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Abstract: This paper examines the causal relationship between combustible renewables and waste consumption, exports and economic growth for a panel of eleven Middle East and North Africa (MENA) countries for the period 1975-2008. We use the Granger causality and the vector error correction model (VECM) to investigate both the short-run and the long-run dynamic relationship between these variables. The results from the panel Granger causality test indicate that in the short-run economic growth has a positive and statically significant impact on exports. However, there is no causal link between economic growth and combustible renewables and waste consumption, and between exports and combustible renewables and waste consumption. In the long-run, the results from the panel error correction model indicate that there is evidence of long-run causality from economic growth and exports to combustible renewables and waste consumption and from economic growth and combustible renewables and waste consumption to real exports. The policy implication of this finding is that combustible renewables and waste is not sufficiently used in private or public industrial sectors in emerging economies, and the consumption policy reserved for production encourages households to use fossil fuels or renewable energy.

Keywords: Combustible renewables and waste; exports; MENA countries; panel cointegration techniques; Granger-causality.

JEL Classification: C33, F43, Q43

1. Introduction

The relationship between combustible renewables and waste consumption, exports and economic growth is one of the important topical studies that we should explore in the literature. However, there is no existing published literature focused on the nexus between these variables especially in the MENA region. Generally, there is little statistical analysis and empirical studies that treat of this region. However, there are many reasons in which existing studies have been failed in the region. First is either that the annual data are not available for all countries of the region and then we investigate the causal relationship between variables for a single country, or that the data are available in a short period of time. Second, empirical

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studies which are based on a model with two variables may be biased due to the omission of linked variables; particularly for MENA region studies we find these kinds of problems (Narayan and Smyth, 2009).

Because combustible renewables and waste include some biomass (liquid or solid) and waste (industrial or municipal) for production, it can be concluded that these kinds of energies are not purely clean as renewable energy sources, but not too pollutant as fossil fuel (non-renewable energy), since in this study we consider the combustible renewables and waste as a substitutable to renewable energy sources. However, the rest of the present section and the next section deal on the causality relationship between energy consumption (renewable and non-renewable or total energy), economic growth and exports.

Some studies are based on the relationship between economic growth and exports, or economic growth and trade (e.g. Lee and Huang, 2002; Kim and Lin, 2009). In addition to income and trade some other studies include energy in order to investigate the direction of the causality relationship between energy consumption and economic growth (e.g. Yoo, 2006; Chen *et al.*, 2007; Squalli, 2007; Akinlo, 2008; Wolde-Rufael, 2009). Some recent studies examine the causal relationship between energy consumption, economic growth and trade (e.g. Lean and Smyth, 2010a, 2010b; Narayan and Smyth, 2009; Sadorsky, 2011, 2012). Given that most of the literature have motivated on these variables nexus and that there is no published research focused on the causal relationship between combustible renewables and waste consumption, economic growth and trade openness, the aim of this paper is to examine the causal linkage between these variables for a sample of MENA countries using panel cointegrations techniques and Granger causality test for the short-run and the long-run association.

This is an important topic to study and there are several reasons to encourage emerging economies to use of combustible renewable and waste energy for production. First, observable trends of climate change continue to cause serious concerns worldwide. However, the continuous issue of CO2 emissions will lead catastrophic consequences to the atmosphere (IPCC, 2007)[2]. Second, the crisis at the Fukushima nuclear power plant transformed the public perception of national energy systems globally. Third, events in North Africa and the Middle East have increased tensions in oil markets and intensified price volatility.

According to the International Energy Agency (IEA, 2009), renewable energy (wind, solar, geothermal, and hydraulic) plays a vital role in emission reduction and offers opportunities for further growth that can facilitate the transition to a global sustainable energy supply. Sadorsky (2009) found that for the G7 countries, real income and CO2 emissions are major drivers behind renewable energy consumption. The World Bank suggests that renewable energy has tremendous potential to provide energy security and reduce greenhouse gas (GHG) emissions in MENA. In fact, the estimation of total GHG from fuel combustion was equal to 1.860 million metric tons of CO2 equivalent in the MENA region for 1980 (World Bank, 2012).

2. Existing literature

The classical school of economics argues that economic growth stimulate through exports. There are several studies analyze the effect of exports on economic growth, specifically for developing countries and highlight the differences between developed and developing countries. In fact, some studies (e.g. Levine *et al.,* 2000; Vohra, 2001; Lee and Huang, 2002) conclude that, for developed countries, exports have a positive impact on economic growth and this can be explained by the fact that few developed countries are not characterized by

[2] IPCC abbreviation refers to the Intergovernmental Panel on Climate Change.

political and economic stability. In addition, most empirical studies that investigate the linkage between economic growth and exports conclude that there is a unidirectional or bidirectional causal relationship between economic growth and exports in developing countries (see for example Al-Yousif 1997; Edwards, 1998; Abu Al-Foul, 2004; Albeydi *et. al.,* 2010). Over the past decade, emerging countries like Egypt, Jordan, Lebanon, Tunisia and Morocco have taken a number of decisions in the transition to more open and private-sector orientated economies. These countries entered into various bilateral and regional trade agreements, reduced tariffs, and other obstacles to trade such as non-tariff barriers and behind-the-border constraints to foster trade liberalization. These efforts have been compensated with an increase in exports and economic growth (World Bank, 2007).

The causal relationship between renewable energy consumption and economic growth has been investigated recently in a number of studies. A panel cointegration and error correction model is employed by Apergis and Payne (2010) to infer the causal nexus for twenty OCDE countries over the period 1985-2005 within a multivariate framework. The results from the panel vector error correction model indicate that there are a bi-directional causality between renewable energy consumption and economic growth in both short-run and long-run relationship. The long-run association indicates that a 1% increase in renewable energy consumption increases real GDP by 0.70%. Sadorsky (2009b) estimates two empirical models of renewable energy consumption and income for a panel of emerging economies. The results of panel cointegration show that real per capita income has a positive and statically significant impact on per capita renewable energy consumption.

In recent years, research studies begin to focus on the dynamic association between renewable energy consumption and economic growth (e.g. Sadorsky, 2009; Apergis and Payne (2010, 2012)). Apergis *et al*., (2010) examines the causal association between CO_2 emissions, nuclear energy consumption, renewable energy consumption, and economic growth for a group of 19 developed and developing countries. They find that renewable energy consumption does not contribute to reductions in emissions. Apergis and Payne (2012) examine the relationship between renewable and non-renewable energy consumption and economic growth for a panel of 80 countries over the period 1990-2007 using a panel error correction model. They conclude that renewable and non-renewable energy are two substitutable sources. Sadorsky (2009) estimates two models of renewable energy consumption and income for a panel of emerging economies. He finds that an increase in real per capita income has a positive and statistically significant impact on per capita renewable energy consumption.

The remainder of this paper is organized as follows: section 3 describes the data. Section 4 presents some descriptive statistics. Section 5 discusses empirical model and results. Finally, concluding remarks.

3. Data

Annual data from 1975 to 2008 is obtained from the Word Bank (2011) Development indicators online database, for MENA countries; namely: Algeria, Cyprus, Egypt, Iran, Israel, Jordan, Morocco, Sudan, Syria, Tunisia, and Turkey. The dimension of the sample is restricted to those countries of the MENA region for which data are available during the selected period. The multivariate framework for the analysis includes combustible renewables and waste consumption (*CRW*)[3] is measured in metric tons of oil equivalent, real GDP per capita (*GDP*) is measured in constant 2000 U.S. dollars, export per capita (*EXP*) is measured in current U.S. dollars, then transformed into real value by dividing by the consumer price index. Data consumer prices are obtained from the Penn World Tables version 7.1 (Heston *et al*., 2012)[4]. All of the data are converted into natural logarithms prior to conducting the empirical analysis.

4. Descriptive statistics

Table 1 and Table 2 present descriptive statistics and the average annual growth rates of each variable, respectively. Fig (1-3) show time series plots of CRW consumption, real GDP per capita and real exports per capita in natural logarithms, respectively.

Table. 1 Descriptive statistics of natural log variables

Statistics	*CRW*	*GDP*	*EXP*
Mean	4.723879	7.622140	1.553301
Median	5.429876	7.431446	1.589595
Maximum	9.397225	9.996117	4.398288
Minimum	-0.729811	5.492005	-2.741840
Observations	374	374	374
Cross sections	11	11	11

Note: all these statistics are made after logarithmic transformation of variables.

Source: Authors (EViews.7 software).

Table. 2 Average annual growth rates over 1975-2008

Country	*CRW*	*GDP*	*EXP*
Algeria	1.8	0.11	4.57
Cyprus	2.79	0.47	4.00
Egypt	0.36	0.49	-17.42
Iran	0.53	0.03	4.92
Israel	4.99	0.19	2.73
Jordan	-42.7	0.33	19.18
Morocco	0.55	0.28	-15.38
Sudan	0.18	0.29	644.01
Syria	60.21	0.20	7.86
Tunisia	0.47	0.35	7.34
Turkey	-0.12	0.27	-12.39
Total	2.64	0.24	59.03

Notes: Sources WDI (2011)

[3] According to the World Development Indicators, the combustible renewables and waste consumption variable used in this empirical analysis includes solid biomass, liquid biomass, biogas, industrial waste, and municipal waste.

[4] The Penn World Tables data code for the consumer prices index is "pc".

Practically, the average annual growth rates of CRW consumption is not large enough and it varies between countries and range from a low of -42.7% in Jordan to a high of 60.21% in Syria. In fact, all countries have a positive and significant growth rate of combustible renewables and waste consumption except Jordan, and Turkey.

The average annual growth rates of real GDP per capita is also positive and significant for all countries. It varies between countries and range from a low of 0.03% in Iran to 0.49% in Egypt. Although we note that the average annual growth rates of CRW consumption are not similar to their respective annual average growth rates of real GDP per capita, meaning that CRW and real GDP per capita are not growing at about the same rate.

The average annual growth rates of real exports per capita grew rapidly in Sudan and range to 644.01%. Except for Sudan, the total average annual growth rates in real exports per capita is 0.54%, and Jordan comes in the second rink with 19.18%, while Egypt is the latest in rank with -17,42%.

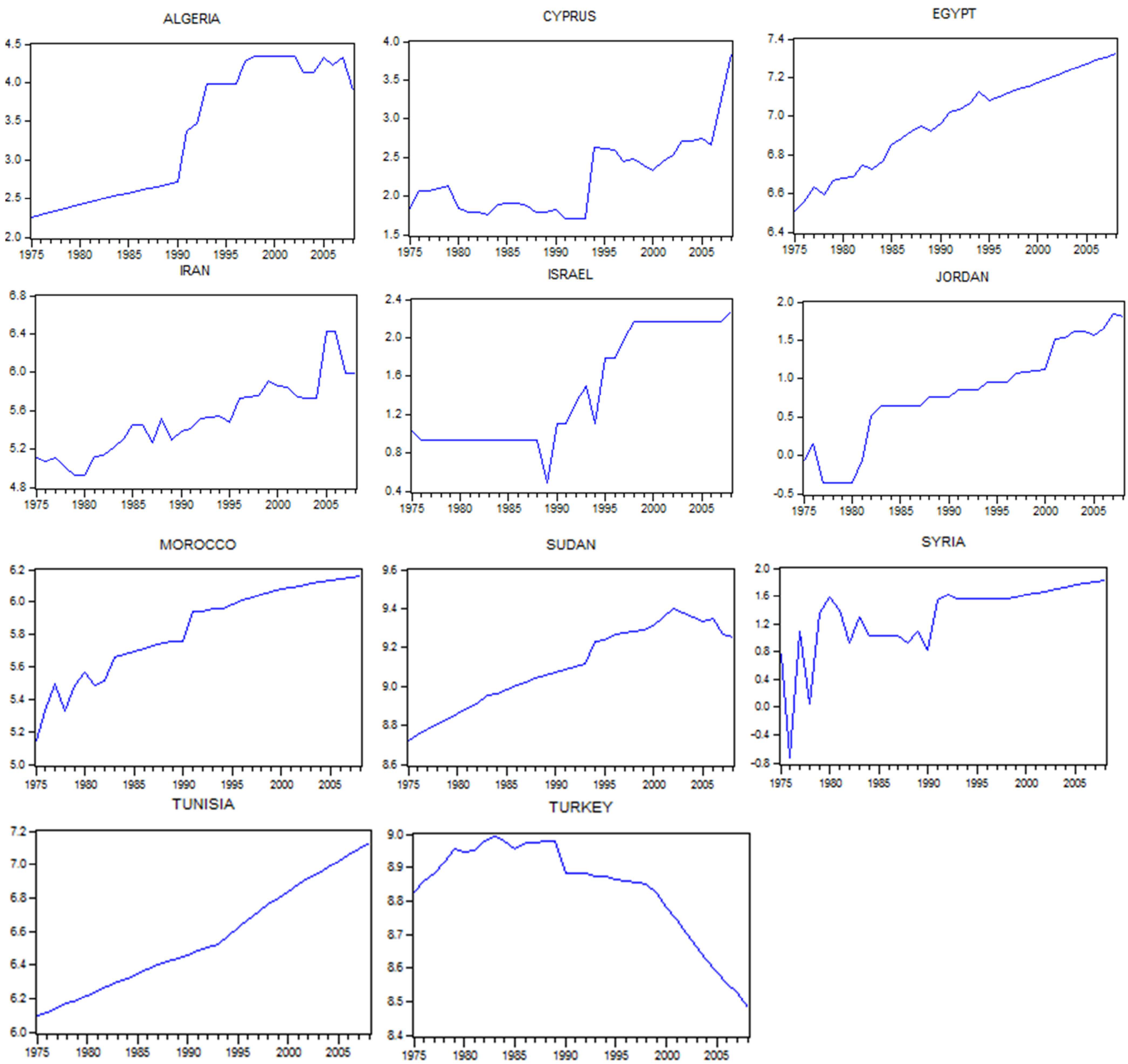

Fig.1 Natural log of combustible renewables and waste consumption

The time series plot of log combustible renewables and waste consumption of each country is reported in Fig 1 and shows that most of the countries have trends to increase. The smallest consumer of combustible renewable and waste is Sudan while Syria is the biggest. Turkey, Israel, and Syria have some drops during this period, while all other countries have increased across time.

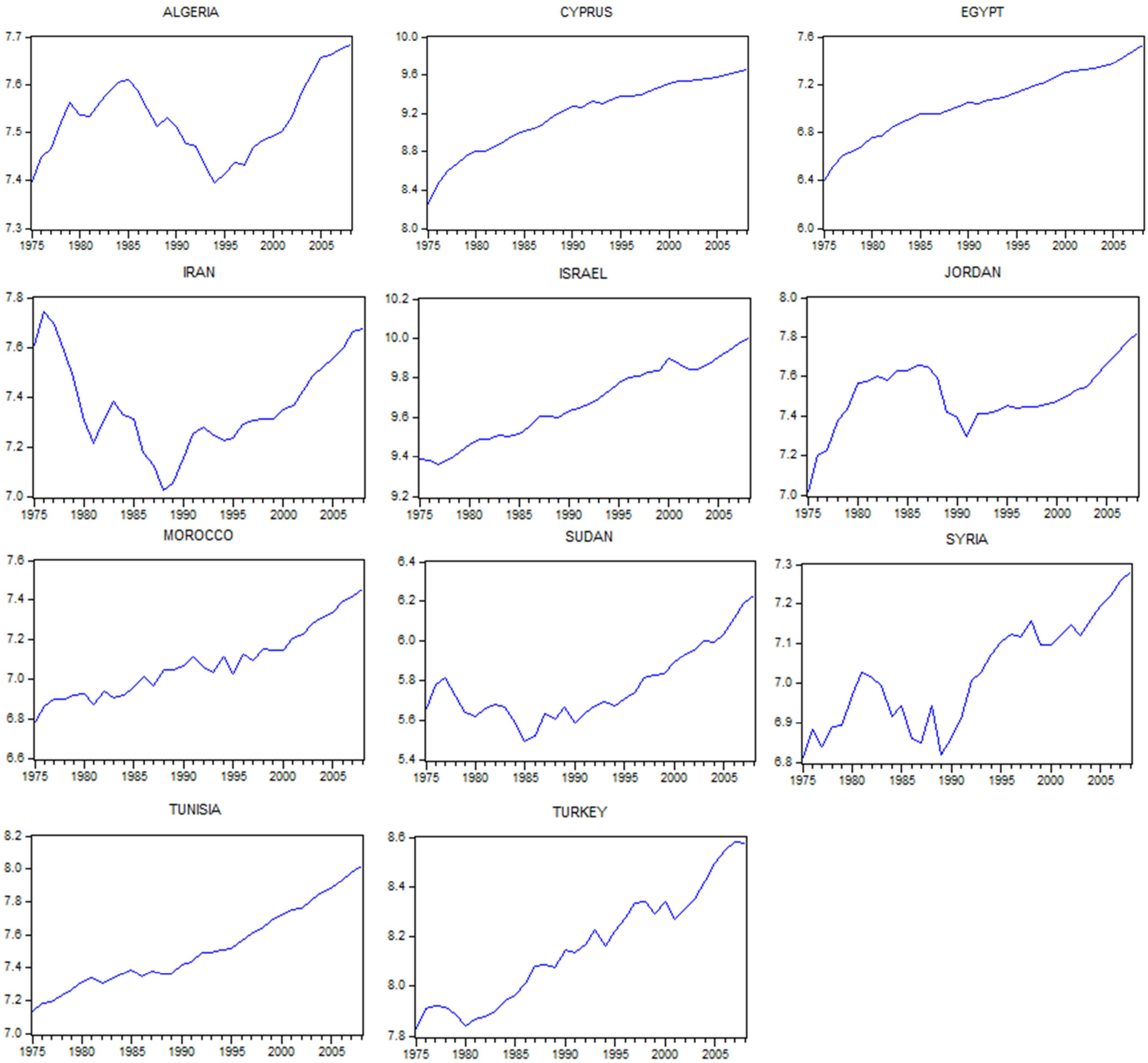

Fig.2 Natural log of real GDP per capita

The time series plot of log real GDP per capita of each country is reported in Fig 2 and shows that Israel has the biggest level of real GDP per capita while Sudan has the smallest level. Frequently, most countries have trends to increase except Algeria, Iran, Jordan and Syria have sharp drop from the 90's.

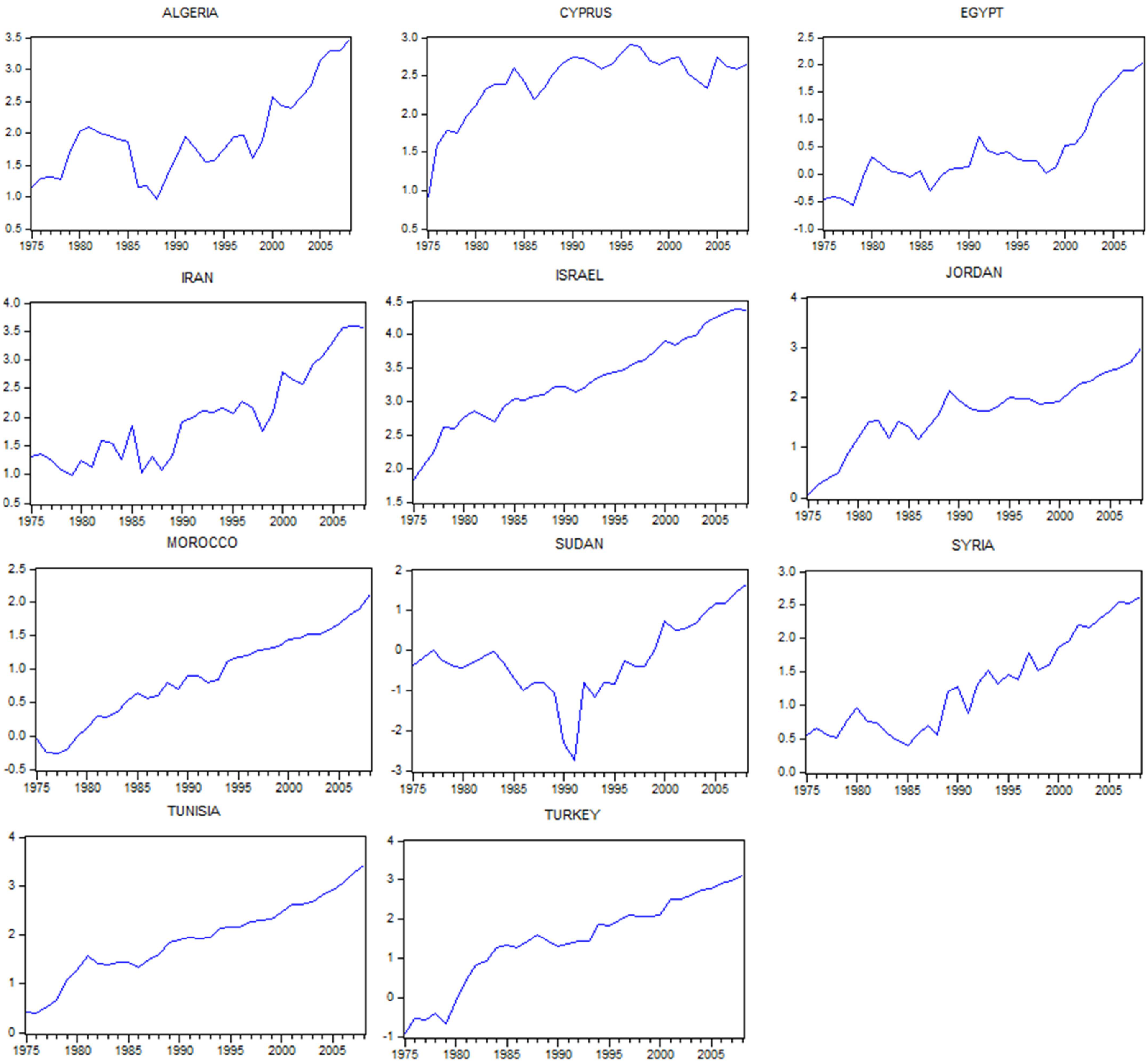

Fig.3 Natural log of real exports per capita

The time series plot of log real exports per capita of each country are reported is Fig 3 and shows that as in combustible renewables and waste and real GDP plots, real exports have a tendency to increase in most countries. Israel is also the best in exports of merchandise among other MENA countries, and Sudan still the smallest not only in CRW and real GDP but also in exports. We can conclude that CRW consumption, real GDP per capita and real exports per capita have increased across times for each of the countries studied, but the magnitude of the increase varies between countries.

5. Empirical methodology and results

We consider the following equation which investigates the long-run causality between combustible renewables and waste consumption, real GDP per capita and real exports per capita:

$$EXP_{i,t} = \alpha_i + \delta_i t + \beta_i GDP_{i,t} + \gamma_i CRW_{i,t} + \varepsilon_{i,t} \quad (1)$$

.where $i = 1,\ldots,11$ denotes the country and $t = 1975,\ldots,2008$ denotes time period. ε denotes the estimated residuals. The parameters α_i and δ_i denote the country specific effects and deterministic trends respectively.

5.1. Unit root tests

We started through testing the presence of a unit root for combustible renewables and waste consumption, real GDP per capita and real exports per capita using three types of panel unit root tests suggested by (Levin et al., 2002; Breitung, 2000 and Im et al., 2003). The null hypothesis for these tests is that there is a unit root while the alternative hypothesis is that there is no unit root.

Table. 3 Panel unit root tests

Method	***CRW***	***GDP***	***EXP***
LLC t-test			
Level	-1.03172 (0.1511)	-2.95736 (0.0016)*	-1.94940 (0.0256)**
First difference	-16.7568 (0.0000)*	-11.0086 (0.0000)*	-13.0659 (0.0000)*
Breitung t-test			
Level	0.84637 (0.8013)	3.48136 (0.9998)	-0.42026 (0.3371)
First difference	-7.02330 (0.0000)*	-5.19178 (0.0000)*	-8.50481 (0.0000)*
IPS W-stat			
Level	-0.78229 (0.2170)	-1.333312 (0.0912)	-1.51360 (0.0651)
First difference	-16.6486 (0.0000)*	-13.9496 (0.0000)*	-13.5847(0.0000)*

Note: "*", "**", statistical significance at 1% and 5% levels, respectively. Lag selection based on Schwarz Information Criteria (SIC). All unit root test regressions are run with constant and trend.

LLC t-test assumes that only CRW contain unit root in level but no unit root in first difference but GDP and EXP are integrated in level and first difference. The Breitung t-test and IPS W-stat assume that each variable contain unit root in level but no unit root in first difference. The results of these unit root tests are presented in Table 3. According to these tests, we assume that each variable is integrated of order one.

5.2. Cointegration tests

To determine whether variables are cointegrated, we employ two kinds of residual tests, i.e. Pedroni (2004)'s and Johansen (1988)'s Fisher cointegration tests. Pedroni (2004)'s based on the seven tests classified as either within-dimension with four panel statistics and between-dimension with three group statistics. These tests are based on the residual from Eq. (1). The null hypothesis is that there is no cointegration in heterogeneous panels ($\rho_i = 1$ for all i) against the alternative of $\rho_i = \rho < 1$ for all i.

Table. 4 Pedroni residual cointegration test (EXP as a dependent variable)

Alternative hypothesis: common AR coefs. (within-dimension)				
			Weighted	
	Statistic	Prob.	Statistic	Prob.
Panel v-Statistic	0.790757	0.2145	0.586363	0.2788
Panel rho-Statistic	-2.023306	0.0215**	-2.224893	0.0130**
Panel PP-Statistic	-2.776241	0.0027*	-3.096872	0.0010*
Panel ADF-Statistic	-2.702045	0.0034*	-3.092782	0.0010*
Alternative hypothesis: individual AR coefs. (between-dimension)				

	Statistic	Prob.
Group rho-Statistic	-1.427559	0.0767
Group PP-Statistic	-3.434475	0.0003*
Group ADF-Statistic	-3.686413	0.0001*

Note: Null hypothesis: No cointegration. "*", "**", denote statistical significance at the 1% and 5% levels, respectively. Automatic lag selection based on SIC with a maximum lag of 7. Newey-West bandwidth selection with Bartlett kernel. Deterministic trend specification: individual intercept and no deterministic trend.

Table 4 reports the Pedroni (2004)'s cointegration test results and shows that panel and group statistics confirm the existence of long-run relationship between variables except for one panel statistic used of the between dimension and one group statistic used of the within dimension (panel v-statistic and group rho-statistic). It means that the null of no cointegration can be rejected, and then we accept the alternative hypothesis that supports the presence of cointegration between variables when combustible renewable and waste is defined as a dependent variable.

It is worth interesting to confirm the existence of a long-run relationship between variables by using a second test proposed by the Johansen (1988) which is based on Fisher statistic.

Table. 5 Johansen (1988) panel cointegration test

Hypothesized No of CE(s)	Fisher stat (trace test)	Prob.
None	56.73*	0.0001
At most 1	22.60	0.4247
At most 2	25.00	0.2972

Note: "*" denotes statistical significance at the 1% level. Trend assumption: linear deterministic trend. Probabilities are computed using asymptotic Chi-square distribution.

Table 5 presents Johansen (1988) panel cointegration based on Trace test statistic (Fisher Statistic) and also reveals that there is cointegration between variables at the 1% level of significance. Thus, EXP, GDP and CRW consumption have a long-run equilibrium relationship between them, and the direction of causality must be examined.

5.3. Granger causality tests

Table. 6 Panel Granger causality test results (Short-run and long-run causality)

	Short-run			**Long-run**
	ΔEXP	***ΔGDP***	***ΔCRW***	***ECT***
ΔEXP	-	3.31916 (0.0373)**	1.19465 (0.3040)	-0.170034 [-4.41350]*
ΔGDP	0.52970 (0.5892)	-		-0.012774 [-0.79871]
ΔCRW	1.11012 (0.3306)	0.0042 (0.9960)	-	-0.008703 [-2.24246]**

Note: "*", "**" indicate statistical significance at the 1% and 5% levels, respectively. The t-statistics are shown in brackets and p-values in parenthesis. ECT represents the coefficient of the error correction term.

The Granger causality test is based on the following regressions:

$$\Delta EXP_{it} = \delta_{1i} + \sum_{k=1}^{p} \delta_{11ik} \Delta EXP_{it-k} + \sum_{k=1}^{p} \delta_{12ik} \Delta GDP_{it-k} + \sum_{k=1}^{p} \delta_{13ik} \Delta CRW_{it-k}$$

$$+\theta_{1i}ECT_{it-1}+u_{1it} \tag{2a}$$

$$\Delta LNGDP_{it}=\delta_{2i}+\sum_{k=1}^{p}\delta_{21ik}\Delta EXP_{it-k}+\sum_{k=1}^{p}\delta_{22ik}\Delta GDP_{it-k}+\sum_{k=1}^{p}\delta_{23ik}\Delta CRW_{it-k}$$

$$+\theta_{2i}ECT_{it-1}+u_{2it} \tag{2b}$$

$$\Delta CRW_{it}=\delta_{3i}+\sum_{k=1}^{p}\delta_{31ik}\Delta EXP_{it-k}+\sum_{k=1}^{p}\delta_{32ik}\Delta GDP_{it-k}+\sum_{k=1}^{p}\delta_{33ik}\Delta CRW_{it-k}$$

$$+\theta_{3i}ECT_{it-1}+u_{3it} \tag{2c}$$

where Δ denotes the first difference of the variable, *ECT* is the error correction term derived from the long-run cointegration relationship of Eq. (1), then we note: $ECT_{it}=EXP_{it}-\hat{\beta}_i GDP_{it}-\hat{\gamma}_i CRW_{it}$, and *p* denotes the lag length determined automatically by the Schwarz Information Criterion (SIC).

The results from Vector Error Correction Model (ECM) and from Granger causality are reported in Table 6. The Granger causality test reveals that in the long-run, the estimated coefficients of *ECT* are negative and statistically significant for CRW consumption and exports equations. Moreover, these results conclude that there is evidence of long-run causality from *i)* Economic growth and real exports to CRW consumption and long-run causality from *ii)* Economic growth and CRW consumption to real exports. Pairwise Granger causality tests result suggests that there is no Granger causality between CRW consumption and real GDP and between CRW and real exports, in the short-run. However, economic growth has a positive and significant impact on real exports at the 5% level. Therefore, there is a unidirectional Granger causality from economic growth to real exports. It means that real exports will be influenced only by real GDP.

The results of Granger causality of short-run and long-run relationship are different to those founded by Narayan and Smyth (2009) for a panel of six Middle Eastern countries. In their study they found unidirectional causality from electricity consumption to economic growth and from economic growth to real exports in the short-run. In the long-run, they found that error correction term is significant for economic growth and electricity consumption equations. This difference is explained by the fact that the two samples of countries and the selected period are not similar or because the quantity of electricity consumed is fairly higher than the level of combustible renewables.

5.4. Panel FMOLS and DOLS estimates

After having established the existence of cointegration relationship between variables then examined the direction of Granger causality in the short-run and long-run, we pass to estimate the long-run structural coefficients using two approaches of estimation such as fully modified OLS (FMOLS) Pedroni (2001, 2004) and dynamic OLS (DOLS) reformed by Kao and Chiang (2001), and Mark and Sul (2003) to the case of panel. All variables are measured in natural logarithms. The estimated coefficients from the long-run cointegration relationship can be deduced as long-run elasticities. Table 7 reports FMOLS and DOLS long-run elasticities for panel and individual tests.

Table. 7 FMOLS and DOLS long run elasticities (EXP as dependent variable)

Country	*FMOLS*		*DOLS*	
	GDP	*CRW*	*GDP*	*CRW*
Algeria	6.685972 (0.0001)*	0.753850 (0.0332)**	6.015342 (0.0005)*	0.715906 (0.0602)***
Cyprus	2.955590 (0.0000)*	0.112449 (0.4059)	2.863807 (0.0000)*	0.050166 (0.6827)
Egypt	1.826952 (0.4835)	-5.658065 (0.0500)**	0.436728 (0.8331)	-4.162793 (0.1452)
Iran	1.266291 (0.0000)*	0.039722 (0.9025)	1.288289 (0.0000)*	0.137716 (0.6757)
Israel[a]	3.576229 (0.0000)*	-0.100867 (0.4504)	3.715843 (0.0000)*	-0.153894 (0.3953)
Jordan	0.912934 (0.0209)**	0.040583 (0.8643)	1.017321 (0.0215)**	0.078763 (0.7896)
Morocco[a]	1.426173 (0.0003)*	1.528867 (0.0000)*	1.754378 (0.0000)*	1.269439 (0.0000)*
Sudan[a]	5.299147 (0.0000)*	-1.055688 (0.2480)	4.821398 (0.0000)*	-0.931239 (0.2809)
Syria	1.676427 (0.0264)**	-0.136353 (0.3112)	1.348330 (0.1701)	-0.072958 (0.6832)
Tunisia	4.693789 (0.0001)*	-5.704763 (0.0007)*	3.594814 (0.0021)*	-4.440257 (0.0047)*
Turkey[a]	6.092340 (0.0000)*	3.399030 (0.0529)***	5.983081 (0.0000)*	2.797470 (0.0948)***
Panel[a]	0.787936 (0.0000)*	-0.055652 (0.0681)***	0.822858 (0.0000)*	-0.040431 (0.1907)

Note: "*", "**" and "***" denote statistical significance at the1%, 5% and 10% levels, respectively. P-value listed in parentheses. "a", indicates estimation results are made with constant and no trends.

The FMOLS panel test results show that real GDP is positive and statistically significant at the 1% level. However, CRW consumption is negative and statistically significant at the 10% level. It means that in the long-run a 1% increase in real GDP increases real exports by 0.78% while a 1% increase in the consumption of CRW decreases exports by 0.05%. FMOLS individual test results suggest that real exports are mainly affected by real GDP. Real GDP is statistically significant and have a positive impact on real exports in Algeria, Cyprus, Iran, Israel, Jordan, Morocco, Sudan, Syria, Tunisia and Turkey. This result confirms the strong relation between real GDP and real exports in all countries except Egypt.

Turning to the effect of CRW on real exports, we find that in Algeria, Morocco, and Turkey, the consumption of CRW has a positive and statistically significant impact on real exports. In Egypt and Tunisia, the consumption of CRW has a negative and statistically significant impact on real exports.

The DOLS panel test results show that real GDP is positive and statistically significant at the 1% level while CRW consumption is not significant. It means that a 1% increase in real GDP increases real exports by 0.82%. DOLS individual test results suggest that real exports are mainly affected by real GDP at mixed significance levels of the 1% and the 5%. Real GDP is statistically significant and have a positive impact on real exports for an overwhelming majority.

The effect of CRW consumption on real exports is not significant for most countries. DOLS individual test show that in Algeria, Morocco, and Turkey, the CRW consumption has a positive and statistically significant impact on real exports. In Tunisia, the consumption of CRW has a negative and statistically significant impact on real exports.

Given that there is a long-run relationship running from real GDP and real exports to CRW consumption, then it is important to evaluate the effect of these variables on CRW using FMOLS and DOLS approaches. Table 8 reports the results of the FMOLS and DOLS long-run elasticities for panel and individual tests.

Table. 8 FMOLS and DOLS long run elasticities (CRW as dependent variable)

Country	*FMOLS*		*DOLS*	
	GDP	***EXP***	***GDP***	***EXP***
Algeria	-8.649898 (0.0009)*	1.622629 (0.0000)*	-6.749555 (0.0087)*	1.334891 (0.0001)*
Cyprus	2.066522 (0.0000)*	-1.228824 (0.0048)*	1.701529 (0.0002)*	-0.902344 (0.0163)**
Egypt	0.908160 (0.0000)*	-0.022647 (0.4943)	0.856899 (0.0000)*	-0.005405 (0.8732)
Iran	-0.492834 (0.0279)**	0.482663 (0.0000)*	-0.418259 (0.0515)***	0.455400 (0.0000)*
Israel	3.581977 (0.0094)*	-0.140952 (0.7247)	3.782198 (0.0141)**	-0.322063 (0.4544)
Jordan	-0.328131 (0.5731)	1.003971 (0.0000)*	-0.390169 (0.5205)	0.894495 (0.0000)*
Morocco	-0.420053 (0.1571)	-0.494002 (0.0000)*	-0.067082 (0.8321)	0.422589 (0.0000)*
Sudan	1.177561 (0.0074)*	-0.129830 (0.1208)	1.057149 (0.0287)**	0.091831 (0.3556)
Syria	2.398604 (0.0353)**	0.095073 (0.6423)	1.754995 (0.1069)	0.207759 (0.3093)
Tunisia	1.014095 (0.0000)*	0.087903 (0.1188)	1.085905 (0.0000)*	0.061403 (0.2803)
Turkey	-0.964442 (0.0001)*	0.081594 (0.0667)***	-0.847296 (0.0003)*	0.069876 (0.1073)
Panel	-0.618635 (0.1842)	-0.817942 (0.0453)**	-0.899752 (0.0548)***	-0.466891 (0.2543)

Note: "*", "**" and "***" denote statistical significance at the1%, 5% and 10% levels, respectively. P-value listed in parentheses.

The FMOLS panel test results show that real exports is negative and statistically significant at the 5% level while real GDP has no impact on CRW consumption. These results imply that a 1% increase in real exports decreases CRW consumption by 0.81%. FMOLS individual test results, we find that CRW consumption is mainly affected by real GDP. Real GDP has a positive and statically significant impact on CRW consumption in Cyprus, Egypt, Israel, Sudan, Syria and Tunisia, but a negative impact in Algeria, Iran, and Turkey. Real exports is statistically significant and have a positive impact on CRW consumption in Algeria, Iran, Jordan and Turkey and a negative impact in Cyprus, Israel, and Morocco.

The DOLS panel test results show that real GDP is negative and statistically significant at the 10% level while real exports has no impact on CRW consumption. These results suggest that a 1% increase in real GDP decreases CRW consumption by approximately 0.90%. DOLS individual test results we find that CRW consumption is affected mainly by real GDP. The impact of real GDP on CRW consumption is positive and statistically significant in Cyprus, Egypt, Israel, Sudan and Tunisia, at mixed significance levels of the 1% and the 5%, while in Algeria, Iran and Turkey the real GDP has a negative and statistically significant impact on CRW consumption at mixed significance levels of the 1% and 10%. For the remaining countries, real GDP does not affect CRW since the coefficients are not statistically significant.

An important result recommends that from the FMOLS individual test products, only in Algeria, Cyprus, Iran, and Turkey, the consumption of CRW is affected by both real GDP and real exports while from DOLS individual test result we find that real GDP and real exports both affect CRW consumption for Algeria, Cyprus and Iran.

6. Concluding remarks

This paper is an attempt to investigate the relationship between CRW consumption, real GDP per capita and real exports per capita for selected MENA countries during the period starting from 1975 to 2008. For this aim, we firstly begin with the stationarity proprieties of each variable. Then, we use panel cointegration regression techniques and Engle and Granger (1987) panel test to get the direction of causality between these variables in two steps (short-run and long-run). Finally, we employ the FMOLS and DOLS panels and individual estimates approaches.

The unit root tests approve that variables are integrated of order one after first difference and the existence of the long-run relationship can be studied. The panel cointegration test is technically based on the vector error correction model (VECM) giving by Eq. (2a), Eq. (2b) and Eq. (2c), and followed by Engle and Granger (1987) to explore the linkages between CRW consumption, real GDP and real exports in the long-runs and the short-run dynamic relationship.

As results, we find that there is no evidence of short-run causality between real GDP and CRW consumption, and between real exports and CRW. However, we find a unidirectional causality relationship from real GDP to real exports. In that way, if real GDP increases real exports increase too. In addition, the long-run dynamic relationship suggests that there is a bidirectional causality running from real exports and CRW consumption to real GDP and from CRW consumption and real GDP to real exports.

Then we examine strength relationship between the analysis variables under individuals and panels FMOLS and DOLS approaches. In the case where real exports are considered as a dependent variable, the FMOLS panel test results show that real GDP is positive and statistically significant while CRW consumption is negative and statistically significant. The FMOLS and DOLS individual test results show that real exports are mainly explained by real GDP. The DOLS panel test shows that real exports are positively statistically explained by real GDP.

In the case where CRW is considered as a dependent variable, the FMOLS panel test results show that real GDP is not statistically significant while real exports is negative and statistically significant at the 5% level. Furthermore, from the FMOLS and DOLS individual test results, we suggest that the consumption of CRW is mainly explained by real GDP. The DOLS panel test results show that real GDP is negative and statistically significant at the 10% level, while real exports is not statically significant.

In the case where real exports are considered as a dependent variable, the FMOLS panel test result shows that real GDP is positive and statistically significant while CRW consumption is negative and statistically significant. The FMOLS and DOLS individual test results show that real exports are mainly explained by real GDP. The DOLS panel test result shows that real exports are positively statistically explained by real GDP.

The policy implications of this study show that there is no strong relationship between CRW and real exports or between CRW and real GDP. We note that in the case where real exports are defined as dependent variable, the contribution of CRW is mostly not significant. This finding reminds us to the degree of differentiation of energy policy and strategy of energy use between countries.

Another policy implication of this study is that CRW is not sufficiently used in public and private industrial sector for emerging economies and the energy consumption policy for production encourages industries or private to use fossil (non-renewable) or renewable energy. The policymakers should take into account the level of economic growth and the energy policy of each country.

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