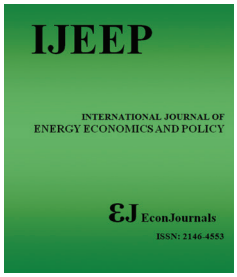


International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2015, 5(2), 385-401.

Review Paper on Economic Growth–Aggregate Energy Consumption Nexus

Zaidi Isa, Ahmed R.M. Al Sayed*, Sek Siok Kun

School of Mathematical Sciences, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia.
*Email: alsayed@siswa.ukm.edu.my

ABSTRACT

The aim of this study is to survey the empirical studies which interested in detecting the causal relationship between energy consumption (EC) and economic growth, and to provide some recommendations to policymakers for designing the environmental policies and policy implications of effective energy. Our review paper concentrates to make a survey depending on included variables in the studies, thus it has been classified into two groups; bivariate framework and multivariate framework. The results show that the multivariate studies support the feedback hypothesis more than the bivariate studies with (45.7%) and (29.5%) respectively. In contrast of that in neutrality hypothesis, the bivariate framework studies support it with (26.2%) which is more than that in multivariate framework (12.1%) only. In the other hand the results by considering the whole empirical studies in our survey support the hypotheses as the following; (34.3%), (24.0%), (19.7%) and (22.0%) for the feedback, growth, conservation and neutrality hypothesis respectively. Moreover we provide some suggestions for future studies; it should focuses more on new approaches consist the multivariate framework rather than by applying common methods with the same variables in bivariate framework only, which could be solved by adding unprecedented variables such as technology innovation, index investment and environmental quality with applying environmental Kuznets curve. In the analysis should considers the possibility of structural breaks, the coefficients signs, and distinguish between the short and long run causality relationship. And it should include two distinct groups of EC; renewable and nonrenewable energy rather than aggregate or disaggregate energy consumption.

Keywords: Economic Growth, Aggregate Energy Consumption, Causality Relationship
JEL Classifications: Q4, Q43

1. INTRODUCTION

The issue of economic growth and energy consumption (EC) relationship becomes a hot topic and it has been extensively examined by researchers and industrial sectors. In the last four decades, the causal relationship between economic growth (gross domestic product [GDP]) and EC has investigated widely in many empirical researches. Early studies had conducted by Griffin and Gregory (1976), Berndt and Wood (1979), and Berndt (1980, 1990) and they have postulated the substitutability and complementarity between GDP and EC, while Bergman (1988), Jorgenson and Wilcoxen (1993), Kemfert and Welsch (2000), and Smulders and de Nooij (2003) and others, had investigated the effects of energy within a general equilibrium approach.

The empirical studies have concentrated on different countries, utilizing a variety of time periods, proxy model variables with applying different methods to detect the relationship between GDP and EC. Moreover the findings of those empirical studies have been reported different results. It appears to be varying on the causality relationships direction and in the long-term versus short-term. Chen et al., (2007) propose that the variation in the results of the previous literatures due to the several changing on the data set, econometric methodologies, different target groups, different characteristics involved the different economic histories and political, different indigenous energy supplies, different political arrangements, different institutional arrangements, different energy policies and different cultures, etc. Karanfil (2008) has expressed that the results in developing countries studies might be not accurate and that due to unrecorded activities into real GDP correctly, subsequently examine the relationship between EC and real GDP may not give reliable results. However most of previous studies have ignored to include other factors in their model study such as environmental quality (EQ) which may have an effect on

GDP, knowing that there are few recent studies considered that variable by using CO_2 or GHG as proxy variables, they suggest that it plays a vital role in both of GDP and EC. The causality relationship between the GDP and EC is not conclusive to support the policy maker to take their decision. Indeed, realization of the interrelationship and the causality direction between GDP, EC and other factors such as EQ, index investment, capital, and technology innovation are significant in designing and implementation of environmental and energy policies.

In light of the aforementioned literatures, the main purpose of this paper is to survey the empirical literatures on the causality relationship between EC and GDP. To best of our knowledge this survey paper is the first paper surveys the relevant literatures on aggregate EC and economics nexus for a period 1978-2014. The remaining parts of this paper is organized as follows; Section 2 illustrates the forth hypotheses which represent the results of the causality relationship between EC and GDP. Section 3 surveys the empirical studies in detecting the causality between EC and GDP by two parts, first part the studies which concentrate into bivariate framework, while the second part focuses into the multivariate framework studies, then the discussion of results. Section 4 provides remarkable conclusion and suggestion for future research.

2. THE FOUR HYPOTHESES REPRESENTING THE RESULTS OF CAUSALITY RELATIONSHIP BETWEEN EC AND ECONOMIC GROWTH

In this area of the empirical researches; there are enormous amount of studies focuses on detecting the causality link between GDP and EC, followed by Kraft and Kraft (1978) who investigated the relationship between those variables for USA, and their findings suggest that causality relationship has a significant policy implications. In other hands those studies have applied several techniques to examine the causality direction in both long run and short run into miscellaneous countries. However those empirical studies have failed to acquire unanimous results. Those studies have reported different outcomes, due to that we are going to categorize them into four groups depending on their findings of the causality direction, as same as the classification of hypotheses on the EC-economic growth nexus. First results group shows bidirectional causality between EC and GDP which represented by feedback hypothesis, it postulates a joint effect between EC and GDP, each one of them has effect the other one, the increasing (decreasing) in EC causes an increasing (decreasing) in GDP level respectively and vice versa. Second group asserts the unidirectional causality running from EC to GDP, and it called growth hypothesis, it illustrates that any an increase (decrease) in EC could causes an increase (decrease) in GDP level; therefore EC has a vital role in production process of GDP. While the third group emphasizes the existence of the unidirectional causality running from GDP to EC which called conservation hypothesis, the increase in GDP may cause an increase on EC. Finally the forth group supports the absence of relationship between GDP and EC and it called neutrality hypothesis, it suggests that there is no significant effect from EC into GDP and *vice versa* (Ozturk, 2010).

3. THE LITERATURES SURVEY OF CAUSALITY EC AND ECONOMIC GROWTH NEXUS

As we have mentioned earlier that there are several empirical studies have interested and attempted to determine the casual relationship between GDP and EC, while the findings of those studies have been intermingled and conflicted. Due to that some studies provide the causality relationship running from GDP to EC, but others showed the reverse that causality relationship running from EC to GDP. However some found that there is bi-directional causality between the two variables while others support that there is no causality relationship between those variables. In this section, we extend a chronological list of the empirical literature on the causality relationship between GDP and EC, providing the applied methodologies, target countries, period spanning, findings, published year, and author name. While most of previous studies have focused in that causality relationship in specific country or cross countries, and in other way most of them have concentrated on industrialized and developed countries only. We are going to divide the survey literatures into two major groups by variables included in the study; First group involved the bivariate framework studies as in Table 1, while the second group shows the multivariate framework as shown in Table 2. Note that our literature survey concentrates on the studies which taken the aggregated EC as a proxy of EC rather than the disaggregate energy levels, to avoid the bias results.

3. 1. Bivariate Framework Studies Depending on the Results of Hypotheses

This part of literature includes the empirical studies which interested into detect the casual relationship between two variables only; economic growth GDP and EC. The direction of causality has been counted in each study according to hypothesis. The bivariate framework studies has summarized in Table 1.

3.1.1 Feedback hypothesis shows bidirectional causality between EC and GDP

The empirical studies which support the feedback hypothesis by specific country and cross countries have been summarized in Table 1. The following studies provide bidirectional causality between EC and GDP on a country specific; Hwang and Gum (1992) focuses his study in Taiwan for period spanning from 1961 to 1990 by using Granger causality method. Zarnikau (1997) his target group is USA country during the period 1970-1992 by employed the Granger causality. Jumbe (2004) his analysis included data spanning from 1970 to 1999 of Malawi country. Erdal et al. (2008) concentrate their study in Turkey for the period 1970 to 2006 by using pair-wise Granger causality and Johansen co-integration. Belloumi (2009) focuses in Tunisia for monthly data from 1971 to 2004 by applying Granger causality and vector error correction model (VECM) approaches. Zhang (2011) focuses in Russia over the period 1970-2008 by using time-varying co-integration and Toda Yamamoto (TY) causality test. Zhang and Xu (2012) his study conducted in China over the period 1995 to 2008 by using panel causality tests. Shahiduzzaman and Alam (2012) concentrate in Australia for times series 1960-2009 by employing

Table 1: The summary of empirical studies on EC and GDP nexus for bivariate framework

Author	Methodology	Year	Scope	Findings and Results
Kraft and Kraft (1978)	Granger and Sims causality	1947-1974A	USA	GDP→EC
Akarca and Long (1980)	Sims causality	1950-1970A	USA	GNP — EC
Yu and Choi (1985)	Sims and granger causality	1947-1979A	USA	GNP — EC
		1950-1976A	UK	EC→GNP
		1950-1976A	Poland	GNP — EC
		1950-1976A	Philippines	EC→GNP
		1954-1976A	South Korea	GNP→EC
Erol and Yu (1987a)	Sims and granger causality	1950-1982A	Japan	EC↔GNP
		1950-1982A	Germany	GNP→EC
		1950-1982A	Italy	GNP→EC
		1950-1982A	Canada	EC→GNP
		1950-1980	France	GNP — EC
		1950-1982A	UK	GNP — EC
Nachane et al. (1988)	EG	1950-1985A	Argentina	CEC→GDP
			Brazil	CEC↔GDP
			Chile	CEC→GDP
			Colombia	CEC↔GDP
			Greece	CEC→GDP
			Guatemala	CEC→GDP
			India	CEC↔GDP
			Israel	CEC↔GDP
			Portugal	CEC→GDP
			Mexico	CEC→GDP
			Venezuela	CEC↔GDP
			France	CEC→GDP
			Germany	CEC↔GDP
			Italy	CEC→GDP
			Japan	CEC↔GDP
			UK	CEC→GDP
Abosedra and Baghestani (1991)	Granger causality	1947-1987A	USA	GNP→EC
Hwang and Gum (1992)	Granger causality	1961–1990A	Taiwan	GNP↔EC
Yu and Jin (1992)	Granger causality	1974–1990A	USA	GDP— EC
Ebohon (1996)	Granger causality	1960-1981A	Tanzania	GDP↔EC
		1960-1984A	Nigeria	GDP↔EC
Masih and Masih (1996)	JJ and VDC	1955-1990A	India	GNP→EC
		1955-1990A	Pakistan	GNP↔EC
		1960-1990A	Indonesia	GNP→EC
		1955-1990A	Malaysia	GNP — EC
		1960-1990A	Singapore	GNP — EC
		1955-1991A	Philippines	GNP — EC
Zarnikau (1997)	Granger causality	1970-1992A	USA	GNP↔EC
Glasure and Lee (1998)	EG	1961-1990A	South Korea	GDP↔EC
			Singapore	GDP↔EC
Yang (2000)	EG	1954-1997A	Taiwan	EC↔GDP
Soytas et al. (2001)	Co-integration, Granger causality	1960-1995A	Turkey	EC→GDP
Fatai et al. (2002)	Granger causality, ARDL and TY	1960-1999A	New Zealand	GDP — EC
Ghosh (2002)	Cointegration	1950-1997A	India	GDP→EC
Soytas and Sari (2003)	JJ and VDC	1950-1990A	Argentina	GDP↔EC
		1950-1992A	Canada	GDP — EC
		1950-1992A	France	EC→GDP
		1950-1992A	Germany	EC→GDP
		1960-1992A	Indonesia	GDP — EC
		1953-1991A	Italy	GDP→EC
		1950-1992A	Japan	EC→GDP
		1953-1991A	Korea	GDP→EC
		1965-1994A	Poland	GDP — EC

(*Contd...*)

Table 1: (*Continued...*)

Author	Methodology	Year	Scope	Findings and Results
		1950-1992A	Turkey	GDP↔EC
		1950-1992A	UK	GDP — EC
		1950-1992A	USA	GDP — EC
Altinay and Karagol (2004)	Granger causality	1950-2000A	Turkey	GDP — EC
Fatai et al. (2004)	Granger-causality, TY, ARDL and JJ	1960-1999A	Australia	GDP→EC
			New Zealand	GDP→EC
			India	EC→GDP
			Indonesia	EC→GDP
			Thailand	EC↔GDP
			Philippines	EC↔GDP
Wolde-Rufael (2004)	TY	1952-1999A	Shanghai	EC→GDP
Jumbe (2004)	Cointegration	1970-1999A	Malawi	GDP↔EC
Wolde-Rufael (2005)	ARDL and TY	1971-2001A	Algeria	GDP→EC
			Benin	GDP — EC
			Cameroon	EC→GDP
			DR Congo	GDP→EC
			Rep Congo	GDP — EC
			Egypt	GDP→EC
			Gabon	GDP↔EC
			Ghana	GDP→EC
			Ivory Coast	GDP→EC
			Kenya	GDP — EC
			Morocco	EC→GDP
			Nigeria	EC→GDP
			Senegal	GDP — EC
			South Africa	GDP — EC
			Sudan	GDP — EC
			Togo	GDP — EC
			Tunisia	GDP — EC
			Zambia	GDP↔EC
			Zimbabwe	GDP — EC
Lee and Chang (2005)	JJ	1954-2003A	Taiwan	EC↔GDP
Al-Iriani (2006)	Pedroni panel cointegration	1971-2002A	Panel of 6 countries in Middle East	GDP→EC
Chontanawat et al. (2006)	JJ and dynamic panel estimation	1960-2000A	OECD countries	
			Australia	GDP→EC
			Austria	EC→GDP
			Belgium	EC→GDP
			Canada	GDP→EC
			Czech	EC→GDP
			Denmark	EC→GDP
			Finland	GDP→EC
			France	GDP↔EC
			Germany	GDP↔EC
			Greece	GDP↔EC
			Hungary	GDP↔EC
			Iceland	GDP↔EC
			Ireland	EC→GDP
			Italy	GDP↔EC
			Japan	GDP↔EC
			Korea	EC→GDP
			Luxembourg	GDP — EC
			Mexico	EC→GDP
			The Netherlands	EC→GDP
			New Zealand	GDP↔EC
			Norway	GDP↔EC
			Poland	EC→GDP

(*Contd...*)

Table 1: (*Continued...*)

Author	Methodology	Year	Scope	Findings and Results
			Portugal	GDP↔EC
			Slovakia	GDP↔EC
			Spain	GDP→EC
			Sweden	GDP→EC
			Switzerland	EC→GDP
			Turkey	GDP — EC
			UK	GDP — EC
			USA	GDP — EC
		1971-2000A	Non-OECD	
			Albania	GDP→EC
			Algeria	GDP→EC
			Angola	GDP↔EC
			Argentina	GDP↔EC
			Bahrain	GDP — EC
			Bangladesh	EC→GDP
			Benin	GDP — EC
			Bolivia	GDP→EC
			Brazil	GDP↔EC
			Brunei	GDP↔EC
			Bulgaria	GDP→EC
			Cameroon	GDP — EC
			Chile	EC→GDP
			China	GDP — EC
			Colombia	EC→GDP
			Congo	GDP — EC
			Congo Republic	EC→GDP
			Costa Rica	GDP→EC
			Cote d'Ivoire	GDP — EC
			Cuba	GDP→EC
			Cyprus	EC→GDP
			Dominican Republic	EC→GDP
			Ecuador	GDP — EC
			Egypt	EC→GDP
			El Salvador	GDP→EC
			Ethiopia	GDP→EC
			Gabon	GDP — EC
			Ghana	GDP↔EC
			Gibraltar	GDP↔EC
			Haiti	GDP — EC
			Honduras	GDP — EC
			Hong Kong	GDP — EC
			India	GDP — EC
			Iran	GDP↔EC
			Iraq	GDP — EC
			Israel	EC→GDP
			Jamaica	GDP — EC
			Jordan	GDP↔EC
			Kenya	EC→GDP
			Kuwait	GDP↔EC
			Lebanon	GDP↔EC
			Libya	GDP — EC
			Malaysia	GDP — EC
			Malta	GDP — EC
			Morocco	GDP↔EC
			Mozambique	GDP↔EC
			Myanmar	GDP↔EC
			Nepal	EC→GDP
			Nicaragua	GDP — EC
			Nigeria	GDP — EC
			Oman	EC→GDP
			Pakistan	GDP — EC
			Panama	GDP→EC
			Paraguay	GDP→EC
			Peru	GDP→EC

(*Contd...*)

Table 1: (*Continued...*)

Author	Methodology	Year	Scope	Findings and Results
			Philippines	EC→GDP
			Qatar	GDP↔EC
			Romania	GDP↔EC
			Saudi Arabia	GDP→EC
			Senegal	GDP — EC
			Singapore	GDP — EC
			Sri Lanka	GDP — EC
			Sudan	GDP↔EC
			Taiwan	GDP↔EC
			Tanzania	GDP — EC
			Thailand	GDP→EC
			Togo	GDP — EC
			Trinidad	GDP↔EC
			Tunisia	GDP↔EC
			UAE	GDP↔EC
			Uruguay	EC→GDP
			Venezuela	GDP→EC
			Vietnam	EC→GDP
			Yemen	GDP↔EC
			Zambia	GDP — EC
			Zimbabwe	GDP→EC
Lee (2006)	TY	1960-2001A	Belgium	EC→GDP
		1965-2001A	Canada	EC→GDP
		1960-2001A	France	GDP→EC
		1971-2001A	Germany	GDP — EC
		1960-2001A	Italy	GDP→EC
		1960-2001A	Japan	GDP→EC
		1960-2001A	The Netherlands	EC→GDP
		1960-2001A	Sweden	GDP — EC
		1960-2001A	Switzerland	EC→GDP
		1960-2001A	UK	GDP — EC
		1960-2001A	USA	GDP↔EC
Francis et al. (2007)	EG	1971-2002A	Haiti	GDP↔EC
			Jamaica	GDP↔EC
			Trinidad and Tobago	GDP↔EC
Lise and Montfort (2007)	EG	1970-2003A	Turkey	GDP→EC
Mehrara (2007a)	Pedroni panel cointegration	1971-2002A	Panel of 7 countries in middle east	GDP→EC
Mehrara (2007b)	TY and JJ	1971-2002A	Iran	GDP→CEC
			Kuwait	GDP→CEC
			Saudi Arabia	CEC→GDP
Ang (2007)	Cointegration, VECM	1960-2000A	France	EC→GDP
Ho and Siu (2007)	Cointegration, VECM	1966–2002A	Hong Kong	EC→GDP
Chiou et al. (2008)	JJ; Baek and Brock non-linear Granger causality	1954-2006A	Taiwan	EC→GDP
		1971-2003A	Hong Kong	EC→GDP
		1971-2003A	Singapore	GDP→EC
		1971-2003A	Korea	GDP — EC
		1971-2003A	Malaysia	GDP — EC
		1971-2003A	Indonesia	GDP↔EC
		1971-2003A	Philippines	GDP→EC
		1971-2003A	Thailand	GDP — EC
		1960-2003A	USA	GDP — EC
Ang (2008)	JJ and VECM	1971-1999A	Malaysia	GDP→EC
Erdal et al. (2008)	Pair-wise Granger causality and JJ	1970-2006A	Turkey	GDP↔EC
Akinlo (2008)	ARDL	1980-2003A	Gambia	GDP→EC
			Ghana	GDP→EC
			Sudan	GDP→EC
			Zimbabwe	GDP→EC
			Congo	GDP→EC

(*Contd...*)

Table 1: (*Continued*...)

Author	Methodology	Year	Scope	Findings and Results
			Senegal	GDP — EC
			Cameroon	GDP — EC
			Coted' Ivories	GDP — EC
			Nigeria	GDP — EC
			Kenya	GDP — EC
			Togo	GDP — EC
Belloumi (2009)	Granger causality and VECM	1971-2004M	Tunisia	GDP↔EC
Zhang and Cheng (2009)	Granger causality	1960-2007A	China	GDP→EC
Bowden and Payne (2009)	TY	1949-2006A	United States	GDP — EC
Ozturk et al. (2010)	Pedroni panel cointegration	1971-2005A	51 countries:	
			Low income 14	GDP→EC
			Lower middle 24	GDP↔EC
			Upper middle 13	GDP↔EC
Ozturk and Acaravci (2010)	ARDL and ECM	1980-2006A	Albania	GDP — EC
			Bulgaria	GDP — EC
			Hungary	GDP↔EC
			Romania	GDP — EC
Bartleet and Gounder (2010)	ARDL cointegration, ECM causality	1960-2004A	New Zealand	GDP→EC
Tsani (2010)	TY	1960-2006A	Greece	EC→GDP
Warr and Ayres (2010)	JJ, cointegration, VECM	1946-2000A	USA	EC→GDP
Hossain and Saeki (2011)	Panel causality (Granger, EG and GMM)	1971-2007A	Panel of South Asian countries	EC→GDP
Zhang (2011)	TY and Time-varying cointegration	1970-2008A	Russia	GDP↔EC
Eggoh et al. (2011)	Panel cointegration, Panel causality	1970-2006A	African countries 21	GDP↔EC
			Energy exporters 11	GDP↔EC
			Energy importers 10	GDP↔EC
Belke et al. (2011)	Dynamic Panel causality	1981-2007A	Panel of 25 OECD	GDP↔EC
Lau et al. (2011)	Granger causality test and FMOLS	1980 – 2006A	Panel of 17 Asian countries	GDP→EC
Abid and Sebri (2011)	VECM	1980-2007A	Tunisia	GDP↔EC
Sadorsky (2012)	Panel cointegration, Panel causality	1980-2007A	Panel of 7 countries in South American	GDP↔EC
Narayan and Popp (2012)	Panel cointegration, Panel causality	1980-2006A	Global panel 93	GDP↔EC
			Western European 20	EC→GDP
			Asian panel 17	EC→GDP
			Latin American 17	EC→GDP
			Middle East panel 12	GDP — EC
			African panel 25	GDP↔EC
			G6 panel 6	EC→GDP
Souhila and Kourbali (2012)	Threshold cointegration and Granger causality	1965-2008A	Algeria	GDP→EC
Fuinhas and Marques (2012)	ARDL cointegration, and ECM	1965-2009A	Portugal	GDP↔EC
			Italy	GDP↔EC
			Greece	GDP↔EC
			Spain	GDP↔EC
			Turkey	GDP↔EC
Pirlogea and Cicea (2012)	Co-integration tests	1990-2010A	Romania	EC→GDP
			Spain	EC→GDP
Zhang and Xu (2012)	Panel cointegration, Panel causality	1995-2008A	China	GDP↔EC
Shahiduzzaman and Alam (2012)	JJ, cointegration, and VECM	1960-2009A	Australia	GDP↔EC
Wesseh Jr and Zoumara (2012)	Parametric and non-parametric Granger causality approaches	1980-2008A	Liberian	GDP↔EC
Ocal and aslan (2013)	ARDL and TY	1990-2010A	Turkey	GDP→REC

(*Contd*...)

Table 1: (*Continued*...)

Author	Methodology	Year	Scope	Findings and Results
Herrerias et al. (2013)	Panel cointegration techniques	1995-2009A	Chinese	GDP→EC
Dergiades et al. (2013)	Parametric and non-parametric test	1960-2008A	Greece	EC→GDP

The unidirectional causality, bidirectional causality and no causality between EC and GDP have been represented by the symbols →, ↔ and — respectively. For the abbreviations of methods; TY: Toda-Yamamoto causality test, JJ: Johansen-Juselius. ARDL: Autoregressive distributed lag bounds test. EG: Engle-Granger. VDC: Forecast error variance decomposition. VECM: Vector error correction model. ECM: Error correction model. PECM: Panel error-correction model. GMM: Generalized method of moments. While the abbreviations of main variables and scope; GNP or GDP represent the economic growth. EC: Energy consumption, CEC: Commercial energy consumption. G6: France, West Germany, Italy, Japan, the United Kingdom and the United States. OECD: Organization for economic co-operation and development countries, GDP: Gross domestic product, GNP: Gross national product

Table 2: The summary of empirical studies on EC and GDP for multivariate framework

Author	Methodology	Year	Scope	Additional variables	Findings anf Results
Yu and Hwang (1984)	Sims and Granger causality	1947-1979A	USA	EMP	GNP — EC EC→EMP
Stern (1993)	Granger causality and VAR	1947-1990A	USA	EMP and capital	EC→GDP
Cheng (1996)	EG	1947-1990A	USA	Capital	EC — GNP
Cheng (1997)	EG	1963-1993A	Brazil	Capital	EC→GDP
		1949-1993A	Mexico		EC — GDP
		1952-1993A	Venezuela		EC — GDP
Cheng and Lai (1997)	EG	1955-1993A	Taiwan	EMP	GDP→EC EC→EMP
Masih and Masih (1997)	JJ, VDC and IRF	1961-1990A	Korea	Consumer prices	GDP↔EC
			Taiwan		GDP↔EC
Cheng (1998)	JJ and Hsiao's Granger causality	1952-1995A	Japan	Capital and EMP	GNP→EC
Masih and Masih (1998)	JJ, VDC and IRF	1955-1991A	Thailand	Consumer prices	EC→GDP
			Sri Lanka		EC→GDP
Cheng (1999)	JJ, Co-integration, ECM and Granger causality	1952-1995A	India	Capital and population	GNP→EC
Asafu-Adjaye (2000)	JJ	1973-1995A	India	Consumer prices	EC→GDP
		1973-1995A	Indonesia		EC→GDP
		1971-1995A	Thailand		EC↔GDP
		1971-1995A	Philippines		EC↔GDP
Stern (2000)	JJ and Granger causality	1948-1994A	USA	EMP and capital	EC→GDP
Aqeel and Butt (2001)	EG	1955-1996A	Pakistan	EMP	GDP→EC
Glasure (2002)	JJ and VDC	1961-1990A	Korea	Energy prices	EC↔GDP
Hondroyiannis et al. (2002)	JJ and VECM	1960-1999A	Greece	Consumer prices	EC↔GDP
Ghali and El-Sakka (2004)	JJ, VDC and VEC	1961-1997 A	Canada	Capital and EMP	EC↔GDP
Oh and Lee (2004a)	JJ, Granger causality and VECM	1970-1999 A	Korea	Capital and labor	EC↔GDP
Oh and Lee (2004b)	JJ	1981-2000Q	South Korea	Capital, labor and real energy prices	GDP→EC
Paul and Bhattacharya (2004)	EG and JJ	1950-1996A	India	Population and capital	EC↔GDP
Lee (2005)	Pedroni panel cointegration	1975-2001A	Panel of 18 Developing countries	Capital	EC→GDP
Soytas and Sari (2006a)	TY and VDC	1971-2002A	China	labor force and capital	EC—GDP
Soytas and Sari (2006b)	JJ and VDC	1960-2004A	Canada	Labor force and real	EC↔GDP
		1970-2002A	France	gross fixed capital	EC→GDP
		1971-2002A	Germany	formation	EC↔GDP
		1960-2004A	Italy		EC↔GDP
		1960-2004A	Japan		EC↔GDP
		1960-2004A	UK		EC↔GDP
		1960-2004A	USA		EC→GDP
Climent and Pardo (2007)	JJ	1984-2003Q	Spain	Consumer prices and employment	EC↔GDP

(*Contd*...)

Table 2: (*Continued*...)

Author	Methodology	Year	Scope	Additional variables	Findings anf Results
Jobert and Karanfil (2007)	JJ	1960-2003A	Turkey	IVA	EC—GNP EC—IVA
Mahadevan and Asafu-Adjaye (2007)	Pedroni panel cointegration; JJ and VECM	1971-2002A	Exporters developed	Consumer prices	EC↔GDP
			Australia		EC↔GDP
			Norway		EC↔GDP
			UK		EC↔GDP
			Exporters developing		EC↔GDP
			Argentina		EC↔GDP
			Indonesia		EC↔GDP
			Kuwait		EC↔GDP
			Malaysia		EC↔GDP
			Nigeria		EC↔GDP
			Saudi Arabia		EC↔GDP
			Venezuela		EC↔GDP
			Importers developed		EC↔GDP
			Japan		EC↔GDP
			Sweden		EC↔GDP
			USA		EC↔GDP
			Importers developing		EC→GDP
			Ghana		EC↔GDP
			India		EC→GDP
			Senegal		EC→GDP
			South Africa		EC↔GDP
			South Korea		EC→GDP
			Singapore		EC↔GDP
			Thailand		EC→GDP
Narayan and Smyth (2007)	Pedroni panel cointegration	1972-2002A	Panel of 7 western countries	Capital	EC→GDP
Soytas et al. (2007)	TY and VDC	1960-2000A	USA	Real gross fixed capital formation, labor force and CO_2	EC — GDP
Zachariadis (2007)	JJ, ARDL and TY	1960-2004A	Canada	IVA	All: GDP→EC
			France		JJ: EC↔GDP ARDL: EC→GDP TY: EC — GDP
			Germany		JJ: EC↔GDP ARDL: GDP→EC TY: EC — GDP
			Italy		JJ: EC↔GDP ARDL: EC↔GDP TY: EC — GDP
			Japan		JJ: EC↔GDP ARDL: EC↔GDP TY: EC→GDP
			UK		All: GDP→EC
			USA		All: EC — GDP
Zamani (2007)	EG	1967-2003A	Iran	IVA and AVA	GDP→EC
Yuan et al. (2008)	JJ and IRF	1963-2005A	China	Capital, employment	EC↔GDP
Huang et al. (2008)	Dynamic panel estimation, GMM and VAR	1972-2002A	Low income	Capital stock+labor force	EC — GDP
			Middle income		GDP→EC
			High income		GDP→EC
			Over all panel		EC↔GDP
Lee and Chang (2008)	Pedroni panel cointegration	1971-2002A	Asian panel,	Capital stock and labor force	EC→GDP
			APEC,		EC→GDP
			ASEAN		EC→GDP

(*Contd*...)

Table 2: (*Continued*...)

Author	Methodology	Year	Scope	Additional variables	Findings anf Results
Soytas and Sari (2008)	TY and VDC	1960-2000A	Turkey	Real gross fixed capital formation, labor force and CO_2	EC — GDP
Payne (2009)	TY	1949-2006A	USA	Real gross fixed capital formation and Employment	EC — GDP
Apergis and Payne (2009)	Pedroni panel cointegration	1980-2004A	Panel of 6 South America countries	Real gross fixed capital formation and labor force	EC→GDP
Costantini and Martini (2010)	VECM	1960-2005A	71 countries	Energy prices	GDP→EC
			26 OECD		EC↔GDP
			45 non-OECD		GDP→EC
Acaravci and Ozturk (2010)	Cointegration, ARDL	1960e2005	19 Europe countries	CO_2	
			Austria		EC — GDP
			Belgium		EC — GDP
			Denmark		EC — GDP
			Finland		EC — GDP
			France		EC — GDP
			Germany		EC — GDP
			Greece		GDP→EC
			Hungary		EC — GDP
			Iceland		EC — GDP
			Ireland		GDP→EC
			Italy		EC — GDP
			Luxembourg		EC — GDP
			Netherlands		EC — GDP
			Norway		EC — GDP
			Portugal		EC — GDP
			Spain		EC — GDP
			Sweden		EC — GDP
			Switzerland		EC↔GDP
			United Kingdom		EC — GDP
Apergis and Payne (2010)	Cointegration and ECM	1985-2005A	20 OECD countries	Capital and labor force	EC↔GDP
Odhiambo (2010)	Cointegration, ARDL and ECM	1972-2006A	South Africa	Energy prices	EC→GDP
			Kenya		EC→GDP
			congo		GDP→EC
Ozturk and Acaravci (2010)	Cointegration, ARDL	1968-2005A	Turkey	CO_2, employment ratio	EC — GDP
Hatzigeorgiou et al. (2011)	cointegration, JJ and VECM	1977-2007A	Greece	CO_2	GDP→EC
Pao and Tsai (2011)	Cointegration panel causality	1980-2007A	panel of 4 BRIC countries	FDI and CO_2	EC↔GDP
Hossain (2011)	Granger causality and EG	1971-2007A	Panel of 9 NIC	CO_2	GDP→EC
Wang et al. (2011)	Panel cointegration, VECM	1995-2007A	China	CO_2	EC↔GDP
Alam et al. (2011)	Dynamic modeling	1971-2006A	India	Fixed capital stock, labor force and CO_2	EC — GDP
Farhani and Ben (2012).	Panel cointegration, Panel causality	1973-2008A	15 MENA countries	CO_2	GDP→EC
Hossein et al. (2012)	EG and ECM	1980-2008A	Iran	Energy price	GDP→EC
			Iraq		GDP→EC
			Qatar		GDP→EC
			UAE		GDP→EC
			Saudi Arabia		GDP→EC
			Algeria		EC→GDP

(*Contd*...)

Table 2: (*Continued*...)

Author	Methodology	Year	Scope	Additional variables	Findings anf Results
			Angola		EC→GDP
			Ecuador		EC→GDP
			Kuwait		EC→GDP
			Libya		EC→GDP
			Nigeria		EC→GDP
			Venezuela		EC→GDP
Shahbaz et al. (2012)	ARDL and VECM	1972-2011A	Pakistan	Capital and labor	EC↔GDP
					EC↔GDP
Al-mulali and Che Sab (2012)	Panel cointegration, Panel causality	1980-2008A	Panel of 30 Sub-Saharan African countries	Financial development and CO_2	EC↔GDP
Abalaba, and Dada, (2013)	ECM and JJ	1971-2010A	Nigeria	Financial development, monetary policy rate and consumer prices	EC — GDP
Saboori and Sulaiman (2013a)	ARDL and JJ	1980-2009 A	Malaysia	CO_2	EC↔GDP
Saboori and Sulaiman (2013b)	ARDL and VECM	1971-2008 A	Indonesia	CO_2	EC↔GDP
			Malaysia		EC↔GDP
			Philippines		EC↔GDP
			Singapore		GDP→EC
			Thailand		GDP→EC
Alkhathlan and Javid (2013)	ARDL, VECM	1980-2011A	Saudi Arabia	CO_2	EC — GDP
Yang, and Zhao (2014)	Granger causality and DAG	1979-2008A	India	CO_2	EC→GDP
					EC→CO_2

The unidirectional causality, bidirectional causality and no causality between EC and GDP have been represented by the symbols →, ↔ and — respectively. For the Abbreviations of methods; TY: Toda-Yamamoto causality test, JJ: Johansen-Juselius, ARDL: Autoregressive distributed lag bounds test. EG: Engle-Granger. VDC: Forecast error variance decomposition. VECM: Vector error correction model. ECM: Error correction model. PECM: Panel error-correction model. GMM: Generalized method of moments. While the abbreviation of main variables and scope; GNP or GDP represent the economic growth. EC: Energy consumption, CEC: Commercial energy consumption. AVA: Agricultural value added. IVA: Industrial value added. CO_2: Carbon dioxide emissions. EMP: Employment. FDI: Foreign direct investment. NIC: Newly industrialized countries; Iran, Israel, Kuwait, Oman, Saudi Arabia and Syria. BRIC countries: Brazil, Russia, India and China. OECD: Organization for Economic Co-operation and Development countries. APEC: Asia-Pacific Economic Cooperation. ASEAN: Association of Southeast Asian Nations, GDP: Gross domestic product, GNP: Gross national product

Johansen co-integration and VECM causality tests. Wesseh Jr and Zoumara (2012) interested in Liberian over the period 1980-2008 by applying parametric and non-parametric Granger causality approaches. In the other hand there are some studies support the bidirectional causality relationship between EC and GDP by considering several countries in one panel in analysis such as; Eggoh et al. (2011) their analysis included 21 African countries, 10 of them are energy exporters, while 11 are energy importers countries over the period 1970-2006 by using panel causality. Belke et al. (2011) covered 25 organization for economic co-operation and development countries during the period 1981-2007 by using dynamic panel causality. Sadorsky (2012) concentrates his analysis in 7 countries of South American for annual time series data 1980-2007 by applying panel causality. Ozturk et al. (2010) have included 51 countries in his analysis and he divided them into three groups low income, lower middle income and upper middle income, the bidirectional causality relationship found in panels of (lower and upper) middle income countries. Narayan and Popp (2012) used 93 countries in the analysis into one panel and the findings support the feedback hypothesis. Furthermore there are several studies support bidirectional causality between EC and GDP in some individual country of their cross countries analysis such as in; Erol and Yu (1987) the bidirectional causality relationship has noted in Japan only, while Nachane et al. (1988) existed it in Brazil, Colombia, India, Israel, Venezuela, Germany and Japan. Ebohon (1996) supports that causality relationship in Tanzania and Nigeria. Masih and Masih (1996) found it in Pakistan only. Glasure and Lee (1998) found it in South Korea and Singapore. Soytas and Sari (2003) suggest that it existed in Turkey only. Wolde-Rufael (2005) showed it in Gabon and Zambia. Chontanawat et al. (2008) support that in France, Germany, Greece, Hungary, Iceland, Italy, Japan, New Zealand, Norway, Portugal, Slovakia, Angola, Argentina, Brazil, Brunei, Ghana, Gibraltar, Iran, Jordan, Kuwait, Lebanon, Morocco, Mozambique, Myanmar, Qatar, Romania, Sudan, Taiwan, Trinidad, Tunisia, UAE and in Yemen. Lee (2006) found it in USA only. Francis et al. (2007) support it in Haiti, Jamaica and Trinidad. Chiou-Wei et al. (2008) suggest that it is exist in Indonesia. Fuinhas and Marques (2012) resulting it in the all countries of their study; Portugal, Italy, Greece, Spain and Turkey.

3.1.2. Growth hypothesis asserts the unidirectional causality running from EC to GDP

Furthermore many empirical studies support the growth hypothesis. First we start with studies which provide a unidirectional causality running from EC to GDP onto country specific such as Soytas et al. (2001) concentrates in Turkey with annual time series data 1960-1995 and he used cointegration and Granger causality in the analysis. Ang (2007) interested in France during the period 1960-2000 by using cointegration and VECM approach in his analysis. Ho and Siu (2007) focused in Hong Kong region by applying Cointegration and VECM in the annual data spanning from 1966 to 2002. Tsani (2010) used TY causality test in annual data 1960-2006 in Greece. Warr and Ayres (2010) focus is USA

by using the Johansen cointegration causality and VECM in their analysis over the annual period 1946 to 2000. Dergiades et al. (2013) focused in Greece by using annual data from 1960 to 2008 and employing Parametric and non-parametric test. However there are few studies support the growth hypothesis by one panel countries such as; Hossain and Saeki (2011) included several Asian countries in one panel over the period 1971-2007 by using Granger causality, Engle-Granger (EG) and generalized method of moments (GMM). While in Narayan and Popp (2012) study, they included several countries panels, the growth hypothesis has existed in; Western European panel which involved 20 countries, and in other panel consisted of 17 countries of Asian, panel of 17 Latin American countries and 6 countries of G6. In the other hand there are some empirical studies support the growth hypothesis in individual country such as; Erol and Yu (1987) it has existed in Canada. Nachane et al. (1988) study, it has resulted in Argentina, Chile, Greece, Guatemala, Portugal, Mexico, France, Italy and UK. Soytas and Sari (2003) found it in France, Germany and Japan. Wolde-Rufael (2005) found it in Cameroon, Morocco and Nigeria. Chontanawat et al. (2006) support the growth hypotheses in the following countries; Austria, Belgium, Czech, Denmark, Ireland, Korea, Mexico, Netherlands, Poland, Switzerland, Bangladesh, Chile, Colombia, Congo, Cyprus, Dominican Republic, Egypt, Israel, Kenya, Nepal, Oman, Philippines, Uruguay and Vietnam. Lee (2006) found it in Belgium, Canada, Netherlands and Switzerland. Mehrara (2007a) support it in Saudi Arabia. Chiou-Wei et al. (2008) showed it in Taiwan and Hong Kong. While Pirlogea and Cicea (2012) support it in Romania and Spain.

3.1.3. Conservation hypothesis emphasizes the unidirectional causality running from GDP to EC

In addition there are several studies providing the conservation hypothesis. First we start with studies which provide a unidirectional causality relationship running from EC to GDP on a country specific such as; Kraft and Kraft (1978) study and in Abosedra and Baghestani (1991) study, they used annual data from 1947-1974 and 1947-1987 respectively in same country USA by applying same method Granger and Sims causality. Ghosh (2002) focused in India over the period 1950-1997. Lise and Montfort (2007) interested in Turkey during the period 1970-2003 by applying EG method. Ang (2008) concentrated in Malaysia during 1971-1999 by using Johansen cointegration and VECM approaches. Zhang and Cheng (2009) focused in China over the period 1960-2007 by employing Granger causality. Souhila and Kourbali (2012) interested in Algeria over the time period 1965-2008 by using the threshold cointegration and Granger causality tests. Ocal and aslan (2013) interested in Turkey over the period 1990-2010 by employing autoregressive distributed lag (ARDL) and TY approaches. Herrerias et al. (2013) focused in Chinese for annual data from 1995 to 2009 by using panel cointegration techniques. However there are some studies support the growth hypothesis by using panel countries analysis such as; Al-Iriani (2006) his study covered six countries from middle east in one panel for annual data spanning from 1971 to 2002 by employing Johansen-Juselius and dynamic panel estimation. And Mehrara (2007a) his study involved seven countries from middle east in one panel with annual data spanning from 1971 to 2002 by employing pedroni panel cointegration. Ozturk et al. (2010) his study contain from several panels of countries, one of them represented 14 countries in low income group, and by using panel cointegration method for annual data from 1971 to 2005 the finding support Conservation hypothesis. Lau et al. (2011) examined the relationship between GDP and EC in panel of 17 Asia countries. In the other hand there are some empirical studies support the Conservation hypothesis in individual country such as; Erol and Yu (1987) has existed it in Germany and in Italy. Masih and Masih (1996) found it in India and in Indonesia. Soytas and Sari (2003) provided it in Italy and in Korea. Wolde-Rufael (2005) supports it in Algeria, Congo, Egypt, Ghana and Ivory Coast. Chontanawat et al. (2006) have found it in Australia, Canada, Finland, Spain, Sweden, Albania, Algeria, Bolivia, Bulgaria, Costa Rica, Cuba, El Salvador, Ethiopia, Panama, Paraguay, Peru, Saudi Arabia, Thailand, Venezuela and Zimbabwe. Lee (2006) supports it in France, Italy and in Japan. Mehrara (2007a) found it in Iran and in Kuwait. Chiou-Wei et al. (2008) supports it in Singapore and in Philippines. Akinlo (2008) found it in Gambia, Ghana, Sudan, Zimbabwe and Congo.

3.1.4. Neutrality hypothesis supports the absence of causality relationship between GDP and EC

Moreover it has noted clearly among the empirical researches some finding supports the neutrality hypothesis, which means no relationship between EC to GDP. We are going to illustrate them by starting on a country specific studies such as; Akarca and Long (1980) concentrates in USA over the period 1950-1970 by applying Sims causality. Yu and Jin (1992) interested in USA by using Co-integration and Granger causality into annual data spanning from 1974 to 1990. Fatai et al. (2002) focused in New Zealand over the period 1960-1999 by using TY Granger causality and ARDL. Altinay and Karagol (2004) they focused in Turkey over the period 1950-2000 by applying Hsiao's version of Granger causality. Bowden and Payne (2009) in USA by using TY causality test in annual data spanning from 1949 to 2006. However we have not met studies has taken several countries in one panel into their analysis except one study for middle east panel contain of 12 countries for Narayan and Popp (2012) study. In the other hand there are some empirical studies support the neutrality hypothesis in individual country of their studies such as; Erol and Yu (1987) support it in France and UK. Masih and Masih (1996) found it in Malaysia, Singapore and Philippines. Soytas and Sari (2003) found it in Canada, Indonesia, Poland, UK and USA. Wolde-Rufael (2005) supports it in Benin, Congo, Kenya, Senegal, South Africa, Sudan, Togo, Tunisia and Zimbabwe. Chontanawat et al. (2008) support the neutrality hypothesis in Luxembourg, Turkey, UK, USA, Bahrain, Benin, Cameroon, China, Congo, Cote d'Ivoire, Ecuador, Gabon, Haiti, Honduras, Hong Kong, India, Iraq, Jamaica, Libya, Malaysia, Malta, Nicaragua, Nigeria, Pakistan, Senegal, Singapore, Sri Lanka, Tanzania, Togo and Zambia. Lee (2006) found it in Germany, Sweden and UK. Chiou et al. (2008) found it in Korea, Malaysia, Thailand and USA. Akinlo (2008) support it in Senegal Cameroon, Coted'Ivoire, Nigeria Kenya and Togo. Ozturk and Acaravci (2010) support it Albania, Bulgaria and Romania.

3.2. Multivariate Framework Studies Depending on the Results of Hypotheses

Nevertheless, some of authors claim that the bivariate analysis has resulted inaccurate findings on detecting the relationship

between EC and GDP. Many researchers suggest that is due to the possibility of omitted variable bias Lu¨tkepohl (1982). Tang and Tan (2013) bivariate model specification may not appropriate for examining the energy growth nexus. After that suggestion, there are several studies had used the multivariate framework to investigate that causality relationship. In addition of the later variables they employed additional factors in the analysis such as; labor force in the following studies; Oh and Lee (2004b), Soytas and Sari (2006a), Soytas and Sari (2006b), Soytas et al. (2007), Huang et al. (2008), Lee and Chang (2008), Soytas and Sari (2008), Apergis and Payne (2009), Apergis and Payne (2010), Alam et al. (2011), Shahbaz et al. (2012), among others. Moreover some other studies had included the employment as a main factor in their analysis such as; Yu and Hwang (1984), Stern (1993), Cheng and Lai (1997), Cheng (1998), Stern (2000), Aqeel and Butt (2001), Ghali and El-Sakka (2004), Climent and Pardo (2007), Yuan et al. (2008), Payne (2009) and Ozturk and Acaravci (2010), among others. However some studies added the real gross fixed capital formation as a main variable; Stern (1993), Cheng (1996), Cheng (1997), Cheng (1998), Cheng (1999), Stern (2000), Ghali and El-Sakka (2004), Oh and Lee (2004a), Oh and Lee (2004b), Paul and Bhattacharya (2004), Lee (2005), Soytas and Sari (2006b), Soytas and Sari (2006a), Narayan and Smyth (2007), Soytas et al. (2007), Yuan et al.(2008), Huang et al. (2008), Lee and Chang (2008), Soytas and Sari (2008), Payne (2009), Apergis and Payne (2009), Apergis and Payne (2010), Alam et al. (2011), Shahbaz et al. (2012) and among others. As well some studies had included consumer or real energy prices; Masih and Masih (1997), Masih and Masih (1998), Asafu-Adjaye (2000), Glasure (2002), Hondroyiannis et al. (2002), Oh and Lee (2004b), Climent and Pardo (2007), Mahadevan and Asafu-Adjaye (2007), Costantini and Martini (2010), Odhiambo (2010), Hossein et al. (2012), Abalaba, and Dada, (2013). Furthermore in recent studies many other researchers has added the carbon dioxide emissions CO_2 in their analysis, as they claim it has an important effect in the causality relationship between EC and GDP, some of those studies are; Soytas et al.(2007), Soytas and Sari (2008), Acaravci and Ozturk (2010), Hatzigeorgiou et al. (2011), Pao and Tsai (2011), Hossain (2011), Wang et al. (2011), Alam et al. (2011), Al-mulali and Che Sab (2012), Farhani, and Ben (2012), Saboori and Sulaiman (2013a), Saboori and Sulaiman (2013b), Alkhathlan and Javid (2013), among others. While some studies has added the population as main factor in their model such as; Cheng (1999), Paul and Bhattacharya (2004), among others. And other has considered the industrial value added in their analysis, Jobert and Karanfil (2007), Zachariadis (2007), Zamani (2007), and the later had included the agricultural value added in his analysis too. Pao and Tsai (2011) had considered the foreign direct investment in his molding. Al-mulali and Che Sab (2012) involve the financial development in their analysis.

In additional on the study outlined in Table 2 we summarized some of them which has included different factors in the estimated model as following; Soytas et al. (2007) he studied the long run Granger causality between EC, CO_2 and the GDP in the USA. Moreover he added some other factors in his model such as the labor force and investment in capital, while his findings do not support the existence of the causality direction neither between the GDP and CO_2, nor between the GDP and EC. Moreover he confirmed that the main resource of emission is the EC. Soytas and Sari (2008) their study has focuses on examine the Granger causality relationship in long run only between GDP, EC and CO_2 which is the most common pollutant emission in Turkey province, and they controlling the labor force and gross fixed capital, data spanning from 1960 to 2000. Moreover he applied five unit root tests (ADF, PP, KPSS, DF-GLS, and NP-Z) in his diagnostic analysis to examine the stationarity in the variables. His significant findings show that there is uni-directional causality running from CO_2 to EC but the reverse is not true. And his result support that in the long run the EC does not seem to be Granger causing GDP in Turkey. In conclusion of their paper, they suggest that to take the technology investments and its effects into account. Ozturk and Acaravci (2010) concentrated on the causal relationship between the following variables; GDP, CO_2, EC and employment ratio in turkey during the period 1968-2005 by applying recently developed ARDL bounds cointegration method for testing the long run relationships between the variables, and they used the error-correction based Granger causality models to test the causality. The findings indicate the expectance of long-run relationship between variables. There is no evidence show Granger causality of neither CO_2 nor EC cause GDP in turkey. However in short run employment ratio causes GDP. Furthermore there is no causal relationship between GDP and CO_2, due to that there is no any evidence support the environmental Kuznets curve (EKC) hypothesis. Moreover there is no causal relationship between GDP and both of EC and employment ratios. In additional of that the Long run causality have found only for the real GDP equation. In conclusion of that there is no sufficient evidence to say there is adverse effect from EC and CO_2 to GDP. Zhang and Cheng (2009) concentrated to examine the Granger causal relationship among the GDP, EC and CO_2 in china during the period 1960 to 2007 by using multivariate model for those variables including the gross fixed capital formation and urban population. They conducted three unit root tests ADF, PP and KPSS. Moreover they used ZA unit root test which can test the stationary of series with structural break. The results indicate the existence of two unidirectional Granger causality relationships; first one is running from GDP to EC, while the second one running from EC to CO_2 in long run. In additional of that no clear evidence to enhance the influence of CO_2 or EC towards the GDP. Al Sayed and Sek (2013) detect the relationship between GDP and CO_2 for developed and developing countries for data spanning from 1961 to 2009 by using Panel data method. The EKC relationship has been detected in CO_2. As a conclusion from those studies in Table 2, it is difficult to reach a consensus on the causal relationship between EC and GDP.

4. DISSECTION THE RESULTS OF FOUR HYPOTHESES EXISTENCE IN THE SURVEYED STUDIES

The results of our empirical studies survey which concentrates in detecting the causality relationship between GDP and EC supporting one of the following hypotheses; growth, conservation, neutrality and feedback hypotheses. As we divided the survey studies into two classifications, bivariate and multivariate

frameworks, we are going to calculate the percentage of each classification separately, and then we figure the results of the whole empirical studies. In one hand we illustrate the percentage of existence four hypotheses in the bivariate framework studies; the highest percentage supports the feedback hypothesis with 29.5%, followed by 26.2% for the neutrality hypothesis, then the growth hypothesis with 23.6%, and finally the lowest percentage is found in the conservation hypothesis. In the other hand the multivariate studies shows different results; as the highest percentage is also supports the existence of feedback hypothesis with 45.7%, but it followed by 25.0% in favor to growth hypothesis, and then 17.2% for the conservation hypothesis, and the lowest percentage is found in neutrality hypothesis with 12.1% only. However the percentages of those hypothesis in the whole survey empirical studies has presented as the following; in the leading position is the feedback hypothesis with 34.3%, then the growth hypothesis supported by 24.0%, and 22.0% in favor to the neutrality hypothesis, and only 19.7% for the conservation hypothesis. Table 3 and Figure 1 illustrate those results clearly. From the previous results we noted that the percentages among the two frameworks; bivariate and multivariate in the hypotheses are different. In conclusion we claim that the additional variables may increase (decrease) the probability of the feedback (neutrality) hypothesis existence, as it found 29.5% and 26.2% in bivariate framework, while it reach to 45.7% and 12.1% in multivariate framework respectively.

5. CONCLUSION

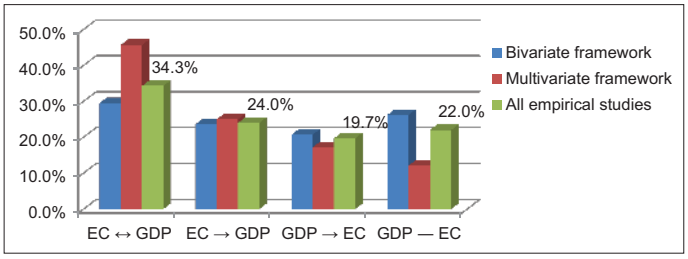
Detecting the relationship between the EC and economic growth is very important for policy makers and to conserve the environment and to reduce the consumption of the nonrenewable energy. This survey has conducted to classify the studies into two groups by the framework bivariate and multivariate of the previous empirical studies. Secondly, to detect that if there is a significant influence of the additional variables to the bivariate framework into the four hypotheses. From our survey we conclude that there is no consensus on the direction of causality relationship between EC and GDP as the finding of those empirical studies have showed uneven results in terms of the four hypotheses (feedback, growth, conservation, and neutrality).

Table 3: The percentages of the hypothesis existence among the bivariate and multivariate framework studies

Empirical studies (%)	Hypotheses			
	Feedback EC↔GDP	Growth EC→GDP	Conservation GDP→EC	Neutrality GDP — EC
Bivariate framework	29.5	23.6	20.7	26.2
Multivariate framework	45.7	25.0	17.2	12.1
All empirical studies	34.3	24.0	19.7	22.0

EC→GDP: Unidirectional causality relationship running from EC to economic growth. GDP→EC: Unidirectional causality relationship running from economic growth to EC. EC↔GDP: Bidirectional causality relationship between economic growth and EC. GDP — EC: No causality relationship between economic growth and EC. EC: Energy consumption, GDP: Gross domestic product

Figure 1: The percentages of the hypothesis existence in the surveyed studies



At the end of it, we provide some suggestions for future researches; as we have mention earlier that no consensus in the results of direction into the causality relationship between the EC and GDP in a specific countries or panel countries, income classification groups, exporters and importers countries, etc. we recommend who interested to investigate that relationship to consider the following suggestions; future researches should focus more on new approaches and perspectives in multivariate framework rather than applying common methods with the same variables in bivariate framework only, most of the studies just changed the target group and the period time which does not lead to more potential contribution into that causality relationship. And that may be by adding new variables in the analysis such as; technology innovation recently undertaken by Tang and Tan (2013) but they used the electricity consumption as a main variable instead of take the aggregate EC. And other variables; GDP deflator, exchange rates, interest rates and EQ including CO_2, SO_2, GHG, SPM_{10}, etc. Also we recommend of using several methods into detecting the causal relationship to get more robust findings which has supported by Zachariadis (2007) study. And to include the possibility of structural breaks in both the unit root process of the individual variable and in the tests for cointegration among the variables to get more accurate results. Moreover most of the previous study had ignored to detect the coefficients signs of the casualty relationship and the magnitude of that relationship, it should be considered and it might lead to clear explanation of that relationship. There is other limitation in the previous conducted studies; they considered the aggregation or the disaggregation EC as a proxy of the EC; they have not considered the renewable energy into their analysis. It should be taken into account, the influence of renewable EC not as same as of the nonrenewable EC towards GDP, investigating that relationship with considering the nonrenewable and renewable EC separately could appear new demonstration. In additional of that the causality relationship should be distinguished between the short and long run causality relationship. Taken the level of GDP in consideration also may lead to unmatched findings.

REFERENCES

Abalaba, B.P., Dada, M.A. (2013), Energy consumption and economic growth nexus: new empirical evidence from Nigeria. International Journal of Energy Economics and Policy, 3(4), 412-423.

Abid, M., Sebri, M. (2011), Energy consumption-economic growth nexus: does the level of aggregation matter? International Journal of Energy Economics and Policy, 2(2), 55-62.

Abosedra, S., Baghestani, H. (1991), New evidence on the causal relationship between United States energy consumption and gross national product. Journal of Energy and Development, 14, 285-292.

Acaravci, A., Ozturk, I. (2010), On the relationship between energy

consumption, CO_2 emissions and economic growth in Europe. Energy, 35(12), 5412-5420.
Akarca, A.T., Long, T.V., (1980), On the relationship between energy and GNP: a reexamination. Journal of Energy Development, 5, 326-331.
Akinlo, A.E. (2008), Energy consumption and economic growth: evidence from 11 Sub-Sahara African countries. Energy Economics, 30, 2391-2400.
Al Sayed, A.R., Sek, S.K. (2013), Environmental kuznets curve: evidences from developed and developing economies. Applied Mathematical Sciences, 7(22), 1081-1092.
Alam, M.J., Begum, I.A., Buysse, J., Rahman, S., Van Huylenbroeck, G. (2011), Dynamic modeling of causal relationship between energy consumption, CO^2 emissions and economic growth in India. Renewable and Sustainable Energy Reviews, 15(6): 3243-3251.
Al-Iriani, M.A. (2006), Energy-GDP relationship revisited: an example from GCC countries using panel causality. Energy Policy, 34, 3342-3350.
Alkhathlan, K., Javid, M. (2013), Energy consumption, carbon emissions and economic growth in Saudi Arabia: An aggregate and disaggregate analysis. Energy Policy, 62: 1525-1532.
Al-mulali, U., Che Sab, C.N., (2012), The impact of energy consumption and CO2 emission on the economic growth and financial development in the Sub Saharan African countries. Energy, 39(1), 180-186.
Altinay, G., Karagol, E. (2004), Structural break, unit root, and the causality between energy consumption and GDP in Turkey. Energy Economics, 26, 985-994.
Ang, J.B. (2007), CO^2 emissions, energy consumption, and output in France. Energy Policy, 35,4772-4778.
Ang, J.B., (2008), Economic development, pollutant emissions and energy consumption in Malaysia. Journal of Policy Modeling, 30, 271-278.
Apergis, N., Payne, J.E. (2009), Energy consumption and economic growth in Central America: evidence from a panel cointegration and error correction model. Energy Economics, 31, 211-216.
Apergis, N., Payne, J.E. (2010), Renewable energy consumption and economic growth: evidence from a panel of OECD countries. Energy Policy, 38, 656-660.
Aqeel, A., Butt, S. (2001), The relationship between energy consumption and economic growth in Pakistan. Asia Pacific Development Journal, 8, 101-110.
Asafu-Adjaye, J. (2000), The relationship between energy consumption, energy prices, and economic growth: time series evidence from Asian developing countries. Energy Economics, 22, 615-625.
Bartleet, M., Gounder, R., (2010), Energy consumption and economic growth in New Zealand: results of trivariate and multivariate models. Energy Policy, 38(7), 3508-3517.
Belke, A., Dobnik, F., Dreger, C., (2011), Energy consumption and economic growth: new insights into the cointegration relationship. Energy Economic, 33(5), 782-789.
Belloumi, M., (2009), Energy consumption and GDP in Tunisia: cointegration and causality analysis. Energy Policy, 37(7), 2745-2753.
Bergman, L. (1988), Energy policy modeling: a survey of general equilibrium approaches. Journal of Policy Modeling, 10, 377-399.
Berndt, E.R. (1980), Energy price increases and the productivity slowdown in United States manufacturing: decline in productivity growth. Paper Presented at Federal Reserve Bank of Boston Conference Series, Boston, MA.
Berndt, E.R. (1990), Energy use, technical progress and productivity growth: a survey of economic issues. Journal of Productivity Analysis, 2, 67-83.
Berndt, E.R., Wood, D.O. (1979), Engineering and economic interpretation of energy-capital complementarity. American Economic Review, 69, 343-354.
Bowden, N., Payne, J.E., (2009), The causal relationship between US energy consumption and real output: a disaggregated analysis. Journal of Policy Modeling, 31(2), 180-188.
Chen, S.T., Kuo, H.I., Chen, C.C., (2007), The relationship between GDP and electricity consumption in 10 Asian Countries. Energy Policy, 35, 2611-2621.
Cheng, B.S. (1996), An investigation of cointegration and causality between energy consumption and economic growth. Journal of Energy and Development, 21, 73-84.
Cheng, B.S. (1997), Energy consumption and economic growth in Brazil, Mexico and Venezuela: a time series analysis. Applied Economics Letters, 4, 671-774.
Cheng, B.S. (1998), Energy consumption, employment and causality in Japan: a multivariate approach. Indian Economic Review, 33(1), 19-29.
Cheng, B.S. (1999), Causality between energy consumption and economic growth in India: an application of cointegration and error correction modeling. Indian Economic Review, 34(1), 39-49.
Cheng, B.S., Lai, T.W. (1997), An investigation of cointegration and causality between energy consumption and economic activity in Taiwan. Energy Economics, 19(4), 435-444.
Chiou-Wei, S.Z., Chen, C.F., Zhu, Z. (2008), Economic growth and energy consumption: evidence from linear and nonlinear Granger causality. Energy Economics, 30, 3063-3076.
Chontanawat, J., Hunt, L.C., Pierse, R. (2006), Causality between energy consumption and GDP: evidence from 30 OECD and 78 non-OECD countries. Surrey Energy Economics Discussion Paper Series 113, University of Surrey, Guildford.
Chontanawat, J., Hunt, L.-C., Pierse, R. (2008), Does energy consumption cause economic growth?: Evidence from a systematic study of over 100 countries. Journal of Policy Modeling, 30, 209-220.
Climent, F., Pardo, A. (2007), Decoupling factors on the energy-output linkage: the Spanish case. Energy Policy, 35, 522-528.
Costantini, V., Martini, C., (2010), The causality between energy consumption and economic growth: a multi-sectoral analysis using non-stationary cointegrated panel data. Energy Economic, 32(3), 591-603.
Dergiades, T., Martinopoulos, G., Tsoulfidis, L. (2013), Energy consumption and economic growth: Parametric and non-parametric causality testing for the case of Greece. Energy Economics, 36, 686-697.
Ebohon, O.J. (1996), Energy, economic growth and causality in developing countries: a case study of Tanzania and Nigeria. Energy Policy, 24, 447-453.
Eggoh, J.C., Bangake, C., Rault, C., (2011), Energy consumption and economic growth revisited in African countries. Energy Policy, 39(11), 7408-7421.
Erdal, G., Erdal, H., Eseng ¨ un, K., (2008), The causality between energy consumption and economic growth in Turkey. Energy Policy, 36(10), 3838-3842.
Erol, U., Yu, E.S.H. (1987[a]), On the causal relationship between energy and income for industrialized countries. Journal of Energy and Development, 13, 113-122.
Farhani, S., Ben Rejeb, J. (2012), Energy consumption, economic growth and CO_2 emissions: Evidence from panel data for MENA region. International Journal of Energy Economics and Policy, 2(2), 71-81.
Fatai, K., Oxley, L., Scrimgeour, F.G. (2004), Modelling the causal relationship between energy consumption and GDP in New Zealand, Australia, India, Indonesia, the Philippines, and Thailand. Mathematics and Computers in Simulation, 64, 431-445.
Fatai, K., Oxley, L., Scrimgeour, F., (2002), Energy consumption and employment in New Zealand: searching for causality. NZAE Conference, Wellington, 26-28 June, 2002.

Francis, B.M., Moseley, L., Iyare, S.O. (2007), Energy consumption and projected growth in selected Caribbean countries. Energy Economics, 29, 1224-1232.

Fuinhas, J.A., Marques, A.C., (2012), Energy consumption and economic growth nexus in Portugal, Italy, Greece, Spain and Turkey: an ARDL bounds test approach (1965–2009). Energy Economic, 34(2), 511-517.

Ghali, K.H., El-Sakka, M.I.T. (2004), Energy and output growth in Canada: a multivariate cointegration analysis. Energy Economics, 26, 225-238.

Ghosh, S. (2002), Electricity consumption and economic growth in India. Energy Policy, 30, 125-129.

Glasure, Y.U. (2002), Energy and national income in Korea: further evidence on the role of omitted variables. Energy Economics, 24, 355-365.

Glasure, Y.U., Lee, A.R. (1998), Cointegration, error correction, and the relationship between GDP and energy: the case of South Korea and Singapore. Resource and Energy Economics, 20, 17-25.

Griffin, J.M., Gregory, P.R. (1976), An intercountry translog model of energy substitution responses. American Economic Review, 66, 845-857.

Hatzigeorgiou, E., Politakis, H., Haralambopoulos, D., (2011), CO_2 emissions, GDP and energy intensity: a multivariate cointegration and causality analysis for Greece, 1977–2007. Applied Energy, 88(4), 1377-1385.

Herrerias, M.J., Joyeux, R., Girardin, E. (2013), Short-and long-run causality between energy consumption and economic growth: Evidence across regions in China. Applied Energy, 112, 1483-1492.

Ho, CY., Siu, K.W., (2007), A dynamic equilibrium of electricity consumption and GDP in Hong Kong: an empirical investigation. Energy Policy, 35(4), 2507-2513.

Hondroyiannis, G., Lolos, S., Papapetrou, E. (2002), Energy consumption and economic growth: assessing the evidence from Greece. Energy Economics, 24, 319-336.

Hossain, M.D.S., Saeki, C. (2011), Does electricity consumption panel granger cause economic growth in South Asia? Evidence from Bangladesh, India, Iran, Nepal, Pakistan and Sri-Lanka. European Journal of Social Sciences, 25(3): 316-328.

Hossain, M.S. (2011), Panel estimation for CO_2 emissions, energy consumption, economic growth, trade openness and urbanization of newly industrialized countries. Energy Policy, 39(11), 6991-6999.

Hossein, S.S.M., Yazdan, G.F., Hasan, S. (2012), Consideration the relationship between energy consumption and economic growth in oil exporting country. Procedia-Social and Behavioral Sciences, 62: 52-58.

Huang, B.N., Hwang, M.J., Yang, C.W. (2008), Causal relationship between energy consumption and GDP growth revisited: a dynamic panel data approach. Ecological Economics, 67, 41-54.

Hwang, D., Gum, B. (1992), The causal relationship between energy and GNP: the case of Taiwan. Journal of Energy and Development, 12, 219-226.

Jobert, T., Karanfil, F. (2007), Sectoral energy consumption by source and economic growth in Turkey. Energy Policy, 35, 5447-5456.

Jorgenson, D.W., Wilcoxen, P.J. (1993), Reducing US carbon emissions: an econometric general equilibrium assessment. Resource and Energy Economics, 15, 7-25.

Jumbe, C.B.L. (2004), Cointegration and causality between electricity consumption and GDP: empirical evidence from Malawi. Energy Economics, 26, 61-68.

Karanfil, F. (2008), Energy consumption and economic growth revisited: does the size of unrecorded economy matter? Energy Policy, 36(8), 3029-3035.

Kemfert, K., Welsch, H. (2000), Energy-capital-labor substitution and the economic effects of CO_2 abatement: evidence for Germany. Journal of Policy Modeling, 22, 641-660.

Kraft, J., Kraft, A., (1978) On the relationship between energy and GNP. Journal of Energy and Development, 3, 401-403.

Lau, E., Chye, X.H., Choong, C.K. (2011), Energy-growth causality: Asian countries revisited. International Journal of Energy Economics and Policy, 1(4), 140-149.

Lee, C.C. (2005), Energy consumption and GDP in developing countries: a cointegrated panel analysis. Energy Economics, 27, 415-427.

Lee, C.C. (2006), The causality relationship between energy consumption and GDP in G-11 countries revisited. Energy Policy, 34(9), 1086-1093.

Lee, C.C., Chang, C.P. (2005), Structural breaks, energy consumption, and economic growth revisited: evidence from Taiwan. Energy Economics, 27, 857-872.

Lee, C.C., Chang, C.P. (2008), Energy consumption and economic growth in Asian economies: a more comprehensive analysis using panel data. Resource and Energy Economics, 30, 50-65.

Lise, W., Montfort, K.V. (2007), Energy consumption and GDP in Turkey: is there a co-integration relationship? Energy Economics, 29, 1166-1178.

Lu¨tkepohl, H. (1982), Non-causality due to omitted variables. Journal of Econometrics, 19, 267-378.

Mahadevan, R., Asafu-Adjaye, J. (2007), Energy consumption, economic growth and prices: a reassessment using panel VECM for developed and developing countries. Energy Policy, 35, 2481-2490.

Masih, A.M.M., Masih, R. (1996), Energy consumption, real income and temporal causality: results from a multi-country study based on cointegration and error-correction modelling techniques. Energy Economics, 18, 165-183.

Masih, A.M.M., Masih, R. (1997), On temporal causal relationship between energy consumption, real income, and prices: some new evidence from Asian-energy dependent NICs based on a multivariate cointegration/vector error correction approach. Journal of Policy Modeling, 19, 417-440.

Masih, A.M.M., Masih, R. (1998), A multivariate cointegrated modeling approach in testing temporal causality between energy consumption, real income, and prices with an application to two Asian LDCs. Applied Economics, 30, 1287-1298.

Mehrara, M. (2007a), Energy consumption and economic growth: the case of oil exporting countries. Energy Policy, 35, 2939-2945.

Mehrara, M. (2007b), Energy-GDP relationship for oil-exporting countries: Iran, Kuwait, and Saudi Arabia. OPEC Review, 31, 1-16.

Nachane, D.M., Nadkarni, R.M., Karnik, A.V. (1988), Cointegration and causality testing of the energy-GDP relationship: a cross-country study. Applied Economics, 20, 1511-1531.

Narayan, P.K., Smyth, R. (2007), Energy consumption and real GDP in G7 countries: new evidence from panel cointegration with structural breaks. Energy Economics, 30, 2331-2341.

Narayan, P.K., Popp, S., (2012), The energy consumption-real GDP nexus revisited: empirical evidence from 93 countries. Economic Modelling, 29(2), 303-308.

Ocal, O., Aslan, A. (2013), Renewable energy consumption–economic growth nexus in Turkey. Renewable and Sustainable Energy Reviews, 28, 494-499.

Odhiambo, N.M., (2010), Energy consumption, prices and economic growth in three SSA countries: a comparative study. Energy Policy, 38(5), 2463-2469.

Oh, W., Lee, K. (2004a), Causal relationship between energy consumption and GDP revisited: the case of Korea 1970-1999. Energy Economics, 26, 51-59.

Oh, W., Lee, K. (2004b), Energy consumption and economic growth in Korea: testing the causality relation. Journal of Policy Modeling, 26, 973-981.

Ozturk, I., Acaravci, A., (2010), The causal relationship between energy consumption and GDP in Albania, Bulgaria, Hungary and Romania:

evidence from ARDL bound testing approach. Applied Energy, 87(6), 1938-1943.
Ozturk, I., Acaravci, A. (2010), CO_2 emissions, energy consumption and economic growth in Turkey. Renewable and Sustainable Energy Reviews, 14(9), 3220-3225.
Ozturk, I., Aslan, A., Kalyoncu, H. (2010), Energy consumption and economic growth relationship: Evidence from panel data for low and middle income countries. Energy Policy, 38(8): 4422-4428.
Ozturk, I. (2010), A literature survey on energy–growth nexus. Energy Policy, 38(1), 340-349.
Pao, H.T., Tsai, C.M. (2011), Multivariate granger causality between CO2 emissions, energy consumption, FDI and GDP: evidence from a panel of BRIC (Brazil, Russian Federation, India and China) countries. Energy, 36(1), 685-693.
Paul, S., Bhattacharya, R.N. (2004), Causality between energy consumption and economic growth in India: a note on conflicting results. Energy Economics, 26, 977-983.
Payne, J.E. (2009), On the dynamics of energy consumption and output in the US. Applied Energy, 86(4), 575-577.
Pirlogea, C., Cicea, C. (2012), Econometric perspective of the energy consumption and economic growth relation in European Union. Renewable and Sustainable Energy Reviews, 16(8), 5718-5726.
Saboori, B., Sulaiman, J. (2013a), Environmental degradation, economic growth and energy consumption: Evidence of the environmental Kuznets curve in Malaysia. Energy Policy, 60, 892-905.
Saboori, B., Sulaiman, J. (2013b), CO_2 emissions, energy consumption and economic growth in Association of Southeast Asian Nations (ASEAN) countries: A cointegration approach. Energy, 55, 813-822.
Sadorsky, P., (2012), Energy consumption output and trade in South America. Energy Economic, 34(2), 476-488.
Shahbaz, M., Zeshan, M., Afza, T. (2012), Is energy consumption effective to spur economic growth in Pakistan? New evidence from bounds test to level relationships and Granger causality tests. Economic Modelling, 29(6): 2310-2319.
Shahiduzzaman, M., Alam, K., (2012), Cointegration and causal relationships between energy consumption and output: assessing the evidence from Australia. Energy Economic, 34(6), 2182-2188.
Smulders, S., de Nooij, M. (2003), The impact of energy conservation on technology and economic growth. Resources and Energy Economics, 25, 59-79.
Souhila, C., Kourbali, B. (2012), Energy consumption and economic growth in Algeria: cointegration and causality analysis. International Journal of Energy Economics and Policy, 2(4), 238-249.
Soytas, U., Sarı, R., Ozdemir, O. (2001), Energy consumption and GDP relation in Turkey: acointegration and vector error correction analysis. In: Economies and Business in Transition: Facilitating Competitiveness and Change in the Global Environment Proceedings. Global Business and Technology Association. p. 838-844. Available from: http://www.sari_r2.web.ibu.edu.tr/yayinlarim/Ener gy%20 Soytas_Sari_Ozdemir.pdfS. [Last accessed on 2014 Dec 24].
Soytas, U., Sari, R. (2003), Energy consumption and GDP: causality relationship in G-7 and emerging markets. Energy Economics, 25, 33-37.
Soytas, U., Sari, R. (2006[a]), Can China contribute more to the fight against global warming? Journal of Policy Modeling, 28, 837-846.
Soytas, U., Sari, R. (2006[b]), Energy consumption and income in G7 countries. Journal of Policy Modeling, 28, 739-750.
Soytas, U., Sari, R. (2008), Energy consumption, economic growth, and carbon emissions: challenges faced by an EU candidate member. Ecological Economics, 68(6), 1667-1675.
Soytas, U., Sari, R., Ewing, B.T. (2007), Energy consumption, income, and carbon emissions in the United States. Ecological Economics, 62, 482-489.
Stern, D.I. (1993), Energy and economic growth in the USA: a multivariate approach. Energy Economics, 15, 137-150.
Stern, D.I. (2000), A multivariate cointegration analysis of the role of energy in the US macroeconomy. Energy Economics, 22, 267-283.
Tang, C.F., Tan, E.C. (2013), Exploring the nexus of electricity consumption, economic growth, energy prices and technology innovation in Malaysia. Applied Energy, 104, 297-305.
Tsani, S.Z. (2010), Energy consumption and economic growth, a causality analysis for Greece. Energy Economic, 32(3), 582-590.
Wang, S., Zhou, D., Zhou, P., Wang, Q. (2011), CO_2 emissions, energy consumption and economic growth in China: A panel data analysis. Energy Policy, 39(9), 4870-4875.
Warr, B.S., Ayres, R.U., (2010), Evidence of causality between the quantity and quality of energy consumption and economic growth. Energy, 35(4), 1688-1693.
Wesseh Jr. P.K., Zoumara, B. (2012), Causal independence between energy consumption and economic growth in Liberia: Evidence from a non-parametric bootstrapped causality test. Energy Policy, 50, 518-527.
Wolde-Rufael, Y. (2004), Disaggregated industrial energy consumption and GDP: the case of Shanghai, 1952 1999. Energy Economics, 26, 69-75.
Wolde-Rufael, Y. (2005), Energy demand and economic growth: the African experience. Journal of Policy Modeling, 27, 891-903.
Yang, H.Y. (2000[a]), A note on the causal relationship between energy and GDP in Taiwan. Energy Economics, 22, 309-317.
Yang, Z., Zhao, Y. (2014), Energy consumption, carbon emissions, and economic growth in India: Evidence from directed acyclic graphs. Economic Modelling, 38, 533-540.
Yu, E.S.H., Choi, J.Y. (1985), The causal relationship between energy and GNP: an international comparison. Journal of Energy and Development, 10, 249-272.
Yu, E.S.H., Hwang, B. (1984), The relationship between energy and GNP: further results. Energy Economics, 6, 186-190.
Yu, E.S.H., Jin, J.C. (1992), Cointegration tests of energy consumption, income, and employment. Resources and Energy, 14, 259-266.
Yuan, J., Kang, J., Zhao, C., Hu, Z. (2008), Energy consumption and economic growth: evidence from China at both aggregated and disaggregated levels. Energy Economics, 30, 3077-3094.
Zachariadis, T. (2007), Exploring the relationship between energy use and economic growth with bivariate models: new evidence from G-7 countries. Energy Economics, 29, 1233-1253.
Zamani, M. (2007), Energy consumption and economic activities in Iran. Energy Economics, 29, 1135-1140.
Zarnikau, J. (1997), A reexamination of the causal relationship between energy consumption and gross national product. Journal of Energy and Development, 21, 229-239.
Zhang, C., Xu, J. (2012), Retesting the causality between energy consumption and GDP in China: evidence from sectoral and regional analyses using dynamic panel data. Energy Economics, 34(6), 1782-1789.
Zhang, X.P., Cheng, X.M. (2009), Energy consumption, carbon emissions, and economic growth in China. Ecological Economics, 68(10), 2706-2712.
Zhang, Y.J. (2011), Interpreting the dynamic nexus between energy consumption and economic growth: empirical evidence from Russia. Energy Policy, 39(5), 2265-2272.