Literature survey on the relationships between energy variables, environment and economic growth

Sofien, Tiba and Omri, Anis

Faculty of Economics and Management of Nabeul, University of Carthage, Tunisia

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Sofien Tiba
Faculty of Economics and Management, University of Sfax, Tunisia
E-mail: sofienetiba@gmail.com

Anis Omri
Corresponding author
Higher Institute of Industrial Management, University of Sfax, Tunisia
E-mail: omrianis.fsegs@gmail.com
Phone: +216 97914294

Abstract

This paper provides an extensive survey of the great progress in the literature of energy- environment-growth nexus for both specific- and multi-county studies covering the period from 1978 to 2014. The survey focuses on country (ies) coverage, periods, modeling methodologies, and empirical conclusions. Our survey is based on the direction of causality between (i)energy consumption (electricity, nuclear, renewable and non-renewable) and economic growth; (ii) between economic growth and environment; and between the three variables at the same time. As a general remark from these studies is that the literature produced paradoxical and not conclusive results which energy consumption can boost economic growth through the productivity enhancement and it can boost also the environmental damages through the enhancement of pollutant emissions. This survey gives researchers a 'snap shot' of the literature on the causality between the four types of energy, environment and economic growth for both individual and collective cases. Understanding the causal links between environment, economic growth and different types of energy consumption provides a basis for discussion in order to design and implementating effective energy and environmental policies.

Keywords: Literature survey, economic growth, energy consumption, environment.

1. Introduction

For a several decades, economic growth is the ultimate aim for each and every policy makers which it considers the only tool for a sustainable development. Since the third millennium, precisely when the Kyoto protocol to the United Nations framework convention on climate change on December 1997 which this protocol includes the environmental quality as a crucial variable to determine the sustainability of development consistent with the fifth generation of human rights. Indeed, the summit of Johannesburg and Rio de Janeiro are organized in the same field. However, economic growth can exert a pressure on environmental quality, through energy consumption as a transmission channel, which it seem to conflicting in terms of goals and may the economic growth policy adopted at odds to environmental aims who policy makers have a great challenging to arbitrate between growth and environment. In fact, the interaction between economic growth, energy consumption and environmental quality has been topic of considerable academic research in the literature of energy economics (e.g Ang, 2008; Apergis and Payne, 2010; Omri, 2013) and thus revitalizing the long debate in both academic and policy spheres about their advantages and related costs caused by their interactions. There is an impressive body of literature which has as a subject the three-way linkages economic growth, environmental quality and energy consumption. This relationship has attracted the attention of many debates an academic research in different countries and for a long time. Indeed environmental quality may generate positive or negative externalities and consequently stimulates economic growth through the bias of human health which that can potentially affected by the evil impact of pollutant emissions. The relationship among economic growth, environmental quality and energy consumption has been the subject of conflicting and paradoxical aims wished by the policy makers. This postulates, understanding the relationship between economic growth, energy consumption and environment is crucial to understanding the current energy and environmental policy, is a cornerstone for new insight about energy and environmental policy, and this relationship is the basis for making sound economic policy, consistent with their objectives in terms of environmental and energy policy. The past empirical literature on the causal relationship between energy consumption and economic growth can be categorized into three lines of research. The first line of researches focuses on the nexus between economic growth and energy consumption. This nexus suggests that higher economic growth requires more energy consumption and more efficient energy use needs a higher level of economic growth. Since the pioneer work of Kraft

and Kraft (1978), Granger causality test approach has become a popular tool for studying the relationship between economic growth and energy consumption in different countries (e.g. Belloumi, 2009; Bozoklu and Yilanci, 2013; Pao and Fu, 2013). Bozoklu and Yilanci (2013) have been investigated the causal linkage between energy consumption and economic growth and find that economic growth Granger causes energy consumption (conservation hypothesis) and also, they found that energy consumption Granger causes economic growth for a sample of 20 OECD countries. While Pao and Fu (2013) using the co-integration tests found unidirectional causal relationship running from economic growth to energy consumption for Brazil covering the period from 1980 to 2010.

The second line of research focuses on the validity of the Environmental Kuznets Curve (EKC) hypothesis. The EKC hypothesis postulates that the relationship between economic development and the environment resembles an inverted U-curve (e.g. Ang, 2007; Arouri et al., 2012; Saboori et al., 2012). That is, environmental pollution levels increase as output increase, but begin to decline as rising incomes pass beyond a turning point. However, a higher level of national income does not necessarily warrant greater efforts to contain the *CO2* emissions. Arouri et al. (2012) investigated the Environmental Kuznets Curve (EKC) hypothesis for MENA countries over the period 1981-2005. The results show that real GDP exhibits a quadratic relationship with CO_2 emissions for the region as a whole. However, although the estimated long-run coefficients of income and its square satisfy the EKC hypothesis in most studied countries, the turning points are very low in some cases and very high in other cases, hence providing poor evidence in support of the EKC hypothesis. Also, Govindaraju and Tang (2013) examined the nexus of *CO2* emissions, economic growth and coal consumption in China and India. In the case of China Granger causality test for China reveal a strong evidence of unidirectional causality running from economic growth to *CO2* emissions. Moreover, there is a bi-directional causality between economic growth and coal consumption as well as *CO2* emissions and coal consumption in the short and long run. In the case of India, only a short-run causality is detected. Causality between economic growth and *CO2* emissions as well as *CO2* emissions and coal consumption are bi-directional.

Finally, the last one focuses on the three-way linkages between economic growth energy consumption (renewable and non-renewable energy) and *CO2* emissions; and economic growth, renewable energy consumption and *CO2* emissions. More recently, Apergis

and Payne (2014) investigated this causality using the VECM and find that renewable energy consumption, economic growth, and *CO2* emissions are co-integrated.

The existing energy and environment economics literature provides three survey studies by Payne (2010) reviewed electricty-growth nexus as well as energy-growth nexus. Then, Ozturk, (2010) surveyed studies on electricty-growth and energy-growth nexus. More recently, Omri (2014) surveyed studies on the causal relationships between four energy variables and economic growth for country-specific studies. We have extended the survey by incorporating the environmental variable. Thus, the objective of this study is to provide a survey of the international studies on the causality between energy consumption (electricity, nuclear, and renewable consumption), environment and economic growth for both specific- and mylti-country studies covering the period from 1978 to 2014. To the best of our knowledge, this is the first study that surveys and discusses at the same time the causal relationships between energy, environment and economic growth each of which nexus has important recommendations for the researchers in the energy and environment economics field. The rest of this paper is organized as follows: after the introduction, which is presented in Section 1 above, we move to section 2 to review and analyze the literature for county-specific studies and multi-countries studies on the causality between (i) energy consumption-economic growth; (ii) between environmental and economic growth; (iii) and between environment-energy-economic growth. The concluding remarks are given in the third section.

2. Growth-Energy-Environment nexus: A literature survey

After the pioneer seminal work of Kraft and Kraft (1978), who examined the causal link among energy consumption and economic growth for United States, several studies has attempted to establish the relationship among different other variables by employing different econometric methodologies. Therefore, we analyze, in this section, these issues by giving chronological lists of the existing empirical studies classified by author, country, period, methodology, and results.

2.1. A literature survey on the causality between energy consumption and economic growth

The topic relationship between economic growth and energy consumption is well studied in the energy economic literature. As known this relationship between economic growth and energy consumption has been structured around four hypotheses. First, *the growth hypothesis* refers to a case in which energy consumption plays a vital role in the economic growth

process directly: there is evidence of unidirectional causality relationship running from energy consumption to economic growth, therefore, energy conservation policies aimed at reducing energy consumption will have negative impact on economic growth. Second, *the conservation hypothesis* suggests that there is unidirectional causal relationship running from economic growth to energy consumption. It implies that energy consumption plays an important role in economic growth both directly and indirectly in the production process as a complement to labor and capital. So, we may conclude that energy is a limiting factor to economic growth and, hence, shocks to energy supply will have a little or no adverse effect on economic growth. Third, *the feedback hypothesis* suggests that there is a bidirectional causality relationship among energy consumption and economic growth. In this case, energy conservation policies designed to reduce energy consumption may decrease economic growth performance, likewise, changes in economic growth are reflected back to energy consumption. Finally, *the neutrality hypothesis* that the absence of causality between energy consumption and economic growth which supports the presence of neutrality hypothesis. In this case energy conservation policies devoted to reducing energy consumption will not have any impact on economic growth.

In this section, we provide chronological lists of the empirical literature on the causality between energy consumption and economic growth given by author, time frame, country, methodology, and empirical results in Tables 1 and 2. We survey the literature under two sections. In the first section, the country-specific literature survey is given and in the second, multi-country studies survey is given.

2.1.1. Country-specific studies on energy consumption–growth nexus

For the individual case, the causality analysis between energy consumption and economic growth which policy makers have the attention to know and understanding this linkage and the additional variables which lead economic growth in order to manage tools such as rationing energy consumption and controlling environmental degradation. Hence, several empirical studies that have a topic of the relationship between economic growth and energy consumption which their results are not conclusive and mixed. The absence of consensus can be explained by time periods, used variables, model specifications, and econometric methodologies undertaken.

In this context, Squalli (2007) using the the Toda-Yamamoto procedure, the results show the presence of the growth and the feedback hypothesis for Indonesia and Iran, respectively. Nevertheless, Soytas and Sari (2007) found the existence of the growth hypothesis for Turkey by applying Vector Error Correction Model. Belloumi (2009) investigated the linkage between energy consumption and economic growth for the case of Tunisia covering the period from 1971 to 2004, using the Granger causality tests and VECM, which he has been found the evidence of bidirectional relationship between energy consumption and economic growth supported the feedback hypothesis in the long run and he has been also found the presence of unidirectional relationship which he supports the growth hypothesis. Furthermore, Halicioglu (2009) investigated the relationship between energy consumption and economic growth, during the period of 1960-2005, for Turkey by applying the Granger causality tests, ARDL and cointegration. The results showed that there is no evidence relationship between the variables that consistent with the neutrality hypothesis. In addition, Zhang and Cheng (2009) have been examined this relationship for China over the period from 1960 to 2007 by applying the Granger causality tests, which the findings show that economic growth Granger causes energy consumption and consistent with the conservation hypothesis. Nevertheless, Soytas and Sari (2009) investigated this linkage by applying the Toda-Yamamoto procedure For Turkey over the period 1960-2000. The results show that there is no evidence of causal relationship proving the neutrality hypothesis. Moreover, Jamil and Ahmad (2010) have been studied the linkage between economic growth and energy consumption for Pakistan using the VECM during the period from 1960 to 2008 and they found a unidirectional causal relationship running from economic growth to energy consumption supporting the conservation hypothesis. Also, Lotfalipour et al. (2010) have studied this linkage for Iran which they employed Toda-Yamamoto procedure for the study period 1967-2007, the results show the presence of conservation hypothesis. Besides, Ahamad and Islam (2011) investigated this relationship using the Vector Error Correction Model in the case of Bangladesh over the period 1971-2008 which they found a bidirectional relationship in line with the feedback hypothesis. Also, Kaplan et al. (2011), where they applied Johansen -Juselius and Granger causality, covering the period of 1971-2006 for Turkey. They confirmed the feedback hypothesis.

Recently, Yildirim and Aslan (2012) have been investigated this linkage for Turkey applying the bootstrapped Toda-Yamamoto procedure covering the period from 1970 to 2009, the findings show that no causal relationship is found supported the neutrality hypothesis.

Shahbaz et al. (2012) have been examined this linkage using the Vector Error Correction Model in the case of Pakistan during the period from 1972 to 2011 which they found a bidirectional causal link between energy consumption and economic growth consistent with the feedback hypothesis. Moreover, Shahbaz and Lean (2012) examined this causality for Pakistan during the period 1972-2011 using the Vector Error Correction Model and the findings supported the feedback hypothesis. More recently, Shahbaz et al. (2013a) examined[1] the relationship between energy consumption and economic growth using production function in the case of China. The findings show that energy consumption Granger causes economic growth. Shahbaz et al. (2013b) supported the feedback hypothesis in the case of Indonesia. In fact, the energy use may have dramatic damages to economic growth by affecting the productivity through human health. Many studies include renewable energy consumption in their empirical results such as, sari et al. (2008), Payne (2009), Menyah and Wolde-Rufael (2010), among others, Shahbaz et al. (2012), Yildirim et al. (2012), and Pao and Fu (2013).

The findings of the recent empirical studies on the causal links between energy consumption and economic growth for country-specific studies are summarized in Table 1.

[Please Insert Table 1 about Here]

2.1.2. Multi-country studies on energy consumption–growth nexus

About the multi-countries studies, Chen et al. (2007) studied this linkage using VECM over the period 1971-2007. The results show the presence of the growth and the conservation hypothesis for Indonesia, South Korea, and Philippines, respectively. Although Squalli (2007) using the Toda-Yamamoto procedure, the results show the presence of the growth and the feedback hypothesis for Indonesia and Iran, respectively. Also, Narayan and Prasad (2008) examined this linkage for a panel of three countries using Bootstrapped Toda-Yamamoto and they found the feedback for South Korea and neutrality hypothesis for Mexico and Turkey. Additionally, Ozturk et al. (2010) examined the linkage between energy consumption and economic growth applying panel co-integration and causality tests for a panel of 51 countries over the period 1971-2005. The results show that there is evidence of unidirectional relationship running from energy consumption to economic growth and bidirectional causal

[11] Every attempt was made to include all the studies published in refereed academic journals that examine the causality among energy consumption and economic growth. If a study has been overlooked or misinterpreted, I extend my apologies to the author(s).

relationship supported the conservation one and the feedbeck hypothesis, respectively. Nevertheless, Eggoh et al. (2011) used the panel co-integration and panel causality tests during the period from 1981 to 2007 for a panel 25 OECD countries which their findings are consistent with the feedback hypothesis. Also, Fuinhas and Marques (2011) employed the autoregressive distributed lag ARDL for a panel of 5 countries namely Greece, Italy, Portugal, Spain, and Turkey covering the period of 1965-2009. They found the feedback hypothesis.

Moreover, Tiwari (2011) investigated the relationship between economic growth and energy consumption using a Panel vector autoregressive approach for a sample of 16 European and Eurasian countries during the period from 1965 to 2009. The findings supported the existence of feedback hypothesis. Recently, Yildirim and Aslan (2012) studied the relationship between energy consumption and economic growth for a panel of 17 OECD countries by using bootstrapped-corrected causality test covering the period from 1970 to 2009. The empirical results have supported the existence of the neutrality hypothesis. Further, Bozoklu and Yilanci (2013) examined this linkage for 20 OECD countries by employing the Granger causality test. The empirical results show of causality running from GDP to energy consumption, there is a short run relationship for Australia, Austria, Canada, Italy, Japan, Mexico, the Netherlands, Portugal, the UK, the USA, and a long run relationship for Austria, Belgium, Denmark, Germany, Italy, Japan, the Netherlands, Norway, and the USA. They also found a short run relationship for Austria, Denmark, Italy, the Netherlands, Norway and Portugal, and a long run relationship for Belgium, Finland, Greece, Italy, Japan, and Portugal. The empirical studies have been summarized in the Table 2 below.[2]

[Please Insert Table 2 about Here]

Further the high level of economic growth which generate by an industrials' process through the high level of energy consumption that may generate a high level of greenhouse gas and pollutants emissions as a negative externalities that it can affected the level of economic growth through the bias of human health. In this context the environmental quality has constituted a relevant variable in the determining of the growth level aimed by the policy makers. The relationship between environment and economic growth constitute the topic of

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several previous studies in the past few decades that they lighting the big challenge for both high- and-middle-income countries and for many policy makers in terms of growth level and environmental quality.

2.2. A literature survey on the validity of the EKC hypothesis

The relationship between economic growth and environment has been the topic of several previous studies and attracted the attention of researchers for the past few decades. This nexus was focused on the validity of the Environmental Kuznets Curve (EKC) hypothesis. The EKC postulates that the nexus between environment and economic growth resembles an inverted U- shaped (e.g. Ang, 2007; Saboori et al., 2012; Omri, 2013). That is, environmental damage increase as with output until a threshold was reached it begins to decline. It is described as the EKC following the observation of Kuznets (1955). This EKC hypothesis is intended to represent a long run relationship between environmental impact and economic growth. This hypothesis was first proposed and tested by Grossman and Krueger (1991), Stern (2004) and Dinda (2004) which offer extensive review surveys studies. Further exemples consist of Friedl and Getzner (2003), Dinda and Coondoo (2006), and Managi and Jena (2008). However, a higher level of national income does not necessarily warrant greater effort to contain the pollutant emissions. As income moves beyond the EKC turning point, it is assumed that transition to improving environmental quality starts. Thus, it could be a depiction of the natural process of economic development from a clean agrarian economy to a polluting industrial economy, and, finally, to a clean service economy (Arrow et al., 1995).

In this section, we provide chronological lists of the empirical literature on the causality between environmental degradation and economic growth by author, time frame, country, methodology, and empirical results in Tables 3 and 4. We survey the literature under[3] two sections. In the first section, the country-specific literature survey is given and in the second, multi-country studies survey is given.

2.2.1. Country-specific studies on environment–growth nexus

[3] Every attempt was made to include all the studies published in refereed academic journals that examine the EKC. If a study has been overlooked or misinterpreted, I extend my apologies to the author(s).

In this framework, Friedl and Getzner (2003) investigated the economic growth-CO_2 emissions nexus for Australia covering the period 1960-1999. The empirical evidence showed an N-shaped relationship between income and CO_2 emissions. The empirical results of Martinez-Zarzoso and Begochea-Morancho (2004) are consistent with the EKC hypothesis. Also, Coondoo and Dinda (2008), Akbostanci et al. (2009), and Lee and Lee (2009) investigated the time series dynamics between output and pollutant emissions to deduce the direction of causality. The empirical results appear to be inconclusive. Akbostanci et al. (2009) tested for the existence of EKC in Turkey using co-integration techniques and both time series and provincial panel data over the periods 1968-2003 and 1992- 2001. The findings show that a monotonically increasing relationship between CO_2 emissions and output in the times series analysis, which suggests that the EKC hypothesis does not hold for CO_2 emissions. He and Richard (2010) investigated the relationship between per capita CO_2 emissions and per capita income for Canada during the period 1948-2004. They found little evidence in favor of the EKC. In stark contrast to He and Richard (2010), Ang (2007), and Iwata et al. (2010) supported the EKC for CO_2 emissions in France and China. Copeland and Taylor (2004), Grossman and Krueger, (1995), Machado (2000), Ang, (2008), Halicioglu, (2009), and Jalil and Mahmud, (2009) examined the effects of trade openness on the EKC for various countries. The empirical findings reveal a positive link between trade and carbon dioxide emissions was found by Halicioglu (2009) for Turkey, and Ang (2008), Jalil and Mahmud (2009) for China. Similarly, Fodha and Zaghdoud (2010) investigated this linkage for Tunisia over the period from 1961 to 2004. They found that CO_2 is co-integrated with per capita output, but their results for CO_2 indicated a monotonically increasing relationship relative to economic growth. More recently, Lau et al. (2014) examined this relationship including FDI and trade, in the case of Malaysia over the period 1970-2008 using the Bounds tests and Granger causality test. The results show that there is evidence of the inverted-U shaped relationship does exist between economic growth and CO_2 emission in both the short- and long-run for Malaysia.

[Please Insert Table 3 about Here]

2.2.2. Multi-country studies on environment–growth nexus

In the case of multi-country studies, De Bruyn et al. (1998) studied the linkage between economic growth and pollutant emissions using dynamic time series models for the

Netherlands, West Germany, the United Kingdom, and the United State. They found that economic growth has had a positive effect on pollutant emissions. The empirical results of Martinez-Zarzoso and Begochea-Morancho (2004) are consistent with the EKC hypothesis. In addition, Coondoo and Dinda (2008), Akbostanci et al. (2009), and Lee and Lee (2009) investigated the time series dynamics between output and pollutant emissions to deduce the direction of causality. The empirical results appear to be inconclusive. Additionally, Jaunky (2010) examined the Environmental Kuznets Curve Hypothesis for a sample of 36 high-income countries (including Bahrain, Oman and UAE) covering the period 1980-2005, the findings show that there is evidence of unidirectional causal relationship running from economic growth to pollutant emissions in both the short-run and the long-run. While, Holtz-Eakin and Selden (1995) and Shafik (1994) found a monotonic rising curve and an N-shaped curve has been found by Friedl and Getzner (2003). In addition, Richmond and Kaufmann (2006) found that there is no causal significant relationship between economic growth and pollutant emissions. Moreover, Pao and Tsai (2010) studied this relationship for the BRIC countries over the period 1971-2005, the empirical findings find a unidirectional causal relationship running from emissions to economic growth.

More recently, Lopez et al. (2014) studied the validity of the EKC hypothesis in the case of Ecuador during the period 1980-2010 by applying the co-integration techniques. The empirical results not support the fulfillment of the EKC hypothesis. Nevertheless, Onafowora and Owoye (2014) examine this linkage for eight countries namely Brazil, China, Egypt, Japan, Mexico, Nigeria, South Korea, and South Africa using the ARDL bounds test. The empirical results show that the inverted U-shaped EKC hypothesis holds in Japan and South Korea. For the remaining countries, the long-run relationship between CO_2 emissions and economic growth is monotonically follows an N-shaped. Besides, Farhani et al. (2014) investigated the linkage growth-environment by studying two different EKC specifications for a sample of 10 MENA countries covering the period from 1990 to 2010 applying panel data methods. The results show that there is an inverted U-shape relationship between environmental degradation and output.[4]

[Please Insert Table 4 about Here]

[4] Every attempt was made to include all the studies published in refereed academic journals that examine the EKC. If a study has been overlooked or misinterpreted, I extend my apologies to the author(s).

2.3. *A literature survey on energy-environment-growth nexus*

As often mentioned in the environmental Kuznets curve (EKC) literature, economic growth and energy consumptionmay generate considerable pressure on the environment. These relationships between output and energy consumption, as well as output and environmental pollution, have been the subject of intense research over the past few decades. In this section, we provide chronological lists of the empirical literature on the causality between environmental degradation, energy consumption and economic growth given by author, time frame, country, methodology and empirical results in Table 5 and 6. We survey the literature under two sections. In the first section, the country-specific literature survey is given and in the second, multi-country studies survey is given.

2.3.1. Country-specific studies on energy-environment–growth nexus

In this context, Ang (2007) investigated this relationship in the case of France over the period 1960-2000 using the co-integration and vector error correction modeling. The results show that there is evidence of a fairly robust long-run link among these three variables. Also, the results reveal that economic growth exerts a causal relationship on energy consumption and on the level of pollutant emissions, more in the short-run there is evidence of a unidirectional causal relationship running from energy consumption to economic growth. Moreover, Ang (2008) examined the three-way linkages for Malaysia over the period from 1971 to 1999 using the co-integration and the recent causality test. The results show that pollutant emissions and energy consumption are positively related to the economic growth. In addition, Alam et al. (2011) investigated the causal linkages between energy consumption, CO_2 emissions and output in the case of India using a multivariate framework of Toda and Yamamoto procedure covering the period from1971 to 2006. Their findings provide that there is evidence of bidirectional (feedback) Granger causality between energy consumption and CO_2 emissions in the long-run but neither CO_2 emissions nor energy consumption causes movements in real income. Then, there is no long-run causality relationship between income and CO_2 emissions but in the short-run causality exists in India. Besides, Ozturk and Acaravci (2013) investigated the causal relationship between financial development, trade, economic growth, energy consumption, and CO_2 emissions in case of Turkey over the period from 1960 to 2007 using co-integration techniques. The results prove that there is evidence of a long-run

linkage among CO_2emissions, energy consumption, income, the square of real income, trade openness and financial development. Furthermore, Shahbaz et al. (2013) studied the relationship between economic growth, energy consumption, financial development, international trade, and pollutants emissions in the case of Malaysia covering the period from 1975 to 2011 using Vector error correction model Granger causality and ARDL Bounds tests and Innovative Accounting Approach (IAA). The empirical findings reveal that The VECM causality analysis has shown the feedback hypothesis between energy consumption and CO_2 emissions. Economic growth and CO_2 emissions are also interrelated implying that there is evidence of bidirectional causality. Financial development Granger causes CO_2 emissions. More recently, Yang and Zhao (2014) studied these linkages for India during the period 1970-2008 by using Granger causality tests and directed acyclic graphs (DAG), and they show that energy consumption Granger causes carbon emissions and economic growth, while there is bidirectional causal link among CO_2 emissions and economic growth. Also, they find that trade openness is one of the important determinants of energy consumption and carbon emissions.

[Please Insert Table 5 about Here]

2.3.2. Multi-country studies on energy-environment–growth nexus

Apergis and Payne (2010) studied the linkages between energy consumption, economic growth, and CO_2 emissions for a sample of eleven countries of Commonwealth of Independent States over the period from 1992 to 2004 within a panel vector error correction model. The results show that in the short run there is the evidence of unidirectional causality running from energy consumption and real output, respectively, to carbon dioxide emissions along with bidirectional causality between energy consumption and real output. In the long-run there appears to be bidirectional causality between energy consumption and carbon dioxide emissions. Also, Pao and Tsai (2010) examined the linkages between economic growth, energy consumption and CO_2 emissions for the BRIC countries, namely Brazil, Russia, India, and China during the period 1971-2005 The panel causality results indicate there is evidence of bidirectional causal relationship between energy consumption and CO_2 emissions and bidirectional causal link between energy consumption and economic growth, also there is evidence of unidirectional both short-run causalities from emissions and energy consumption, respectively, to output. Among other, Arouri et al. (2012) using Co-integration techniques for 12 MENA countries, Mensah (2014) examines this linkage for emerging

African countries, Saboori and Sulaiman (2013) for ASEAN countries, Alam et al. (2012) for Bangladesh, Soytas et al. (2007), Halicioglu (2009), Zhang and Cheng (2009). The results show that the EKC hypotheses are satisfied in the region as a whole. Recently, Omri (2013) investigated the nexus among CO_2 emissions, energy consumption, and economic growth for a sample of 14 MENA countries during the period from 1990 to 2011 applying the simultaneous-equations models. The findings show that there is evidence of a bidirectional causal relationship between energy consumption and economic growth. Also, the results support the existence of unidirectional causal relationship running from energy consumption to CO_2 emissions without feedback, and there is evidence of bidirectional causal relationship between economic growth and *CO2* emissions for the region as a whole. Furthermore, Saboori et al. (2014) examined the relationships between energy consumption, CO_2 emissions, and economic growth in the transport sector for the OECD countries using Fully Modified Ordinary Least Squares Co-integration approach over the period 1960-2008, and they find long-run bidirectional relationship between CO_2 emissions and economic growth, road sector energy consumption and economic growth and CO_2 emissions and road sector energy consumption for the panel as a whole.

[Please Insert Table 6 about Here]

According to several previous studies are proved that pollution is closely related to energy consumption since more energy consumption leads to higher economic development through productivity enhancement but it also leads to higher pollutant gases. This important conclusion may be it supported the role of alternatives energies such as renewable and nuclear energy in the fulfillment of the both purpose in terms of level of economic growth and environmental quality. The seminal role that played by renewable energy in the duality between economic growth and environment, and this ability to solve the arbitration growth-environment consist the topic of several academic and scientist research in past few decades and in the starting point of the third millennium. In this same context, the renewable energy consumption has been introduced in the analytical framework in order to prove the ability to release the both objectives growth and sustainable environmental quality. There is a several studies are investigated the three-way linkages between renewable energy consumption, economic growth and environment such as Chien and Hu,2007; Ewing et al.,2007; Sadorsky,2009; Mengaki, 2011; Payne, 2011; Fang, 2011;Tiwari, 2011a; Salim and Rafiq,2012 ; Tugcu et al., 2012; Ben Aïssa et al., 2013. Also, Apergis et al. (2010)

investigated the linkages between CO_2 emissions, renewable energy, nuclear energy, and economic growth for a panel of 19 developed and developing countries over the period 1984-2007 using a panel error correction model. The result suggest that nuclear energy has statistically significant negative impact on the CO_2 emissions, however renewable energy consumption has a statistically significant positive impact on CO_2 emissions. This implies that, in the short-run nuclear energy consumption plays an important role in reducing CO_2 emissions whereas renewable energy consumption does not contribute to reductions in emissions. More recently, Apergis and Payne (2014) examined the relationship between CO_2 emissions, renewable energy, fossil fuel prices, and economic growth for a panel of seven Central American countries over the period 1980 to 2010.

3. Concluding remarks

The purpose of this study is to survey and discuss the literature dealing with the causal relationship between energy consumption, environmentand economic growth for individual and collective cases in order to suggest some policy implications for the futures studies. In addition, this survey gives researchers a 'snap shot' of the literature on the causality between energy, environment and economic growth for both specific- and multi-country studies. Understanding the causal links between energy, environment and economic growth provides a basis for discussion in order to design and implementating effective energy and environmental policies.

The general conclusion that we can raise from these studies is that there is no consensus either on the existence or on the direction of causality between these variables in literature. These conflicting results may be attribuated to the different data set, selected variables and countries, and econometric approaches which have been used (Ozturk, 2010 ; Payne 2010 ; Omri, 2014). In order to avoid these conflicting results, the researchers should focus more on the new methodology and employ multivariate modeling rather than use usual methodologies including a set of common variables for different countries or regions different intervals of time to get more conclusive and consistent findings and more appreciate the conflicting linkage between economic growth-energy consumption-environmental quality. On the other hand, one important critique for the existing studies on the validity of the environmental Kuznets curve (EKC) is that they are based on a reduced from model where there is no feedback effect from the environment to economic growth and therefore environmental quality is invariably viewed as the outcome of economic growth (Tamazian et

al., 2009; He and Richard, 2010). In all of the EKC empirical literature, the effect of economic growth on environmental quality is estimated directly. However, it is well known that, in addition to the effect of economic growth on environmental quality, environmental degradation may directly impact upon economic growth through a restriction or reduction in production (Barbier, 1994; Pearce and Warford, 1993) and adverse effects upon production factors (Van Ewijk and Van Wijnbergen, 1995), or indirectly through higher emissions reduction costs. Generally, the economic growth and the environment are jointly determined (Perrings, 1987; Hung and Shaw, 2006). It is therefore in appropriate to estimate a single equation model of unidirectional causality from economy to environment. As Stern (1998) concluded, "estimating single equation relationships by ordinary least squares where simultaneity exists produced biased and inconsistent estimates". Hence, "a simultaneous-equations model may be more appropriate for understanding the environment-income relationship" (Borghesi, 1999).

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