then we can say that they have long-term association that means in the long-run they will move together. But for cluster 2 countries since some of the variables, but not all are non-stationary at level, this could lead to spurious results unless co-integration between the variables is asserted.

In table4, Pedroni (1999; 2004) residual based panel co-integration test is provided. There are seven statistics in Pedroni co-integration test. From the results tabulated below, we observe for cluster 1countries that among the seven statistics three of them are statistically significantly different from zero at 5% and one at 10% and the rest three statistics are not statistically significantly different from zero, also for (cluster 2 countries) that among the seven statistics three of them are statistically significantly different from zero at 5% and one at 10% and the rest three statistics are not statistically significantly different from zero. Based on the p- values in parenthesis we can deduce that the majority statistics are statistically significantly different from zero we can reject the null hypothesis. As we reject the null hypothesis at 5% of significance level we can accept the alternative hypothesis that means variables are co-integrated according to Pedroni co-integration test. In conclusion, there is a long term co-integration among our variables in cluster1 and cluster 2 countries.

Table (4): Panel Co-integration Test – Pedroni Residuals- Results for the Clustering Countries in 1990-2015

DEPENDENT VARIABLE: Ln(GDP/UEU)					
Null Hypothesis: No Co-integration					
Region	**Series: LnGDP/UEU, LnGFCF, LnLF, REC**	**without trend**		**with trend**	
		Statistics	**Prob.**	**Statistics**	**Prob.**
Cluster 1	**Alternative hypothesis common AR coefficients (within dimension)**				
	Panel v-Statistic	-0.2574	0.3984	-1.4808*	0.0693
	Panel rho-Statistic	-0.4548	0.3246	0.1362	0.4458
	Panel PP-Statistic	-1.4278*	0.0767	-1.7592**	0.0393
	Panel ADF-Statistic	-1.9482**	0.0257	-1.4178*	0.0781
	Alternative hypothesis common AR coefficients (between dimension)				
	Group rho-Statistic	-1.2245	0.1104	-0.3927	0.3473
	Group PP-Statistic	-3.7951***	0.0001	-3.7125***	0.0001
	Group ADF-Statistic	-4.1352***	0.0000	-3.8564***	0.0001
Cluster 2	**Alternative hypothesis common AR coefficients (within dimension)**				
	Panel v-Statistic	0.7749	0.4384	0.0027	0.9978
	Panel rho-Statistic	-1.997**	0.0458	-1.509	0.1313
	Panel PP-Statistic	-3.490***	0.0005	-3.629***	0.0003
	Panel ADF-Statistic	-0.0627	0.9498	-0.5651	0.5720
	Alternative hypothesis common AR coefficients (between dimension)				
	Group rho-Statistic	-1.761	0.0782	-1.139	0.2547
	Group PP-Statistic	-4.056***	0.0005	-3.774 ***	0.0002
	Group ADF-Statistic	-0.2494	0.8031	-0.3459	0.7294

Note: ***, **, and * represent the significance at levels 1, 5 and 10%.

Table-5 summarizes the results of Kao residual co-integration test. For cluster 1 and cluster 2 countries, we observe that the computed t-statistic is statistically significant at one percent level and five percent level of significance respectively; thus we can reject the null hypothesis of having no co-integration between variables. That means results Kao co-integration test also confirm that our variables into consideration are co-integrated, that means they have long-run association.

Table (5): Panel co-integration test – Kao residuals (1999) results for the clustering countries in 1990-2015

Kao Residual Cointegration test		
DEPENDENT VARIABLE: Ln GDP/UEU		
Null Hypothesis: No Co-integration		
Series: LnGDP/UEU, LnGFCF, LnLF, REC		
Cluster countries	**Augmented Dickey-Fuller**	
	t-Statistics	**Prob.**
Cluster 1 countries	5.8455	0.0000***
Cluster 2 countries	-1.6754	0.0469**

Note: ***, **, and * represent the significance at levels 1, 5 and 10%.

6.3 Panel ARDL Model:

As the variables are co-integrated, we can estimate the long- term and short - term elasticities and the co-integrating equations by following Marinaș et.al. (2018), Naseri, Motamedi & Ahmadian (2016) and Šimelytė & Dudzevičiūtė (2017).

First, the optimum lag length is determined before applying panel ARDL model by using VAR lag order selection criteria for the two clusters as presented in Appendix (2). The criterion AIC and FPE suggest optimal lag should be 2. Whereas the criterion SB and HQ suggest optimal lag should be 1, so we take 1 as the optimal lag length to run the panel ARDL model. Now we can perform panel ARDL model and we get ARDL (1, 1, 1, 1) model in this study for cluster 1 countries and ARDL (1, 0, 0, 2) model for cluster 2 countries. The results of pooled mean group estimates (PMG) are presented in table-6 for cluster 1 and in table 7 for cluster 2.

6.3.1. PMG estimator:

In order to determine the effect of the considered variables, we used error correction estimation based on autoregressive distributed lag panel ARDL (p,q_1,q_2,q_3) model, with an

attention on the exclusive advantage of PMG model comparing to the other error-correction based estimations, MG and DFE. Next, Table 6 and 7 report PMG estimation results plus Hausman-test to “measure the comparative efficiency and consistency among them”.

6.3.1.1. PMG for Cluster 1:

By following Inglesi-Lotz (2016), Hausman test is used to investigate homogeneity constraint validity in the long term across countries and the efficiency of the PMG comparing to other estimators MG and DFE. As projected, the null hypothesis of the homogeneity restriction on the regressors in the long term is accepted by Hausman test, which states that PMG is more efficient estimator than MG. Likewise, comparing the result of DFE and PMG, the Hausman test obviously supports the PMG specification over DFE

The results for the (NMC) are reported in Table 6. In PMG model ECM = -.336 for cluster 1 countries and for this cluster EMC belongs to (-1, 0) and significant at 0.05 level of significance which means that there is a co-integration relation between explanatory variables towards Ln (GDP/UEU); its value means that the speed of adjustment of GDP to the equilibrium point in the long run will be 33.6% between two periods. As shown in Table 6, the coefficient of REC has a positive and significant effect in the long term and it has an effect on GDP/UEU in the short term but it is not significant consistent with the PMG estimator. In the long-run, the positive effect can be explained by the role of renewable energy as input in industries, where renewable energy is added as a new resource to the existing non-renewable energy resources. Moreover, the innovative technology used in the renewable energy systems has a positive effect on raising the productivity in all the industries which use renewable energy as input. In the short-run, the impact of renewable energy is not evident since the increase of renewable energy consumption is very smooth in the last two decades. This result is confirming with Marinaș et al (2018) and Inglesi-Lotz (2016) results. It can be explained

according to what is mentioned in context description chapter by both: the positive influence of policies implemented by different parties in the Mediterranean region as UFM to facilitate and promote regional dialogue and cooperation as well as substantial projects and initiatives in the field of energy leading to a more stable and efficient sources of renewable energy. Besides, the national policies and actions adopted by each government in the selected sample to enhance the generation of electricity from renewable sources and promote investments in renewable energy infrastructure in order to use what is generated in different sectors. Thus adopting any renewable energy conservation policy in these countries must considers the risk of a negative effect in the long run.

Also, the coefficient of LnGFCF has a positively significant effect in the long term and it has an effect on GDP/UEU in the short term but it is not significant consistent with the PMG estimator. Here one percent increase in GFCF, on average increase GDP/UEU 0.103 percent in the long-run, on average. And so, the coefficient of LF has a positively insignificant effect in the long term and has a negative significant effect in the short term on GDP/UEU according to the PMG.

Table 6. The Summary of Panel Regression Model 1 for Cluster 1 Countries during 1990–2015.

Variable			Pooled Mean Group (PMG)	
			Coef.	**Std. Error**
Long-Run Coefficients				
LnGFCF			0.103***	0.030
LnLF			0.091	0.119
REC			0.003**	0.001
	Hausman Test[1]	56.57	0.000	
	Hausman Test[2]	-24.13	0.000	
Short-Run Coefficients				
Error correction Coefficient			-0.336***	0.075
Δ LnGFCF			0.016	0.048
Δ LnGFCF $_{t-1}$			0.006	0.025
Δ LnLF			-1.067*	0.575
Δ LnLF $_{t-1}$			0.302	0.238
Δ REC			0.003	0.002
Δ REC $_{t-1}$			-0.001	0.001
Intercept			-0.253***	0.058
Country			5	
Observation			130	

Note:*, **, and * indicate significance at 10 %, 5 % and 1 %, respectively. Estimations are done by using (xtpmg) routine in Stata. Pooled mean group, mean group, and dynamic fixed effects, all controlling for country and time effects.While the first panel (LR) shows long-run effects. The second panel reports both short-run effects (SR) and the speed of adjustment (ec).Hausman test is indicating that PMG is consistent and efficient estimation than MG and DFE estimation. The lag structure is ARDL (1, 1, 1, 1) and the order of variables is: GDP/UEU, GFCG, LF ,REC . 5 (NMC) , annual data 1990–2015. Source: Authors' estimations.**
The dependent variable is GDP/UEU.

[1]: PMG is efficient estimation than MG based on the null Hypothesis
[2]: PMG is efficient estimation than DFE based on the null hypothesis

6.3.1.2. PMG for cluster 2:

By following Marinaș et al (2018) PMG estimation, the results for the (SMC) beside Israel are reported in Table 7. In PMG model ECM = -0.542 for cluster 2 countries, and it belongs to (-1, 0). ECM is significant at 0.05 significance level which means that there is a co-integration relation among explanatory variables towards LnGDP/UEU. The negative sign for ECM increases the accuracy of equilibrium relation in the long run; and it means that the speed of adjustment of GDP/UEU to the equilibrium point in the long term will be 54.2% between two

periods. As shown in Table 7, the coefficient of REC has a negative significant effect in the long term and a non-significant effect in the short term on GDP/UEU. More explicitly, a 1% increase in REC denotes a decline in the GDP/UEU by 0.002 percent over the long-term. Renewable energy is a substitute for non-renewable energy such as gas and oil which the countries in cluster 2 produce. The countries in cluster 2 mostly import the technology used to produce renewable energy, which may increase imports. This outcome is similar to the result provided by Ocal and Aslan (2013) for Turkey and Brini, Amara and Jemmali (2017). It may be due to mismanagement of the energy sources by governments as no clear regional manner exists in the preferred schemes for supporting REC and some gaps exist in regulations related to this sector as some of the countries selected are mainly focusing on producing non-renewable energy sources. Besides, the tools and technology necessary to generate renewable energy are mainly imported from other countries ; as well as, the nature of production process and production methods used in different sectors may need none of the renewable sources. Although the availability and continuity of renewable energy sources, most electricity sectors in this side of the Mediterranean region are controlled by predominant national electricity companies (monopolists) that often have great interests in fuel (oil and gas) sectors. Finally, the strategies to stimulate renewable energy production generate certain costs to adapt the national energy system taking into account the investments needed to expand the infrastructure and the intermittent character of such forms of energy. Therefore, the transition towards a higher share of renewable energy may trigger in the short run higher average production cost and a decrease of energy efficiency that will negatively affect the GDP/UEU growth rate

Also, the coefficient of LnGFCF has a significant effect in the long-term, but it has a non-significant negative effect in the short-term on GDP/UEU according to the PMG estimator.

And so, the coefficient of LnLF has no significant effect in the long term and in the short run on GDP/UEU consistent with PMG.

Table (7). The Summary of Panel Regression Model 2 for Cluster 2 Countries During 1990–2015.

Variable			Pooled Mean Group (PMG)	
			Coef.	**Std. Error**
Long-Run Coefficients				
LnGFCF			0.0317*	0.019
LnLF			-0.1062	0.088
REC			-0.002**	0.0008
	Hausman Test[1]	24.31	0.000	
	Hausman Test[2]	-24.13	0.000	
Short-Run Coefficients				
Error correction Coefficient			-0.542**	0.263
Δ LnGFCF			-0.004	0.053
Δ LnLF			-0.099	0.378
Δ REC_{t-1}			-0.002	0.004
Δ REC_{t-2}			-0.015	0.012
Intercept			0.838**	0.416
Country			5	
Observation			115	

Note:*, **, and * indicate significance at 10 %, 5 % and 1 %, respectively. Estimations are done by using (xtpmg) routine in Stata. Pooled mean group, mean group, and dynamic fixed effects, all controlling for country and time effects. While, the first panel (LR) shows long-run effects. The second panel reports both short-run effects (SR) and the speed of adjustment (ECT). Hausman test is indicating that PMG is consistent and efficient estimation than MG and DFE estimation. The lag structure is ARDL (1, 0, 0, 2) and the order of variables is: GDP/UEU, GFCG, LF ,REC. 5(NMC), annual data 1990–2015. Source: Authors' estimations.**
The dependent variable is GDP/UEU.

6.4 Granger Causality Test:

Since PMG estimation method is applied for the two clusters (1) and (2), the outcome is a homogenous long-term relationships between GDP/UEU and REC and vice versa, as well as no causality impacts in short-term relationships for each cluster in the panel, based on which the speed of shock adjustment and the Granger causality both on the short term and long term could be investigated.

Table 8 includes the results of testing the growth hypothesis (the existence of a unidirectional causality correlation running from REC to GDP/UEU growth. The null hypothesis states that no Granger causality exists, as we have seen there is a two-direction causality between REC and GDP/UEU for both clusters countries which means REC causes GDP/UEU and GDP/UEU also causes REC on long run at 5% level of significance.

Table (8): Results of Granger Causality Test for Cluster 1 and Cluster 2 Countries

H_0 :no Granger causality			
Direction of Causality	**Statistics**	**Prob.**	**RESULT**
Cluster 1 countries			
REC → GDP/UEU	2.5914***	0.0096	YES
GDP/UEU → REC	9.5919***	0.0000	YES
Cluster2 countries			
REC → GDP/UEU	2.2204**	0.0264	YES
GDP/UEU → REC	2.5233**	0.0116	YES

Our empirical results are consistent with feedback hypothesis that different studies approved before despite the different techniques have been used such as: Amri (2017), Saidi, El Montasser & Ajmi (2018) and Esseghir & Khouni (2014), etc.

Chapter7

Conclusion & Recommandations

Conclusion & Recommandations

In this study, we investigated the relationship between REC and GDP/UEU growth, for a panel of 10 Mediterranean countries classified into two clusters (NMC and SMC & Israel countries), over 1990-2015 period.

The main conclusion that can be drawn from our findings is that renewable energy policies should consider not only the causality direction between GDP/UEU and REC, but also whether it is interim or permanent; consequently, governments must design policy procedures and build cooperation with other countries accordingly. Besides, other stakeholders will benefit from such findings to decide if is profitable to put their investments in renewable energy production sector and in the production of the necessary components and technology that will be needed to extract energy from these resources. Also, individuals will be interested especially when the possible procedures, laws and regulations of taxes will be encouraged.

In the first step, we applied "Im, Pesaran and Shin (IPS)", IPS (Im et al., 2003) panel unit root test to investigate the stationary of the variables and found that variables are integrated and have similar integration order, I(1) for (NMC) panel and mixed order of integration, I(0) and I(1) for (SMC) & Israel panel. In the second step, we used the Pedroni's (1999 and 2004) panel co- integration test, to estimate the long –term relationship between variables and we found indications of existing long–term relationships among them; after that, two-step procedure of Engle and Granger model is applied in this study. In the first step, the panel ARDL testing model of cointegration is conducted to estimate the long-term and short-term elasticities and the co-integration equations between the REC and GDP/UEU growth for each cluster.

Thus, REC has a positive significant effect in the long-term and no effect in the short-term on GDP/UEU growth for cluster 1 as a result of their attention to this sector and policies taken

over the past decades to encourage a stronger presence of renewable energy in different sectors in economies leading to a change in the structure of industries. That means policies to increase usage of REC for achieving the predetermined targets by 2030 in these countries will have greater benefits on GDP/UEU growth over the long term even though tremendous effects would not appear in the short run. At the meanwhile, the governments' energy policy should take into consideration the efficiency of renewable resources available in order to extract the optimum returns. Therefore, direct procedures for reducing energy consumption cannot be implemented without taking into consideration their impact on GDP/UEU growth as a whole.

In cluster 2, REC has a negative significant effect in the long-term and no effect in the short-term on GDP/UEU growth of the five countries. We shed the light here on the features of energy mix from some of these countries which may causes low deployment or transition process with a passive effect on GDP/UEU growth. Financing and coordination among countries with rich renewable resources are major problems in grid-integration. Morocco is rich in natural resources; but renewable energy constitutes only 12% of its electricity production21. In Tunisia, electricity production from renewables constitutes only 4% in 2015 and the rest from other non- renewables. While in Egypt22 , electricity production from Fossil Fuels is 90.5% of the Total Installed Capacity. Israel has primarily hydrocarbon-led energy sector with 6% of electricity production from coal and 33% from natural gas and diesel according to the Israel Electric Corporation (2009)23. Therefore, the current status of renewable energy sources in its energy-mix proposes that if non-renewable sources replaced with renewable ones, it may jeopardize its GDP/UEU growth on the long-term. Hence, any

[21] Available on :https://www.export.gov/article?id=Morocco-Energy
[22] Central Intelligence Agency (CIA). (2018). The World Face Book: Africa: Egypt. Retrieved From: https://www.cia.gov/library/publications/the-world-factbook/geos/eg.html
23 Available on :http://www.timesofisrael.com/topic/israel-electric-corporation/

transition process for full deployment of renewable sources in such countries should not be followed.

In the second step, we used a dynamic error-correction model to measure the short term relations and get the speed of adjustment of the dependent variable to the long run status.

Seeking for robustness, we divided the Mediterranean countries selected into two groups: NCM and SCM &Israel. This classification allows us to gain certain and robust outcomes.

The empirical results of this study provide policy makers a better understanding of the relationship between REC and GDP/UEU growth to design investment policies in Mediterranean countries. Also, to virtually concern about the increase in demand for renewable energy that joins fast GDP/UEU growth in some countries, policy makers should pursue to reveal the causality relationship between REC and GDP/UEU growth and to design suitable renewable energy policies. This duty has become a top priority in the present and near future. Consequently, as a policy implication, Spain, Italy, Greece, Turkey and France could encourage investment in renewable energy infrastructure or formulate energy conservation policies to avoid a reduction possibility in REC which may negatively affect GDP/UEU growth. In addition, policies already taken in cluster 1(NMC), the long-term and strong causality indication may expose that supporting various energy tax preferences, FIT , quota system or financial motivations of energy-saving utilization to encourage both REC and GDP/UEU growth is a feasible policy. Additionally, a proof suggests that policies for renewable energy limitations may have a good effect on GDP/UEU growth in the other cluster (Algeria, Morocco, Tunisia, Egypt and Israel). Hence, it seems that countries surrounding the Mediterranean would not react similarly in setting energy policies. However, if (SMC) beside Israel are insistent to achieve goals were set by 2020 and 2030 as mentioned before without affecting GDP growth negatively or better reversing its effect, they should restructure technology being used in the production process in many sectors to depend more on renewable

energy resources. Also, they can adjust the adopted energy policies to be implemented in a more resistance and controlled manner.

The deployment of renewables has improved since the beginning of the 21st century in most of the countries. Different effects for renewable sources deployment exist across countries due to many reasons as discussed in various reports by international bodies as IEA. Our findings support the differences and heterogeneity in the deployment process application across countries and the role of renewable energy in affecting the GDP/UEU growth process. While the deployment of renewables depends on many elements within and across countries, it is necessary to consider cost, efficiency, infrastructure, regulatory barriers, political situation, Arab spring and institutional structure of any country in the long run deployment process. For instance, the incorporation of renewables with the grid is a main challenge as the grids are largely built to supply electricity generated from fossil fuels. A strong regulation perception is acting as an impediment for increase in renewable investment. In our model, we did not take into account many factors that may directly or indirectly affect GDP/UEU growth due to renewable deployment. Besides, we could not obtain disaggregated data within the renewables due to un- availability of data for long period of time.

At the meanwhile, some major steps towards increasing renewable energy demand can be adopted such as the creation of investment climate that drives growth, improving human experiences, and eliminating financial and political barriers. Major instruments can be used in the deployment process both on the financial side and policy side. For example, (FIT), quota systems, investment incentives, tax or credit incentives and sales tax exemptions for solar panels. Furthermore governments, energy planners, international cooperation agencies and associated bodies must act together more effectively in executing strategies and formulating regulations for renewable deployment across Mediterranean countries.

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Appendices

Appendix 1

Table (1): Results of correlation between the variables in cluster1 countries

```
. corr lgdp lgfcf llf rec if c_id==EUA
(obs=130)
```

	lgdp	lgfcf	llf	rec
lgdp	1.0000			
lgfcf	-0.0886	1.0000		
llf	0.0484	0.7942	1.0000	
rec	0.2878	-0.2525	0.1834	1.0000

Table (2): Results of correlation between the variables in cluster 2 countries

```
. corr lgdp lgfcf llf rec if c_id==NEUA
(obs=130)
```

	lgdp	lgfcf	llf	rec
lgdp	1.0000			
lgfcf	0.0642	1.0000		
llf	0.6316	0.3037	1.0000	
rec	0.1030	-0.5480	-0.1537	1.0000

Appendix 2

Table 1: VAR lag order selection for cluster 1 model countries

```
. varsoc lgdp lgfcf llf rec if country1==EUA

  Selection-order criteria
  Sample:  5 - 0130, but with gaps              Number of obs      =       110
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-159.767				.000231	2.97758	3.01741	3.07578
1	737.93	1795.4	16	0.000	2.5e-11	-13.0533	-12.8541*	-12.5623*
2	762.294	48.729	16	0.000	2.2e-11*	-13.2054*	-12.8469	-12.3216
3	775.322	26.056	16	0.053	2.3e-11	-13.1513	-12.6335	-11.8747
4	794.252	37.859*	16	0.002	2.2e-11	-13.2046	-12.5275	-11.5352

Table 2: VAR lag order selection for cluster 2 model countries

```
. varsoc lgdp lgfcf llf rec if country1==NEUA

  Selection-order criteria
  Sample:  0135 - 0260, but with gaps           Number of obs      =       110
```

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-177.094				.000316	3.29263	3.33246	3.39083
1	730.392	1815	16	0.000	2.9e-11	-12.9162	-12.7171*	-12.4252*
2	751.383	41.984*	16	0.000	2.6e-11*	-13.007*	-12.6485	-12.1232
3	760.894	19.022	16	0.268	3.0e-11	-12.889	-12.3712	-11.6124
4	767.074	12.36	16	0.719	3.6e-11	-12.7104	-12.0333	-11.0411

* indicates lag order selected by the criterion

Here, LL= Log likelihood

LR = sequential modified LR test statistic (each test at 5% level)

FPE = Final prediction error

AIC = Akaike information criterion

SC= Schwarz information criterion

HQ= Hannan-Quinn information criterion