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Causality between Energy Consumption and GDP: Evidence from 30 OECD and 78 Non-OECD Countries

Jaruwan Chontanawat, Lester C. Hunt,
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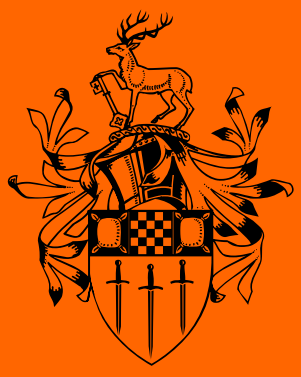
June 2006



SEEDS 113
ISSN 1749-8384

Department of Economics
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CAUSALITY BETWEEN ENERGY CONSUMPTION AND GDP: EVIDENCE FROM 30 OECD AND 78 NON-OECD COUNTRIES

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ABSTRACT

Energy arguably plays a vital role in economic development. Hence many studies have attempted to test for causality between energy and economic growth; however, no consensus has emerged. This paper, therefore, tests for causality between energy and GDP using a consistent data set and methodology for 30 OECD and 78 non-OECD countries. Causality from aggregate energy consumption to GDP and GDP to energy consumption is found to be more prevalent in the developed OECD countries compared to the developing non-OECD countries; implying that a policy to reduce energy consumption aimed at reducing emissions is likely to have greater impact on the GDP of the developed rather than the developing world.

*JEL Classification Numbers:*O13, Q43.

Key Words: Energy; GDP; Development; Causality; Modelling.

Causality between Energy Consumption and GDP: Evidence from 30 OECD and 78 Non-OECD Countries[#]

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1. Introduction

Energy plays an essential role in an economy on both demand and supply. On the demand side, energy is one of the products a consumer decides to buy to maximise his or her utility. On the supply side, energy is a key factor of production in addition to capital, labour and materials and is seen to play a vital role in the economic and social development of countries, being a key factor in increasing economic growth and living standards. This implies that there should be a causal relationship running from energy consumption to national income or GDP as well as vice versa.

This raises a number of important questions: Is energy consumption a stimulus to economic growth?[1] (Or alternatively, does energy 'cause' GDP?) Is economic growth a stimulus for energy consumption? (Or alternatively does GDP 'cause' energy?) The answers to these

[#]**Acknowledgements**

We are grateful for comments received following the presentation of an earlier draft of this paper at the 6th IAEE European Conference, Modelling in Energy Economics and Policy, Zurich September 2004 and the 1st Annual CZAEE/IAEE International Conference, Critical Infrastructure in the Energy Sector, Prague, Czech Republic, November 2004. The authors, of course, are responsible for all errors and omissions.

[1] Via the indirect channels of effective aggregate demand and human capital, improved efficiency and technical progress (Masih and Masih, 1997, p. 418). Toman and Jemelkova (2003) give a more detailed justification for the effect of energy on development. They argue that the increased availability of energy services acts as a 'key' stimulus for economic development at different stages in the development process.

questions, as recognised in many previous studies, have important implications for policy makers.

As noted by Jumbe (2004), amongst others, if causality runs from energy consumption to GDP then it implies that an economy is energy dependent and hence energy is a stimulus to growth implying that a shortage of energy may negatively affect economic growth or may cause poor economic performance, leading to a fall in income and employment. In other words, energy is a limiting factor in economic growth (Stern 2000). Whereas if causality only runs from GDP to energy consumption this implies that an economy is not energy dependent hence, as noted by Masih and Masih (1997) amongst others, energy conservation policies may be implemented with no adverse effect on growth and employment. If, on the other hand, there is no causality in either direction (referred to as the 'neutrality hypothesis'), it implies that energy consumption is not correlated with GDP, so that energy conservation policies may be pursued without adversely affecting the economy (Jumbe 2004).

It is important therefore, to ascertain empirically whether there is a causal link between energy consumption and economic growth. This is particularly true given the current debate about global warming and the need to reduce Greenhouse Gas Emissions by conserving energy consumption, since any constraints put on energy consumption to help reduce emissions will have an effect on growth and development if causality from energy to GDP exists. Moreover, if the causal link is greater for developing countries, then any restraint on energy consumption will have a bigger effect on these countries compared to the more affluent industrialised countries. In this case it could be argued that any reduction in energy consumption should predominantly be undertaken by the developed world so as not to inhibit the development of the less developed nations.

Given the importance of this issue it is not surprising that there have been a number of attempts to quantify the relationship for a number of different countries. The results from these studies are summarised in Table 1 and illustrate that the existence (or otherwise) of causality between energy and GDP has been the subject of some investigation and debate by economists and econometricians. Table 1 also highlights that the results are very mixed with no clear consensus emerging. Different results for different countries are not necessarily surprising given the "many institutional, structural, and policy differences" (Masih and Masih, 1997, p. 419). However, the lack of consensus for particular countries (and countries with similar characteristics and stage of development) is somewhat surprising, which according to Masih and Masih (1997) is primarily due to methodological differences in terms of definition and specification of variables, the econometric techniques employed, and lag structures chosen.

This paper therefore attempts to address this issue. In particular, a systematic and consistent methodology is adopted to test whether there is evidence of causality between energy and GDP for 30 OECD countries and 78 non-OECD countries and in particular test the hypothesis that the link is strongest for the non-OECD developing countries. The next section outlines the methodology, followed by section 3, which presents the results. The final section summarises and concludes.

2. Methodology

Table 1 shows that there have been a number of studies investigating energy-GDP causality, all based upon the 'Granger-causality' principle (Granger, 1969). These studies have generally considered a single country or at most a small group of countries. Moreover, although

Granger-causality is the key definition adopted, there have been a range of methodologies employed; partly explained by the development of new econometric techniques. Considering the different methodologies the studies can be categorised into three main groups:

The first use the conventional methodologies developed by Granger (1969) and Sims (1972), the majority being undertaken in the USA for developed countries covering the period 1947 to 1988.

The second use cointegration and the Error Correction Model (Granger 1988); with several separate studies undertaken for a number of developed and some developing countries covering the period 1950 to 2002.

The third use the Hsiao (1981) technique which enhances Granger-causality by incorporating the use of the Akaike (1969) Final Prediction Error (FPE) criteria; with studies for the USA, Latin America and several Asian Countries covering the period 1947 to 2000.[2]

Consequently, given the single country approach, the different methodologies and the different data sets and periods, as noted above it is not surprising that no clear picture emerges with no clear direction for policy makers. This paper attempts to rectify this by using a consistent approach and data source for over 100 countries.

[2] In addition two very recent articles, published after the analysis was completed for this paper, use the Dolado–Lütkepohl adaptation of the Granger method (see Altinay & Karagol, 2005) and the Toda and Yamamoto adaptation of the Granger method (see Wolde-Rufael, 2005).

'Granger-causality' implies causality in the prediction (forecast) sense rather than in a structural sense. It starts with the premise that '*the future cannot cause the past'*; if event A occurs after event B, then A cannot cause B (Granger 1969). This concept can be examined in the context of a bivariate model consisting of the following two equations:

$$y_t = \alpha_1 + \sum_{i=1}^{m} \beta_i y_{t-i} + \sum_{j=1}^{n} \lambda_j e_{t-j} + \upsilon_t \qquad (1)$$

and

$$e_t = \alpha_2 + \sum_{i=1}^{m} \gamma_i e_{t-i} + \sum_{j=1}^{n} \delta_j y_{t-j} + \varepsilon_t \qquad (2)$$

where: $e_t = \ell n(E_t)$;

$y_t = \ell n(Y_t)$;

E_t = energy consumption per capita; and

Y_t = real GDP per capita.

In equation (1), *e* causes *y* if the current value of *y* is predicted better by including the past values of *e* than by not doing so. In other words, if *e* causes *y*, then *e* helps to forecast *y*. And from equation (2), *y* causes *e* if the current value of *e* is predicted better by including the past values of *y* than by not doing so. In other words, if *y* causes *e*, then *y* helps to forecast *e*.

This initial formulation by Granger used levels of variables as shown in equations (1) and (2). However, following the development of unit root testing and cointegration, for non-stationary variables, integrated of order one or I(1), equations (1) and (2) are replaced by:

$$\Delta y_t = \alpha_1 + \sum_{i=1}^{m} \beta_i \Delta y_{t-i} + \sum_{j=1}^{n} \lambda_j \Delta e_{t-j} + \upsilon_t \qquad (3)$$

and

$$\Delta e_t = \alpha_2 + \sum_{i=1}^{m} \gamma_i \Delta e_{t-i} + \sum_{j=1}^{n} \delta_j \Delta y_{t-j} + \varepsilon_t \quad (4)$$

where Δ is the first difference operator, so that the terms are introduced in differences to ensure that they are stationary or I(0). Here the concept of causality is formulated in terms of changes to the variables and the presence of Granger-causality depends on the significance of the Δe_{t-j} terms and Δy_{t-j} terms in equations (3) and (4) respectively.

Furthermore, if it is found that the two integrated variables co-integrate, then equations (3) and (4) can be augmented as follows:

$$\Delta y_t = \alpha_1 + \sigma_1 EC_{t-1} + \sum_{i=1}^{m} \beta_i \Delta y_{t-i} + \sum_{j=1}^{n} \lambda_j \Delta e_{t-j} + \upsilon_t \quad (5)$$

and

$$\Delta e_t = \alpha_2 + \sigma_2 EC_{t-1} + \sum_{i=1}^{m} \gamma_i \Delta e_{t-i} + \sum_{j=1}^{n} \delta_j \Delta y_{t-j} + \varepsilon_t \quad (6)$$

where EC is the error correction term from a cointegrating equation of the form $y_t = \beta e_t + EC_t$ and hence is I(0). In essence, if a pair of I(1) series are co-integrated, there must be Granger-causality in at least one direction (either e to y and/or y to e) hence it is necessary to add the EC term to equation (3) and equation (4) to avoid miss-specifying the model and missing one source of causation. Hence, in this formulation there are two possible sources of Granger-causality; for the Δy_t equation causality arises either through the lagged Δe terms if $\lambda_j \neq 0$ or through the EC_{t-1} term, if $\sigma_1 \neq 0$ (implying a long run relationship); and for the Δe_t equation it arises either through the lagged Δy terms if $\delta_j \neq 0$ or through the EC_{t-1} term, if $\sigma_2 \neq 0$.[3] In essence, if a pair of I(1) series are co-integrated, there must be Granger-causality in at least one direction so it is necessary to add the EC term in the model otherwise the model will miss one

source of causation and the model will be miss-specified and the possible values of lagged Δe (Δy) in forecasting Δy_t (Δe_t) will be missed.

Whichever formulation is used, past studies have shown that the result of causality is very sensitive to the lag length adopted in the models. However, Hsiao (1981) introduced a way to help determine the optimum lags to be used, by combining the Granger (1969) definition of causality as outlined above and Akaike's FPE criterion. According to Akaike (1970), the FPE is defined as the expected variance of the prediction error (asymptotic mean square of the prediction error) as follows:

$$FPEy_t = E(y_t - \hat{y}_t)^2 = \sigma_u^2\left(1+\frac{k}{T}\right) \qquad (7)$$

where $\hat{\sigma}_u^2 = \left(\frac{SSE(k)}{T-k}\right)$, k is the number of estimated parameters and T is the number of observations.

Thus Akaike defines the estimate of $FPEy(k)$ by

$$FPE(k) = \frac{T+k}{T-k}\frac{SSE(k)}{T} \qquad (8)$$

FPE is minimised in order to choose the number of lags, which is equivalent to applying an approximate (F-test) with varying significance levels. Hsiao (1981, 1982) points out that the major difference between applying Akaike's FPE criterion and the conventional hypothesis testing procedure to decide if a variable should be included in the equation is in the choice of significance level. He argues that the conventional choice of a 5% or 1% significance level is *ad hoc* whilst the FPE criterion is based on an explicit optimality criterion (that of minimising

[3] In some studies a distinction is made between long-run causality from the EC term and short-run causality from the lagged Δy or Δe terms. This distinction is not explicitly used in this paper.

the mean square prediction error). Consequently, the FPE frees the model from the ambiguities inherent in the application of conventional procedures.

Akaike (1969, 1970) also suggests that a decision procedure about the order of a uni-variate stationary autoregressive process and/or on the inclusion or exclusion of a variable in the model based on the minimum FPE criterion is appealing. This is because it balances the risk due to the bias when a lower order is selected and the risk due to an increase in the bias when a higher order is selected. In other words, the minimum FPE can provide the optimum number of lags for the model, since too many lags or too few lags may lead to bias estimates and hence misleading results.

Therefore, Hsiao's procedure requires two steps. To test whether *e* causes *y*, a one-dimensional autoregressive process is first estimated as follows:[4]

$$\Delta y_t = \alpha_1 + \sum_{i=1}^{m} \beta_i \Delta y_{t-i} + \upsilon_t \qquad (9)$$

with varying values for m. The following is then computed for each value of m:

$$FPE(m+1) = \frac{T+m+1}{T-m-1} \frac{SSE(m+1)}{T} \qquad (10)$$

where T is sample size, SSE is sum of squared errors, and FPE is the final prediction error. The minimum value of FPE(m+1) determines the optimal lag length denoted by m*.

The second step involves estimating the following:

$$\Delta y_t = \alpha_1 + \sum_{i=1}^{m^*} \beta_i \Delta y_{t-i} + \sum_{j=1}^{n} \lambda_j \Delta e_{t-j} + \upsilon_t \qquad (11)$$

[4] The details on how to test whether *e* causes *y* are explained here. To test whether *y* causes *e*, the *e* and *y* should be transposed in equations (9) and (11).

for various values for n, the number of lags of Δe, conditional on lag length m* for Δy. The following is then computed for each value of n:

$$FPE(m^*+n+1) = \frac{T+m^*+n+1}{T-m^*-n-1}\frac{SSE(m^*+n+1)}{T} \qquad (12)$$

The minimum value of FPE(m*+n+1) determines the optimal lag length denoted by n*. FPE (m*+n*+1) is then compared with FPE (m*+1); if FPE (m*+n*+1) < FPE (m*+1) then e (Granger) causes y. Whereas if FPE (m*+n*+1) > FPE (m*+1) then e does not (Granger) cause y. For both steps a 'sensible' maximum lag is required therefore the analysis below uses a maximum lag of about 20% of the total observations.[5]

The above explains the Hsiao method where no cointegration is found and therefore applied in the standard Granger methodology, equations (3) and (4). However, this equally applies when the *EC* term is included for a cointegrating relationship as in equations (5) and (6). That is, to test whether *e* causes *y* in this framework the *EC* term is also added at the second stage, equation (11) as follows:

$$\Delta y_t = \alpha_1 + \sigma_1 EC_{t-1} + \sum_{i=1}^{m^*} \beta_i \Delta y_{t-i} + \sum_{j=1}^{n} \lambda_j \Delta e_{t-j} + \upsilon_t \qquad (13)$$

with similar decision criteria as given above.[6,7]

These tests determine whether *e* causes *y*. These can be confirmed by using a number of statistical tests. For the standard Granger model, equation (11) causality can be confirmed by doing a joint F-test for the coefficients of the lagged Δe variables. For the error correction

[5] Therefore, for countries with data covering the period 1960 to 2000 the maximum lag is 8, for countries with data covering the period 1965 to 2000 the maximum lag is 7, for countries with data covering the period 1971 to 2000 the maximum lag is 6 and for countries with data covering the period 1976 to 2000 the maximum lag is 5.

[6] Again this shows how to test whether *e* causes *y*, but to test whether *y* causes *e*, the *e* and *y* should be transposed in equation (13).

model, equation (13), where causality comes from two sources, the *EC* term and the lagged Δe variables, causality can be confirmed by undertaking a joint F-test of the *EC* coefficient *and* the lagged Δe coefficients.

Given the above, the methodology adopted for this paper (illustrated in Figure 1) involves the following stages:

> ***Stage 1:*** Test the stationarity of the variables for each country using the Augmented Dickey Fuller (ADF) test. This is achieved when testing *e* and *y* in levels by including a constant term and a time trend in the ADF equation whereas when testing the first differences of *e* and *y* the ADF equation includes a constant. For both, however, the number of lags is determined by using the Schwarz (SIC) criteria. When deciding whether to reject the null of a unit root (stationarity) the 1% significance is used for the levels and the 10% for the first differences; the disparity being based on the expectation that in general the variables will be I(0) in levels and I(1) in first differences.[8] From this if it is found that either *e* or *y* are found to be I(0) with the other being I(1) or I(2) then the Hsiao (Granger coupled with FPE) procedure is adopted, i.e. proceed to Stage 3a. If, on the other hand, either *e* or *y* are found to be I(2) with the other being I(1) or I(2) then cointegration is still tested (i.e. proceed to Stage 2) by assuming that both variables are I(1), i.e. implicitly assuming the I(2) result is a statistical anomaly.
>
> ***Stage 2:*** Test for cointegration between *e* and *y* using the Johansen technique. For consistency, the specification that allows for a linear trend in the data with an intercept but no trend in the co-integrating vector is utilised with the optimal lag structure for the VAR selected by using the Schwarz (SIC) criteria.[9] Cointegration is accepted if both the Trace and Max-eigenvalue test statistics indicate one cointegrating vector at the 5%

[7] Cheng (1999) has adopted a similar technique in a multivariate model.

[8] Further details of ADF tests can be found in Harris and Sollis (2003).

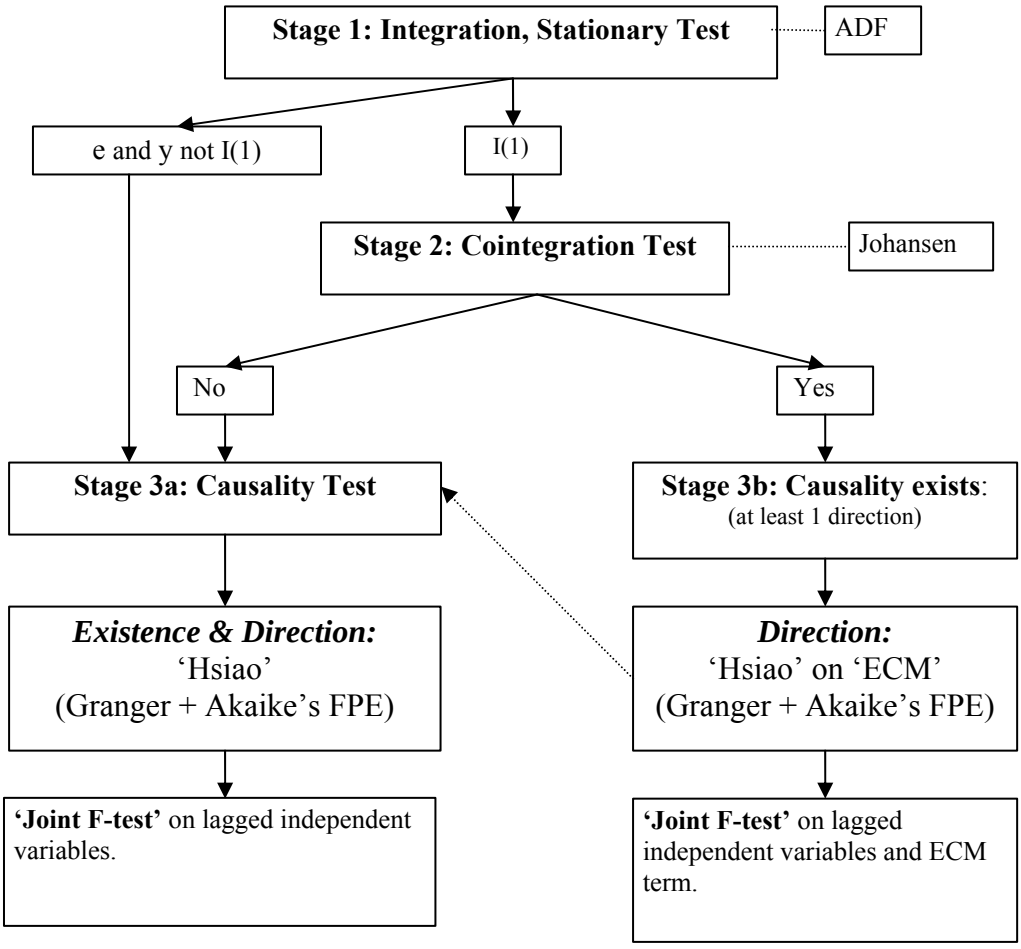
[9] Verbeek (2001:254) notes that the model with the smallest AIC or SIC is preferred. However, while the two criteria differ in their trade-off between fit and parsimony, the SIC criterion can be preferred.

level of significance.[10] From this if cointegration is not found proceed to Stage 3a, but if cointegration is found proceed to Stage 3b.

Stage 3a: Test for causality from *e* to *y* (and *y* to *e*) using the Hsiao (Granger coupled with FPE) procedure (i.e. estimate equation (11) and test accordingly).

Stage 3b: A long run relationship exists so there must be causality for at least one direction. Therefore test if it is from *e* to *y* (and/or *y* to *e*) using the Hsiao method for determining the order of lags for the Error Correction equation (13) and test accordingly. However, if the estimated coefficient of the *EC* term is positive then causality is re-estimated with difference terms as shown in Stage 3a. [11,12]

Figure 1: Causality testing framework



[10] Further details of the Johansen procedure can be found in Harris and Sollis (2003).

[11] Where the estimated coefficient of the *EC* term was positive the cointegration approach was abandoned and causality was re-tested using the Hsiao (Granger coupled with FPE) procedure, i.e. Stage 3a.

[12] Technically, the statements about causality refer to the variables in logs (i.e. *e* and *y*) as used throughout this section on methodology. However, for ease of exposition, references hereafter are in terms of the levels (i.e. E and Y).

Data

In order to ensure consistency, data for all countries comes from the same source the International Energy Agency (IEA) 2002 Energy Statistics for OECD and non-OECD countries. For each country E is Final Energy Consumption in thousand tones of oil equivalent (ktoe) divided by population and Y is real GDP in US dollars using Purchasing Power Parities (PPPs) divided by population. This gives a total of 30 OECD countries with data for most countries from 1960 to 2000 and 78 non-OECD countries with data for most countries from 1971 to 2000. In addition the Human Development Index (HDI) for 2001 has been used to rank the countries.[13] The lists of the OECD/non-OECD countries and the classification of the countries according to the HDI are shown in Appendix A and Appendix B respectively.[14]

3. Results

The results of the vast amount of estimation for the OECD countries are presented in Table 2, Table 3, and Table 4 with a summary given in Table 5. The results for the non-OECD countries are presented in Table 6, Table 7 and Table 8 with a summary given in Table 9.[15]

Stage 1

Table 2 and Table 5 show that *e* and *y* are both found to be I(1) for 28 out of the 30 OECD countries (93% of the total). By contrast, Table 6 and Table 9 show that for the 78 non-OECD countries *e* and *y* are both found to be I(1) for 60 countries (77%).

[13] Human Development Report 2003.

[14] Gibraltar, Iraq, and Taiwan are not included in the three groups shown in Appendix B since they are not ranked according to the HDI.

[15] All estimation was done using EVIEWS 4.1.

Stage 2

Furthermore, Table 3 and Table 5 show that cointegration is found for only 4 OECD countries (13%) whereas Table 7 and Table 9 show that cointegration is found for only 8 non-OECD countries (10%).

Stage 3

When undertaking the testing procedure outlined in Figure 1 there are four possible outcomes from the tests for causality: [16]

i. E Granger causes Y;

ii. Y Granger causes E;

iii. E Granger causes Y and Y Granger causes E;

iv. no Granger-causality exists.

Cases i) and ii) represent uni-directional (i.e one way without feedback) causality and case iii) represents bi-directional causality (i.e. both ways with feedback). The OECD results are given in Table 4 and Table 5 and the non-OECD results in Table 8 and Table 9. In addition, Figure 2a summarises the overall results where some form of causality exists in either or both directions (cases i, ii and iii). This shows that 26 OECD countries (87% of the total) show evidence of some causality compared to only 51 non-OECD countries (65%); giving 77 countries (71%) overall. According to the HDI classification which is illustrated in Figure 2b, some causality is found for 38 countries (84% of the total), 29 countries (67%), and 8 countries (47%) in the high-development group, mid-development group, and low-development group respectively.

[16] When conducting the tests of causality, in the majority of cases the results from the Hsiao procedure were confirmed by the statistical tests at the 10% level but for a small minority they were confirmed at between 11% and 23% levels of significance.

Figure 2a: Evidence of some form of Granger-causality in OECD and non-OECD countries

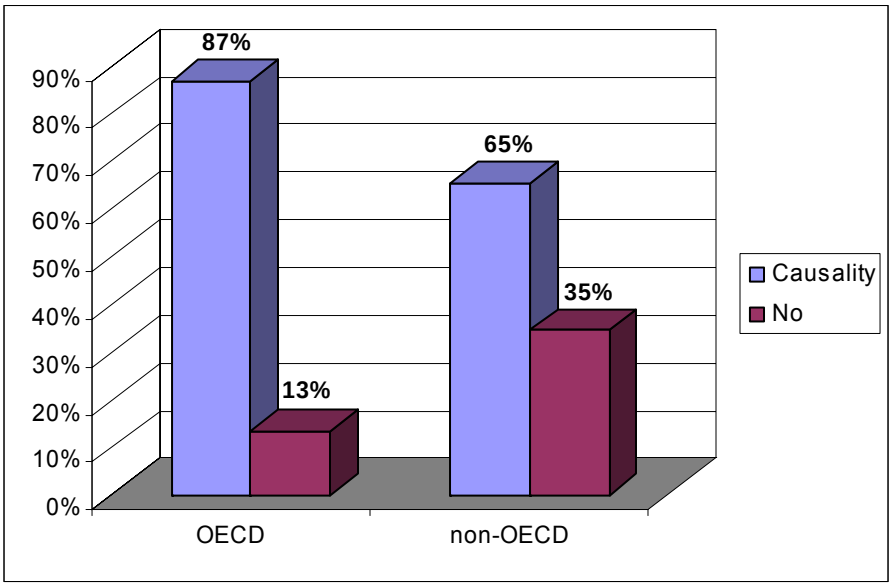
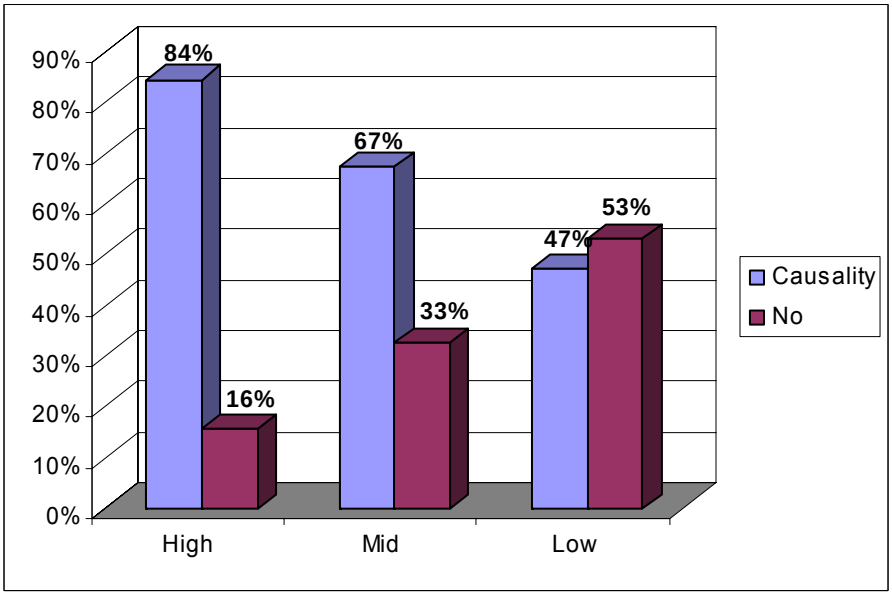


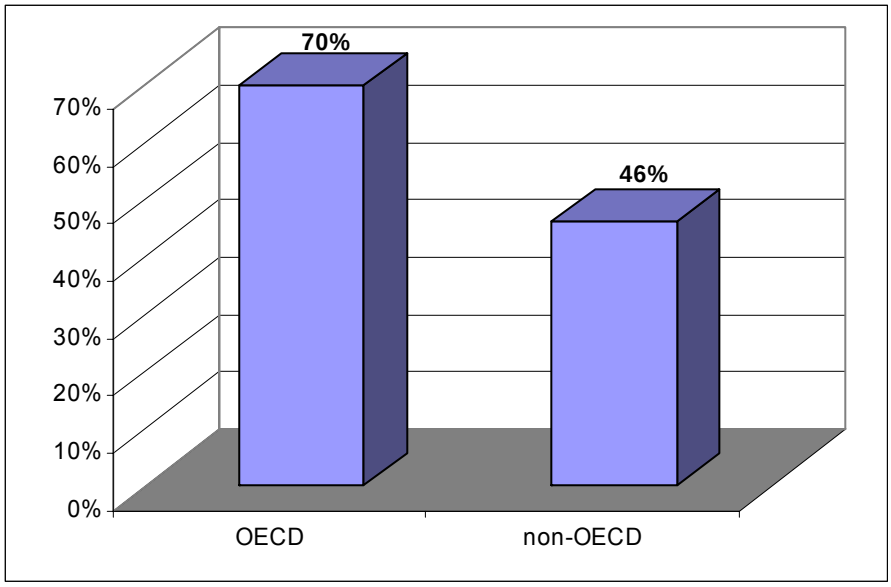
Figure 2b: Evidence of some form of Granger-causality in high-, mid-, and low-development countries



The proportion of countries in the OECD and non-OECD where it is found that E causes Y (with or without feedback - the sum of type i and type iii) is illustrated in Figure 3. This, and Tables 4 and 5, show that 21 OECD countries out of 30 (70%) show evidence of causality from

E to Y whereas, somewhat surprisingly, 36 non-OECD countries from 78 (46%) show this evidence.

Figure 3: Summary of evidence of Granger-causality from E to Y for OECD and non-OECD countries



Since the OECD/non-OECD split could be masking differences in stages of development, it was decided to re-order all countries according to the HDI. The proportions from these rankings are shown in Figure 4. This, however, confirms the previous results; 31 high-development countries out of 45 (69%) show evidence of E to Y causality, whereas only 18 mid-development countries out of 43 (42%) and 6 low-development countries out of 17 (35%) show E to Y causality.

Figure 4: Summary of evidence of Granger-causality from E to Y for high-, mid-, and low-development countries

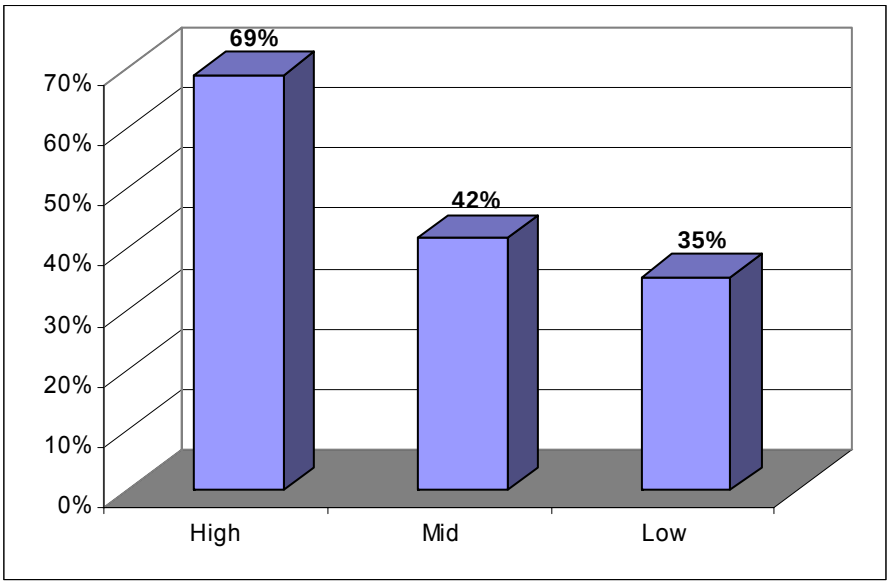
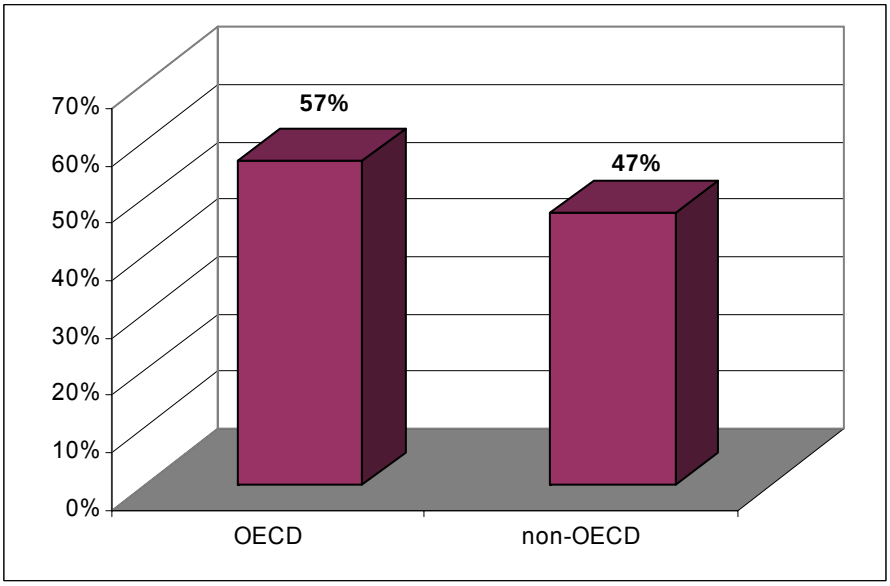


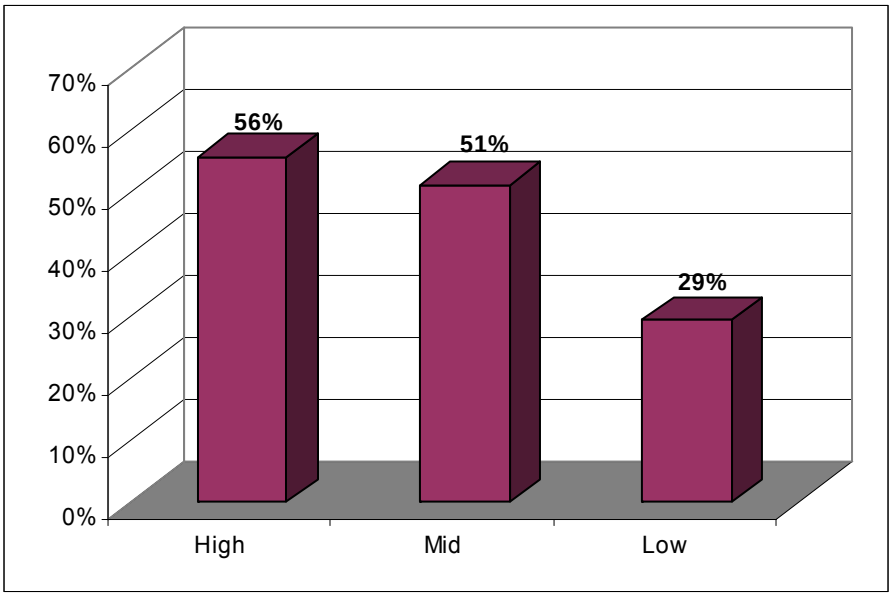
Figure 5 illustrates the proportions of countries in the OECD and non-OECD where it is found that Y causes E (with or without feedback – the sum of type ii and type iii). This shows, that 17 OECD countries out of 30 (57%) and 37 non-OECD countries out of 78 (47%) show evidence of causality from Y to E.

Figure 5: Summary of evidence of Granger-causality from Y to E for OECD and non-OECD countries



The proportions from the rankings according to the HDI are shown in Figure 6. This confirms the previous results: 25 high-development countries out of 45 (56%), 22 mid-development countries out of 43 (51%) and 5 low-development countries out of 17 (29%) show evidence of Y to E causality.

Figure 6: Summary of evidence of Granger-causality from Y to E for high-, mid-, and low-development countries



4. Summary and Conclusion

This study has empirically investigated the causal relationship between energy consumption and economic growth for 30 OECD and 78 non-OECD countries. Causality tests were systematically performed using recently developed techniques. To generate a clearer distinction between developed and developing countries the HDI has been adopted to categorise the countries.

Time series properties of the data were analysed by means of a unit root test before applying tests for co-integration via the Johansen method. Once the cointegrating relationships were identified, the error-correction terms were extracted and embedded as an additional lagged-level regressor in a bivariate VAR system in first differences. This formulation allowed further channels of causality to emerge and provided the opportunity to examine the causal relationship by preserving the short run dynamics without the loss of long run information. Since the result of causality is very sensitive to lag length, the Hsiao's Granger technique was adopted which combines the definition of Granger-causality and final prediction criteria (FPE) to select the optimum lag for the model.

Although there is some evidence of energy-GDP and GDP-energy causality for the OECD/developed group of countries and the non-OECD/developing group of countries the proportion is far greater for the OECD/developed group, therefore refuting the hypothesis set out in Section 1 about the relationship between energy and GDP.

Within this, however, there are some interesting differences. The results indicate that causality from GDP to energy consumption is more prevalent in the OECD/developed countries than the non-OECD/developing countries (but the difference is not as great as the causality from energy to GDP) with GDP to energy causality found for 57% of OECD countries compared to 47% of non-OECD countries and 56% and 51% for the high and mid development countries respectively compared to only 29% for the low development group of countries. This suggests that it is only in the very poor nations that causality from GDP to energy appears to be generally weak, possibly reflecting that a lot of these countries have economies based on agriculture and hence, given their stage of development, are less energy dependent, as

discussed by Jumbe (2004), and hence energy use in these poor countries is not generally affected by income.[17]

As for energy to GDP causality the results, as stated, also indicate that it is more prevalent in the OECD/developed countries than the non-OECD countries, but the distinction is a lot greater than that of the causality from GDP to energy: 70% in OECD countries compared to 46% in non-OECD countries and 69%, 42%, and 35% for the high, mid, and low development countries respectively. Hence the results suggest that the degree of causality from energy to GDP is generally *less* in the developing world than the developed world (or alternatively causality from energy to GDP generally *increases* at higher stages of development).[18] Hence the results support the view that energy is generally neutral with respect to its effect on economic growth in the developing world, implying that the effect of energy conservation policies to help combat global warning would have a greater detrimental effect on the overall growth of OECD/developed countries than that of the non-OECD/developing countries. Nonetheless, a minority of developing countries would be affected given that the results still suggest that there would be causality from energy to GDP for 35% of the poorest nations and 42% of the mid income nations. However causality was not found for the two developing countries with the most impressive growth over recent years: China and India – perhaps suggesting that they should be brought into future climate change agreements.

This work suggests a different result to initial expectations which might reflect the reliance of the large developed economies, such as the USA, on energy sources such as electricity and

[17] This probably highlights that consumers in the poorest of nations still rely on primitive energy source such as biomass, wood, etc. so that conventional more advanced sources, such as electricity, are very limited as GDP grows from a very low base.

[18] This is probably related to the problem of low developed countries not having access to advanced technologies

gasoline whereas many developing countries are still reliant on more primitive energy sources. Furthermore, aggregate energy consumption is arguably a crude approximation to energy services, which is the real driver of growth and development; hence further investigation of the effect of disaggregating fuels (into say electricity and gasoline consumption) would help to support or refute the results presented here. Moreover, in order to do a systematic and consistent study for over 100 countries a bivariate approach has been adopted here, whereas a multivariate analysis might produce different results; however, this could not be performed on such a large number of countries due to data limitations.

Nevertheless, this is, as far as is known, the first systematic study of such a large number of countries and has produced results that are contrary to prior expectations; that is causality between energy to GDP is more prevalent in the developed/OECD world than the developing/non-OECD world. In particular causality from energy to GDP is more prevalent in the developed/OECD world than the developing/non-OECD world which has significant consequences in a global world trying to reduce energy consumption in order to reduce pollutant emissions since it suggests that this will have a greater impact on the GDP of the developed world than the developing world.

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which tend, on average, to require more energy. Hence the low technologies, used by the poorest countries restrict GDP and growth, hence the finding that energy in general does not 'cause' GDP.

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Appendix A

OECD countries:

Australia
Austria
Belgium
Canada
Czech Republic
Denmark
Finland
France
Germany
Greece
Hungary
Iceland
Ireland
Italy
Japan
Korea
Luxembourg
Mexico
Netherlands
New Zealand
Norway
Poland
Portugal
Slovakia
Spain
Sweden
Switzerland
Turkey
United Kingdom
United States

Non-OECD countries:

Albania
Algeria
Angola
Argentina
Bahrain
Bangladesh
Benin
Bolivia
Brazil
Brunei
Bulgaria
Cameroon
Chile
Colombia
China
Congo
Congo Republic
Costa Rica
Cote d'lvoire
Cuba
Cyprus
Dominican Republic
Ecuador
Egypt
El Salvador
Ethiopia
Gabon
Ghana
Gibraltar
Guatemala
Haiti
Honduras
Hong Kong
India
Indonesia
Iran
Iraq
Israel
Jamaica
Jordan
Kenya
Kuwait
Lebanon
Libya
Malaysia
Malta
Morocco
Mozambique
Myanmar
Nepal
Nicaragua
Nigeria
Oman
Pakistan
Panama
Paraguay
Peru
Philippines
Qatar
Romania
Saudi Arabia
Senegal
Singapore
Sri Lanka
Sudan
Taiwan
Tanzania
Thailand
Togo
Trinidad Tobago
Tunisia
United Arab Emirates
Uruguay
Venezuela
Vietnam
Yemen
Zambia
Zimbabwe

Appendix B

High-development countries (According to the HDI):	Mid-development countries (According to the HDI):	Low-development countries (According to the HDI):
Argentina	Albania	Angola
Australia	Algeria	Benin
Austria	Bangladesh	Cameroon
Bahrain	Bolivia	Congo Republic
Belgium	Brazil	Cote d'Ivoire
Brunei	Bulgaria	Ethiopia
Canada	China	Haiti
Chile	Colombia	Kenya
Costa Rica	Congo	Mozambique
Cuba	Dominican Republic	Nepal
Cyprus	Ecuador	Nigeria
Czech Republic	Egypt	Pakistan
Denmark	El Salvador	Senegal
Finland	Gabon	Tanzania
France	Ghana	Yemen
Germany	Guatemala	Zambia
Greece	Honduras	Zimbabwe
Hong Kong	Indonesia	
Hungary	India	
Iceland	Iran	
Ireland	Jamaica	
Israel	Jordan	
Italy	Lebanon	
Japan	Libya	
Korea	Malaysia	
Kuwait	Morocco	
Luxembourg	Myanmar	
Malta	Nicaragua	
Mexico	Oman	
Netherlands	Panama	
New Zealand	Paraguay	
Norway	Peru	
Poland	Philippines	
Portugal	Romania	
Qatar	Saudi Arabia	
Singapore	Sri Lanka	
Slovakia	Sudan	
Spain	Thailand	
Sweden	Togo	
Switzerland	Tunisia	
Trinidad and Tobago	Turkey	
United Arab Emirates	Venezuela	
United Kingdom	Vietnam	
United States		
Uruguay		

Table 1: Summary of energy-output* causality studies

Studies	Countries	Methodology	Period	Results	
				Energy → Output	Output → Energy
1. Kraft & Kraft (1978)	USA	Sims	1947-1974	-	GNP→E
2. Akarca & Long (1979)	USA	Granger	1/1973-3/1978 (monthly)	E→Emp.(-)	-
3. Yu & Hwang (1984)	USA	Sims, Granger: 1. E ,GNP 2. E, Employment	 1947-1979 1948-1979	 - -	 - Emp.→E (Sims)
4. Yu & Choi (1985)	-USA -UK -Poland -S.Korea -Philippines	Sims, Granger	1950-1976	- Gas→GNP - Liquid fuels→GNP E→GNP	- - - GNP→E -
5.Erol & Yu (1987)	USA	Sims : (E, Emp.)	1/73-6/84 (monthly)	-	-
6. Erol & Yu (1988)	-Japan -West Germany -Italy -Canada -France -UK	Granger, Sims	1950-1982 1952-1982 1950-1973 1950-1982 1950-1973 1950-1982 1952-1982 1950-1973 1950-1982 1950-1973 1950-1982 1950-1973 1950-1982 1950-1973	E→GNP - - - - - - - E→GNP - - - - E→GNP	GNP→E GNP→E GNP→E GNP→E - GNP→E - - - - - - -

7. Nachane et al (1988)	16 countries: (11 LDCs, 5 DCs)	Granger, Sims and Cointegration	1950-1985	E→GDP (except Colombia and Venezuela)	GDP→E (except Colombia and Venezuela)
8. Yu et al (1988)	USA	1. Granger 2. Sims (E, Emp., Non-farm Emp.)	1/73-6/84 (monthly)	- E→Non farm Emp.(-)	- -
9. Abosedra & Baghestani (1991)	USA	Granger	1947-1974 47-72, 47-79, 47-87	- -	GNP→E -
10. Hwang & Gum (1992)	Taiwan	Hsiao's Granger	N.A.	E→GNP	GNP→E
11. Murry & Nan (1992)	USA	Granger, Sims	1/74-12/88 (monthly)	-	Emp.→E
12. Yu & Jin (1992)	USA	Cointegration : (E, IP, Non-farm Emp.)	1/71-4/90 (monthly)	-	-
13. Hoa (1993)	Thailand	Cointegration : (Oil, GDP, P)	1/1966-1/1991 (quarterly)	Oil→GDP	GDP→Oil
14. Stern (1993)	USA	Granger (Multivariate:E,GDP, K, L)	1947-1990	E→GDP	-
15. Cheng (1996)	USA	Hsiao's Granger : (Multivariate: E, GNP,K)	1947-1990	-	-
16. Ebohon (1996)	-Tanzania -Nigeria	Granger	1960-1984 1960-1981	E→GNP,GDP E→GNP,GDP	GNP,GDP→E GNP,GDP→E
17. Masih & Masih (1996)	6 Asian Countries: - Malaysia - Singapore - Philippines - India - Indonesia - Pakistan	Cointegration & ECM : (E, GDP)	 1955-1990 1960-1990 1955-1991 1955-1990 1960-1990 1955-1990	 - - - E→GNP - E→GNP	 - - - - GNP→E GNP→E
18. Murry & Nan (1996)	-Developing Cons [a/] -Developing Cons [b/] -More dev.Cons [c/] -NICs [d/]	Granger : (Elec., GDP)	1970-1990	- - Elec.→GDP Elec.→GDP	- GDP→Elec. - GDP→Elec.
19. Cheng (1997)	3 Latin Countries: - Mexico - Venezuela - Brazil	Hsiao's Granger : (Multivariate: E, GDP,K) (Multivariate: E, GDP,K) (Bivariate: E, GDP)	 1949-1993 1952-1993 1963-1993	 K→GDP(-) K→GDP(-) E→GDP(-)	 - - -
20. Cheng & Lai (1997)	Taiwan	Hsiao's Granger : (Bivariate:E, GDP,Emp.)	1955-1993	E→Emp.	GDP→E

21. Glasure & Lee (1997)	South Korea, Singapore	Cointegration & ECM	1961-1990	E→GDP	GDP→E
22. Masih & Masih (1997)	2 Asian NICS: - South Korea - Taiwan	Cointegration & ECM : (Multivariate: E, GNP,P)	 1955-1991 1952-1992	 P→E→GNP P→E→GNP	 GNP→E GNP→E
23. Cheng (1998)	Japan	Hsiao's Granger : (Multivariate: E,Emp,GNP,K)	1952-1995	E→Emp.(-) K→Emp.(-)	GNP,Emp.→E
24. Cheng (1999)	India	Cointegration & ECM, Hsiao's Granger : (Multivariate: E,K,L,GNP)	1952-1995	K→GNP	GNP,K(-),L → E
25. Asafu-Adjaye (2000)	-India -Indonesia -Thailand -Philippines	Cointegration & ECM : (Multivariate: E,GDP,P)	1973-1995 1973-1995 1971-1995 1971-1995	E→GDP (SR) E→GDP (SR) E→GDP (SR) E→GDP (SR)	- - GDP→E (SR) GDP→E (SR)
26. Stern (2000)	USA	Cointegration : (Multivariate: E,GDP, K, L,T)	1948-1994	E→GNP	-
27. Yang (2000)	Taiwan	Hsiao's Granger : (E/Disaggregate E: coal, oil, gas, elec., and GDP)	1954-1997	E→GDP Coal→GDP - Gas→GDP Elec.→GDP	GDP→E GDP→Coal GDP→Oil - GDP→Elec.
28. Aqeel & Butt (2001)	Pakistan	Hsiao's Granger	1955-1996	E→Emp. Elec.→GDP	GDP→E GDP→Oil
29. Fatai et al (2001)	- New Zealand, Australia - India, Indonesia - Thailand, Philippines	Granger & Toda and Yamamoto : (Bivariate)	1960-1999	- - - E→GDP E→GDP	GDP→E, GDP→Indus.E, GDP→Com.E. - GDP→E
30. Ghosh (2002)	India	Cointegration	1950-1997	-	GDP→Elec.
31. Glasure (2002)	Korea	Cointegration & ECM : (Multivariate: E,GDP,rgexp,M^s,roil)	1961-1990	E,roil,M^s →GDP (SR)	GDP,roil,M^s ,rgexp→E (LR)
32. Hondroyiannis et al (2002)	Greece	Cointegration & ECM : (Multivariate: E,GDP,P)	1960-1996	E→GDP,P→GDP Res.E→GDP, P→GDP Indus.E, P→GDP Indus.E→P	GDP→E, P→E Res.E→P, GDP→P - P→Indus.E

33. Soytas & Sari (2003)	G-7& Emerging Mkt: -Argentina -Italy -Korea -Turkey -France -German -Japan -Poland -Indonesia	Cointegration & ECM	 1950-1990 1950-1992 1953-1991 1950-1992 1950-1992 1950-1992 1950-1992 1965-1994 1950-1992	 E→GDP - - E→GDP E→GDP E→GDP E→GDP - -	 GDP→E GDP→E GDP→E - - - - - -
34. Altinay & Karagol (2004)	Turkey	Hsiao's Granger (Bivariate: E,GDP)	1950-2000	-	-
35. Ghali & El-Sakka (2004)	Canada	Cointegration & ECM : (Multivariate: E, GDP,K,L)	1961-1997	E→GDP	GDP→E
36. Jumbe (2004)	Malawi	- Granger - Cointegration & ECM (Elec., GDP, AGDP, NGDP)	1970-1999 1970-1999	Elec.→GDP -	GDP→Elec.,NGDP→Elec. GDP→Elec.,NGDP→Elec.
37. Morimoto & Hope (2004)	Sri Lanka	Granger	1960-1998	Elec.P.→GDP	-
38. Oh & Lee (2004a)	Korea	Cointegration & ECM : (Multivariate: E, GDP,K,L)	1970-1999	E→GDP	GDP→E
39. Oh & Lee (2004b)	Korea	Cointegration & ECM : (Multivariate: E, GDP,K,L)	1/1981-4/2000 (quarterly)	-	GDP→E
40. Paul & Bhattacharya (2004)	India	-Standard Granger -Engle-Granger -Johansen Cointegration	1950-1996 1950-1996 1950-1996	E→GDP(SR) - E→GDP	- GDP→E (LR) GDP→E
41. Wolde-Rufael (2004)	Shanghai	Toda and Yamamoto's Granger : (Bivariate : Disaggregate E, GDP)	1952-1999	Coal→GDP, Coke→GDP, Elec.→GDP, E→GDP	- - -
42. Shiu & Lam (2004)	China	Cointegration & ECM	1971-2000	Elec.→GDP	-
43. Altinay & Karagol (2005)	Turkey	Dolado-Lütkepohl/Granger	1950-2000	Elec.→GDP	-
44. Lee (2005)	18 Developing Countries [e/]	Panel Cointegration & ECM	1975-2001	E→GDP	-

45. Wolde-Rufael (2005)	19 African Countries: -Algeria, Congo DR, Egypt, Ghana, Ivory Coast -Cameroon, Morocco, Nigeria -Gabon, Zambia -Benin, Congo RP, Kenya, Senegal, South Africa, Sudan, Togo, Tunisia, Zimbabwe	Toda and Yamamoto's Granger: (Bivariate: Elec., GDP)	1971-2001 1971-2001 1971-2001 1971-2001	- E→GDP E→GDP -	GDP→E - GDP→E -
46. Yoo (2005)	Korea	Cointegration & ECM	1970-2002	Elec.→GDP	GDP→Elec.

* The definitions of Energy and Output and the abbreviation used are given below:

E = Total energy consumption
Gas = Natural gas consumption
Liquid fuels = Liquid fuel consumption
Elec. = Electricity consumption
Elec.P = Electricity production
Oil = Oil Consumption
Coal = Coal Consumption
Coke = Coke consumption
Res.E = Energy consumption in residential sector
Indus.E = Energy consumption in industrial sector
Com.E = Energy consumption in commercial sector
K = Capital
L = Labour
T = Time trend (technology)
P = Price (Consumer price index)
GDP = Gross domestic product
GNP = Gross national product
AGDP = Agricultural-GDP
NGDP = Non-agricultural-GDP
Emp. = Employment

Non-farm Emp. = Non-farm employment
IP = Industrial production index of manufacturing
roil = Real oil price
rgexp. = Real government expenditure
M^s = Real money supply

(-) = negative (as opposed to positive) causality.

a/ This includes India, Philippines and Zambia.

b/ This includes Colombia, El Salvador, Indonesia, Kenya and Mexico.

c/ This includes Canada, Hong Kong, Pakistan, Singapore and Turkey.

d/ This includes Malaysia and South Korea.

e/ This includes South Korea, Singapore, Hungary, Argentina, Chile, Colombia, Mexico, Peru, Venezuela, Indonesia, Malaysia, Philippines, Thailand, India, Pakistan, Sri Lanka, Ghana and Kenya.

Table 2: ADF Tests for OECD Countries

Countries	Variables	ADF Test			ADF test			Results
		Level	P-value*	Lags**	Difference	P-value*	Lags**	
Australia	Energy	-2.0375	0.5636	0	-6.6279	0.0000	0	I(1)
	GDP	-1.9319	0.6194	0	-6.1815	0.0000	0	I(1)
Austria	Energy	-1.9259	0.6225	0	-5.2976	0.0001	0	I(1)
	GDP	-1.1875	0.8996	0	-1.7948	0.3772	2	I(2)
Belgium	Energy	-2.2819	0.4337	0	-4.8801	0.0003	0	I(1)
	GDP	-1.9767	0.5959	0	-4.8753	0.0003	0	I(1)
Canada	Energy	-1.7320	0.7182	0	-4.4062	0.0011	0	I(1)
	GDP	-2.5409	0.3080	1	-4.2096	0.0020	0	I(1)
Czech Republic [a]	Energy	-1.1905	0.8938	0	-4.5599	0.0012	0	I(1)
	GDP	-2.9210	0.1714	1	-3.8279	0.0072	0	I(1)
Denmark	Energy	-3.2760	0.0853	1	-3.3512	0.0199	4	I(1)
	GDP	-3.2971	0.0813	0	-6.0061	0.0000	0	I(1)
Finland	Energy	-2.2020	0.4756	0	-4.3939	0.0012	0	I(1)
	GDP	-2.2447	0.4528	1	-3.3882	0.0175	0	I(1)
France	Energy	-2.6817	0.2493	1	-3.9876	0.0037	0	I(1)
	GDP	-2.3906	0.3786	0	-3.3134	0.0210	0	I(1)
Germany	Energy	-1.5378	0.7993	0	-4.6705	0.0005	0	I(1)
	GDP	-1.5444	0.7968	0	-4.7850	0.0004	0	I(1)
Greece	Energy	-2.1366	0.5105	0	-4.0881	0.0028	0	I(1)
	GDP	-2.5523	0.3030	0	-4.3694	0.0013	0	I(1)
Hungary [b]	Energy	-1.3810	0.8491	0	-3.4255	0.0169	0	I(1)
	GDP	-2.0309	0.5641	1	-3.6730	0.0092	0	I(1)
Iceland [b]	Energy	-0.7628	0.9597	0	-5.9576	0.0000	0	I(1)
	GDP	-0.5147	0.9780	0	-3.6476	0.0098	0	I(1)
Ireland	Energy	-2.6221	0.2732	0	-7.1537	0.0000	0	I(1)
	GDP	1.8356	1.0000	0	-3.2512	0.0244	0	I(1)
Italy	Energy	-4.1269	0.0122	0	-3.2068	0.0271	0	I(1)
	GDP	-2.0091	0.5788	0	-4.8459	0.0003	0	I(1)
Japan	Energy	-2.7351	0.2290	1	-3.0455	0.0394	0	I(1)
	GDP	-1.8802	0.6455	1	-2.8562	0.0599	0	I(1)
Korea [a]	Energy	-2.3923	0.3749	2	-5.1445	0.0003	0	I(1)
	GDP	-1.8641	0.6469	0	-4.9688	0.0004	0	I(1)

Table 2 continued

Countries	Variables	ADF Test			ADF test			Results
		Level	P-value*	Lags**	Difference	P-value*	Lags**	
Luxembourg	Energy	-2.2328	0.4593	0	-5.9711	0.0000	0	I(1)
	GDP	-0.8861	0.9477	0	-5.3748	0.0001	0	I(1)
Mexico [a]	Energy	-1.2530	0.8796	0	-3.7105	0.0095	0	I(1)
	GDP	-2.1565	0.4946	0	-3.9355	0.0055	0	I(1)
Netherlands	Energy	-2.1516	0.5025	0	-3.9902	0.0037	0	I(1)
	GDP	-2.9280	0.1652	1	-4.7717	0.0004	0	I(1)
New Zealand	Energy	-2.8888	0.1767	0	-8.1576	0.0000	0	I(1)
	GDP	-3.2649	0.0876	2	-5.7130	0.0000	0	I(1)
Norway	Energy	-1.9647	0.6022	0	-4.0055	0.0035	0	I(1)
	GDP	-1.4669	0.8240	1	-3.6109	0.0101	1	I(1)
Poland	Energy	-0.8029	0.9568	0	-4.4155	0.0011	0	I(1)
	GDP	-2.4646	0.3429	1	-3.3594	0.0188	0	I(1)
Portugal	Energy	-2.8845	0.1786	2	-5.6514	0.0000	0	I(1)
	GDP	-2.5727	0.2941	1	-3.4556	0.0153	3	I(1)
Salovakia [a]	Energy	1.8091	1.0000	8	-0.3125	0.9067	8	I(2)
	GDP	-3.3704	0.0759	1	-2.5680	0.1113	0	I(2)
Spain	Energy	-2.7023	0.2416	3	-3.8431	0.0054	0	I(1)
	GDP	-2.5114	0.3212	1	-3.3057	0.0214	0	I(1)
Sweden	Energy	-2.7394	0.2273	0	-4.4985	0.0009	0	I(1)
	GDP	-2.7069	0.2396	1	-3.6106	0.0100	0	I(1)
Switzerland	Energy	-2.7837	0.2113	0	-5.5859	0.0000	0	I(1)
	GDP	-2.3663	0.3905	1	-4.2489	0.0018	1	I(1)
Turkey	Energy	-1.9380	0.6162	0	-5.9922	0.0000	0	I(1)
	GDP	-2.4784	0.3365	0	-6.7583	0.0000	0	I(1)
UK	Energy	-2.4258	0.3615	0	-6.8053	0.0000	0	I(1)
	GDP	-3.8817	0.0224	1	-5.2726	0.0001	1	I(1)
USA	Energy	-2.8627	0.1851	1	-4.0133	0.0034	0	I(1)
	GDP	-4.0104	0.0165	1	-4.8472	0.0003	1	I(1)

Notes:

Date for most countries covers the period 1960-2000 other than:

[a] where data covers the period 1971-2000; and

[b] where data covers the period 1965-2000.

*MacKinnon (1996) one-sided p-values.

** Based on SIC.

Table 3 : Cointegration Tests for OECD Countries

Countries	Year	Lags	Hyphotheses		Johansen Test statistics						Cointegration	Note
			H0	H1	Trace	5%	1%	Max-eigen	5%	1%	accepted?	
Australia	1960-2000	1	r = 0	r > 0	11.46	15.41	20.04	11.46	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.00	3.76	6.65	0.00	3.76	6.65		
Austria	1960-2000	1	r = 0	r > 0	26.84	15.41	20.04	20.63	14.07	18.63	No	Both tests indicate 2 cointegrating equations at 5% level and 1 cointegrating equation at 1% level.
			r < or = 1	r > 1	6.21	3.76	6.65	6.21	3.76	6.65		
Belgium	1960-2000	1	r = 0	r > 0	21.11	25.32	30.45	12.82	18.96	23.65	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	8.29	12.25	16.26	8.29	12.25	16.26		
Canada	1960-2000	1	r = 0	r > 0	9.77	15.41	20.04	9.45	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.33	3.76	6.65	0.33	3.76	6.65		
Czech Republic	1971-2000	1	r = 0	r > 0	6.99	15.41	20.04	6.24	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.75	3.76	6.65	0.75	3.76	6.65		
Denmark	1960-2000	1	r = 0	r > 0	12.87	15.41	20.04	12.85	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.02	3.76	6.65	0.02	3.76	6.65		
Finland	1960-2000	1	r = 0	r > 0	18.20	15.41	20.04	17.42	14.07	18.63	Yes	Both tests indicate 1 cointegrating equation at 5% level and no cointegration at 1% level.
			r < or = 1	r > 1	0.78	3.76	6.65	0.78	3.76	6.65		
France	1960-2000	1	r = 0	r > 0	15.34	15.41	20.04	10.24	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	5.10	3.76	6.65	5.10	3.76	6.65		
Germany	1960-2000	1	r = 0	r > 0	10.12	15.41	20.04	8.74	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	1.38	3.76	6.65	1.38	3.76	6.65		
Greece	1960-2000	1	r = 0	r > 0	11.71	15.41	20.04	9.39	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	2.32	3.76	6.65	2.32	3.76	6.65		
Hungary	1965-2000	1	r = 0	r > 0	6.74	15.41	20.04	5.81	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.93	3.76	6.65	0.93	3.76	6.65		
Iceland	1965-2000	1	r = 0	r > 0	14.25	15.41	20.04	9.40	14.07	18.63	No	Both tests indicate no cointegration at 5% and 1% levels.
			r < or = 1	r > 1	4.85	3.76	6.65	4.85	3.76	6.65		
Ireland	1960-2000	1	r = 0	r > 0	15.47	25.32	30.45	10.86	18.96	23.65	No	Trace test indicates 2 cointegrating equations at 5% level and no cointegration at 1% level.
			r < or = 1	r > 1	4.61	12.25	16.26	4.61	12.25	16.26		Max-eigenvalue test indicates no cointegration at both 5% and 1% levels.
Italy	1960-2000	1	r = 0	r > 0	27.02	15.41	20.04	22.49	14.07	18.63	No	Both tests indicate 2 cointegrating equations at 5% level and 1 cointegrating equation at 1% level.
			r < or = 1	r > 1	4.52	3.76	6.65	4.52	3.76	6.65		
Japan	1960-2000	1	r = 0	r > 0	13.68	15.41	20.04	9.48	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	4.19	3.76	6.65	4.19	3.76	6.65		

Table 3 : Continued

Countries	Year	Lags	Hyphotheses		Johansen Test statistics						Cointegration	Note
			H0	H1	Trace	5%	1%	Max-eigen	5%	1%	accepted?	
Korea	1971-2000	1	r = 0	r > 0	10.98	15.41	20.04	10.78	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.21	3.76	6.65	0.21	3.76	6.65		
Luxembourg	1960-2000	1	r = 0	r > 0	14.03	15.41	20.04	7.58	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	6.45	3.76	6.65	6.45	3.76	6.65		
Mexico	1971-2000	1	r = 0	r > 0	9.40	15.41	20.04	8.65	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.75	3.76	6.65	0.75	3.76	6.65		
Netherlands	1960-2000	1	r = 0	r > 0	16.68	15.41	20.04	14.55	14.07	18.63	Yes	Both tests indicate 1 cointegrating equation at 5% level and no cointegration at 1%.
			r < or = 1	r > 1	2.13	3.76	6.65	2.13	3.76	6.65		
New Zealand	1960-2000	1	r = 0	r > 0	13.25	15.41	20.04	13.02	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.24	3.76	6.65	0.24	3.76	6.65		
Norway	1960-2000	1	r = 0	r > 0	16.39	15.41	20.04	15.59	14.07	18.63	Yes	Both tests indicate 1 cointegrating equation at 5% level and no cointegration at 1%.
			r < or = 1	r > 1	0.80	3.76	6.65	0.80	3.76	6.65		
Poland	1960-2000	1	r = 0	r > 0	10.23	15.41	20.04	6.25	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	3.98	3.76	6.65	3.98	3.76	6.65		
Portugal	1960-2000	1	r = 0	r > 0	8.86	15.41	20.04	8.69	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.17	3.76	6.65	0.17	3.76	6.65		
Salovakia	1971-2000	2	r = 0	r > 0	13.02	15.41	20.04	8.21	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	4.81	3.76	6.65	4.81	3.76	6.65		
Spain	1960-2000	1	r = 0	r > 0	9.28	15.41	20.04	7.32	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	1.96	3.76	6.65	1.96	3.76	6.65		
Sweden	1960-2000	1	r = 0	r > 0	13.22	15.41	20.04	12.92	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.30	3.76	6.65	0.30	3.76	6.65		
Switzerland	1960-2000	1	r = 0	r > 0	22.39	15.41	20.04	20.67	14.07	18.63	Yes	Both tests indicate 1 cointegrating equation at both 5% and 1% levels.
			r < or = 1	r > 1	1.71	3.76	6.65	1.71	3.76	6.65		
Turkey	1960-2000	1	r = 0	r > 0	8.65	15.41	20.04	6.18	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	2.47	3.76	6.65	2.47	3.76	6.65		
UK	1960-2000	1	r = 0	r > 0	7.77	15.41	20.04	7.72	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.05	3.76	6.65	0.05	3.76	6.65		
USA	1960-2000	1	r = 0	r > 0	10.95	15.41	20.04	10.13	14.07	18.63	No	Both tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.82	3.76	6.65	0.82	3.76	6.65		

Table 4 : Causality results for the OECD Countries

Country	Year	Cointegration Results	Direction of Causality	FPE(m*) [a]	FPE(m*,n*) [a]	T1	T2	m*	n*	SSE(m*)	SSE(m*,n*)	F-HSIAO	F-Restrict	Wald-test	d.f	P-value	t-test(long-run)				Joint F-test (cof. of indep.var			Causality Resuts				Note
																	cof.	st.	t-stat	p-value	F-stat	df.	p-value	E---->Y	Y---->E	E<---->Y	E-----Y	
Australia	1960-2000	No	Y = f (E)	0.000393	0.000413	39	39	1	1	0.0138	0.0138	0.0002	0.0002	0.0002	(1, 36)	0.9875									√			
			E = f (Y)	0.000475	0.000343	37	37	3	1	0.0141	0.0097	14.7260	14.7260	14.7260	(1, 32)	0.0006												
Austria	1960-2000	No	Y = f (E)	0.000318	0.000255	37	37	3	3	0.0095	0.0064	4.6855	4.6855	4.6855	(3, 30)	0.0084								√				
			E = f (Y)	0.000982	0.000983	35	35	5	1	0.0243	0.0229	1.6656	1.6656	1.6656	(1, 28)	0.2074												
Belgium	1960-2000	No	Y = f (E)	0.000373	0.000311	39	39	1	1	0.0131	0.0104	9.4453	9.4453	9.4453	(1, 36)	0.0040								√				
			E = f (Y)	0.002531	0.002667	38	38	2	1	0.0821	0.0821	0.0163	0.0163	0.0163	(1, 34)	0.8990												
Canada	1960-2000	No	Y = f (E)	0.000433	0.000454	39	39	1	1	0.0152	0.0152	0.1950	0.1950	0.1950	(1, 36)	0.6614									√			Although tests only accept Y → E causality at 11% level.
			E = f (Y)	0.000953	0.000932	39	39	1	1	0.0335	0.0312	2.7375	2.7375	2.7375	(1, 36)	0.1067												
Czech Republic	1971-2000	No	Y = f (E)	0.000960	0.000765	28	25	1	4	0.0233	0.0117	4.6862	4.6862	4.5321	(4, 19)	0.0097								√				
			E = f (Y)	0.002448	0.002639	27	27	2	1	0.0529	0.0529	0.0131	0.0131	0.0131	(1, 23)	0.9097												
Denmark	1960-2000	No	Y = f (E)	0.000454	0.000248	36	36	4	4	0.0123	0.0053	8.8378	8.8378	8.8378	(4, 27)	0.0001								√				
			E = f (Y)	0.002926	0.002942	32	32	8	1	0.0525	0.0493	1.4357	1.4357	1.4357	(1, 22)	0.2436												
Finland	1960-2000	Yes	Y = f (E)[#]	0.000648	0.000668	38	38	2	1	0.0210	0.0205	0.7734	0.7734	0.7734	(1, 34)	0.3854									√			
			E = f (Y)	0.001318	0.001072	39	39	1	1	0.0464	0.0340	6.3525	6.3525	6.3525	(2, 35)	0.0044	-0.1659	0.0466	-3.5591	0.0011	0.0472	(1, 35)	0.8293					
France	1960-2000	No	Y = f (E)	0.000193	0.000190	39	37	1	3	0.0068	0.0054	2.8187	2.8187	2.5245	(3, 32)	0.0751										√		
			E = f (Y)	0.001464	0.001358	39	39	1	1	0.0515	0.0454	4.8647	4.8647	4.8647	(1, 36)	0.0339												
Germany	1960-2000	No	Y = f (E)	0.000352	0.000297	39	32	1	8	0.0124	0.0050	4.0909	4.0909	2.0626	(8, 22)	0.0856										√		
			E = f (Y)	0.003557	0.003365	39	39	1	1	0.1252	0.1125	4.0642	4.0642	4.0642	(1, 36)	0.0513												
Greece	1960-2000	No	Y = f (E)	0.001178	0.001141	37	37	3	1	0.0351	0.0322	2.9002	2.9002	2.9002	(1, 32)	0.0983										√		
			E = f (Y)	0.003073	0.002906	39	39	1	1	0.1081	0.0971	4.0760	4.0760	4.0760	(1, 36)	0.0510												
Hungary	1965-2000	No	Y = f (E)	0.001409	0.001344	34	34	1	1	0.0426	0.0383	3.4678	3.4678	3.4678	(1, 31)	0.0721										√		
			E = f (Y)	0.001668	0.001153	34	34	1	1	0.0504	0.0329	16.5478	16.5478	16.5478	(1, 31)	0.0003												
Iceland	1965-2000	No	Y = f (E)	0.001353	0.001201	33	33	2	2	0.0372	0.0292	3.8370	3.8370	3.8370	(2, 28)	0.0337										√		Although tests only accept Y → E causality at 11% level.
			E = f (Y)	0.001583	0.001553	34	33	1	2	0.0478	0.0402	2.7653	2.7653	2.3519	(2, 29)	0.1131												
Ireland	1960-2000	No	Y = f (E)	0.000682	0.000635	39	38	1	2	0.0240	0.0195	3.9035	3.9035	3.5290	(2, 34)	0.0405								√				
			E = f (Y)	0.002280	0.002321	39	39	1	1	0.0802	0.0776	1.2277	1.2277	1.2277	(1, 36)	0.2752												
Italy	1960-2000	No	Y = f (E)	0.000388	0.000364	39	39	1	1	0.0137	0.0122	4.3823	4.3823	4.3823	(1, 36)	0.0434										√		
			E = f (Y)	0.000995	0.000944	37	37	3	1	0.0296	0.0266	3.6345	3.6345	3.6345	(1, 32)	0.0656												
Japan	1960-2000	No	Y = f (E)	0.000513	0.000365	32	32	8	7	0.0092	0.0039	3.1188	3.1188	3.1188	(7, 16)	0.0282										√		
			E = f (Y)	0.001408	0.001001	32	32	8	3	0.0253	0.0146	4.9131	4.9131	4.9131	(3, 20)	0.0102												

Table 4 : Continued

Country	Year	Cointegration Results	Direction of Causality	FPE(m*) [a]	FPE(m*,n*) [a]	T1	T2	m*	n*	SSE(m*)	SSE(m*,n*)	F-HSIAO	F-Restrict	Wald-test	d.f	P-value	t-test(long-run)				Joint F-test (cof. of indep.var			Causality Resuts				Note
																	cof.	st.	t-stat	p-value	F-stat	df.	p-value	E---->Y	Y---->E	E<---->Y	E-----Y	
Korea	1971-2000	No	Y = f (E)	0.001627	0.001597	28	28	1	1	0.0395	0.0361	2.3705	2.3705	2.3705	(1, 25)	0.1362								√				Although tests only accept E → Y causality at 14% level.
			E = f (Y)	0.003364	0.003488	27	27	2	1	0.0727	0.0699	0.9234	0.9234	0.9234	(1, 23)	0.3466												
Luxembourg	1960-2000	No	Y = f (E)	0.001132	0.001191	39	39	1	1	0.0398	0.0398	0.0431	0.0431	0.0431	(1, 36)	0.8367											√	
			E = f (Y)	0.003844	0.004038	39	39	1	1	0.1353	0.1350	0.0798	0.0798	0.0798	(1, 36)	0.7792												
Mexico	1971-2000	No	Y = f (E)	0.001471	0.001468	28	28	1	1	0.0357	0.0331	1.9238	1.9238	1.9238	(1, 25)	0.1777								√				Although tests only accept E → Y causality at 18% level.
			E = f (Y)	0.001209	0.001229	27	27	2	2	0.0261	0.0228	1.5907	1.5907	1.5907	(2, 22)	0.2263												
Netherlands	1960-2000	Yes	Y = f (E)[#]	0.000263	0.000255	36	36	4	1	0.0072	0.0066	2.8155	2.8155	2.8155	(1, 30)	0.1037								√				
			E = f (Y)[#]	0.002898	0.002966	38	38	2	1	0.0940	0.0912	1.0296	1.0296	1.0296	(1, 34)	0.3174												
New Zealand	1960-2000	No	Y = f (E)	0.001014	0.000882	39	37	1	3	0.0357	0.0249	4.6504	4.6504	4.1643	(3, 32)	0.0134										√		
			E = f (Y)	0.000732	0.000641	36	36	4	3	0.0199	0.0147	3.3192	3.3192	3.3192	(3, 28)	0.0341												
Norway	1960-2000	Yes	Y = f (E)[#]	0.000242	0.000209	39	33	1	7	0.0085	0.0039	3.9862	3.9862	3.0130	(7, 24)	0.0203										√		
			E = f (Y)	0.001085	0.000711	39	38	1	2	0.0382	0.0207	9.2629	9.2629	8.6867	(3, 33)	0.0002	-0.1433	0.0328	-4.3752	0.0001	3.1736	(2, 33)	0.0549					
Poland	1960-2000	No	Y = f (E)	0.001645	0.001641	39	39	1	1	0.0579	0.0549	1.9954	1.9954	1.9954	(1, 36)	0.1664								√				Although tests only accept E → Y causality at 17% level.
			E = f (Y)	0.002816	0.002958	39	39	1	1	0.0991	0.0989	0.0859	0.0859	0.0859	(1, 36)	0.7711												
Portugal	1960-2000	No	Y = f (E)	0.001132	0.001071	36	36	4	1	0.0308	0.0275	3.5456	3.5456	3.5456	(1, 30)	0.0694										√		
			E = f (Y)	0.001070	0.000948	39	39	1	1	0.0377	0.0317	6.7931	6.7931	6.7931	(1, 36)	0.0132												
Salovakia	1971-2000	No	Y = f (E)	0.001271	0.001103	28	27	1	2	0.0308	0.0221	4.5586	4.5586	4.5494	(2, 23)	0.0216										√		
			E = f (Y)	0.004937	0.002978	28	27	1	2	0.1198	0.0597	11.5985	11.5985	11.0061	(2, 23)	0.0004												
Spain	1960-2000	No	Y = f (E)	0.000328	0.000339	39	36	1	4	0.0116	0.0087	2.4373	2.4373	1.6737	(4, 30)	0.1821									√			
			E = f (Y)	0.001430	0.001200	37	37	3	1	0.0426	0.0338	8.2893	8.2893	8.2893	(1, 32)	0.0071												
Sweden	1960-2000	No	Y = f (E)	0.000316	0.000332	39	39	1	1	0.0111	0.0111	0.0002	0.0002	0.0002	(1, 36)	0.9896									√			Although tests only accept Y → E causality at 12% level.
			E = f (Y)	0.001418	0.001397	39	39	1	1	0.0499	0.0467	2.4849	2.4849	2.4849	(1, 36)	0.1237												
Switzerland	1960-2000	Yes	Y = f (E)	0.000436	0.000396	39	39	1	1	0.0154	0.0126	3.8751	3.8751	3.8751	(2, 35)	0.0302	-0.0005	0.0283	-0.0189	0.9850	7.6827	(1, 35)	0.0089			√		
			E = f (Y)	0.001826	0.001669	37	37	3	1	0.0544	0.0445	3.4325	3.4325	3.4325	(2, 31)	0.0450	-0.3026	0.1178	-2.5679	0.0153	0.3927	(1, 31)	0.5355					
Turkey	1960-2000	No	Y = f (E)	0.001400	0.001424	39	39	1	1	0.0493	0.0476	1.2585	1.2585	1.2585	(1, 36)	0.2694											√	
			E = f (Y)	0.001833	0.001924	39	39	1	1	0.0645	0.0643	0.1143	0.1143	0.1143	(1, 36)	0.7373												
UK	1960-2000	No	Y = f (E)	0.000329	0.000347	38	38	2	1	0.0107	0.0107	0.0063	0.0063	0.0063	(1, 34)	0.9373											√	
			E = f (Y)	0.000812	0.000839	39	39	1	1	0.0286	0.0280	0.7083	0.7083	0.7083	(1, 36)	0.4056												
USA	1960-2000	No	Y = f (E)	0.000426	0.000430	38	38	2	1	0.0138	0.0132	1.5605	1.5605	1.5605	(1, 34)	0.2201											√	
			E = f (Y)	0.000789	0.000796	39	38	1	2	0.0278	0.0245	2.2623	2.2623	1.7801	(2, 34)	0.1840												

Notes:

[#] ECM term has wrong sign so causality is tested by using Hsiao's Granger technique on the standard model.

[a] The maximum lag (m*) and lag(m*,n*) are set at 20% of total observation.

Table 5 : Summary of the integration, cointegration and causality results for OECD countries									
Countries	**Stage 1: Integration: I(1)**	**Stage 2: Cointegration**	**Stage 3: Causality**						
	Both energy & GDP	**Between energy & GDP**	**E ---> Y (i)**	**Y ---> E (ii)**	**E <----> Y (iii)**	**E ---- Y (iv)**	**E <==> Y (i+ii+iii)**	**E ==> Y (i+iii)**	**Y ==> E (ii+iii)**
Australia	√			√			√		√
Austria	(√)*		√				√	√	
Belgium	√		√				√	√	
Canada	√			√			√		√
Czech Republic [a]	√		√				√	√	
Denmark	√		√				√	√	
Finland	√	√		√			√		√
France	√				√		√	√	√
Germany	√				√		√	√	√
Greece	√				√		√	√	√
Hungary [b]	√				√		√	√	√
Iceland [b]	√				√		√	√	√
Ireland	√		√				√	√	
Italy	√				√		√	√	√
Japan	√				√		√	√	√
Korea [a]	√		√				√	√	
Luxembourg	√					√			
Mexico [a]	√		√				√	√	
Netherlands	√	√	√				√	√	
New Zealand	√				√		√	√	√
Norway	√	√			√		√	√	√
Poland	√		√				√	√	
Portugal	√				√		√	√	√
Salovakia [a]	(√)*				√		√	√	√
Spain	√			√			√		√
Sweden	√			√			√		√
Switzerland	√	√			√		√	√	√
Turkey	√					√			
United Kingdom	√					√			
United States	√					√			
Total	**28**	**4**	**9**	**5**	**12**	**4**	**26**	**21**	**17**
%	**93%**	**13%**	**30%**	**17%**	**40%**	**13%**	**87%**	**70%**	**57%**

Data for most countries covers the period 1960-2000 other than:

[a] where data covers the period 1971-2000; and

[b] where data covers the period 1965-2000.

* Either *e* or *y* were found to be I(2) with the other being I(1) or I(2) therefore cointegration was still tested.

Table 6: ADF Tests for Non-OECD Countries

Countries	Variables	ADF Test			ADF Test			Results
		Level	P-value*	Lags**	Difference	P-value*	Lags**	
Albania	Energy	-1.8607	0.6477	1	-3.9096	0.0059	0	I(1)
	GDP	-2.3258	0.4075	1	-3.5759	0.0131	0	I(1)
Algeria	Energy	-1.6516	0.7466	0	-3.4963	0.0157	0	I(1)
	GDP	-1.8658	0.6376	7	-7.5476	0.0000	0	I(1)
Angola	Energy	-1.9624	0.5966	0	-5.4730	0.0001	0	I(1)
	GDP	-3.2477	0.0959	1	-3.8227	0.0073	0	I(1)
Argentina	Energy	-1.1129	0.9094	0	-4.2901	0.0023	0	I(1)
	GDP	-2.8781	0.1836	0	-6.2687	0.0000	0	I(1)
Bahrain	Energy	-4.6252	0.0048	0				I(0)
	GDP	-3.8546	0.0317	6	-4.9589	0.0004	0	I(1)
Bangladesh	Energy	-2.6152	0.2767	0	-7.1887	0.0000	0	I(1)
	GDP	-0.9620	0.9324	3	-2.6025	0.1052	2	I(2)
Benin	Energy	-1.7337	0.7100	0	-5.1914	0.0002	0	I(1)
	GDP	-1.6743	0.7367	0	-4.4621	0.0015	0	I(1)
Bolivia	Energy	-2.0959	0.5221	5	-4.0404	0.0043	0	I(1)
	GDP	-1.4166	0.8343	0	-3.8816	0.0063	0	I(1)
Brazil	Energy	-2.8393	0.1960	1	-2.9229	0.0553	0	I(1)
	GDP	-2.8436	0.1951	2	-5.2355	0.0005	8	I(1)
Brunei	Energy	-1.7832	0.6867	0	-5.4027	0.0001	0	I(1)
	GDP	-2.4331	0.3558	2	-3.9054	0.0061	1	I(1)
Bulgaria	Energy	-1.7328	0.7104	0	-4.2282	0.0027	0	I(1)
	GDP	-2.0255	0.5627	1	-2.4957	0.1272	0	I(2)
Cameroon	Energy	-2.1934	0.4754	0	-5.3660	0.0001	0	I(1)
	GDP	-2.7925	0.2125	4	-3.3773	0.0206	0	I(1)
Chile	Energy	-2.0028	0.5755	0	-4.0916	0.0038	0	I(1)
	GDP	-2.3741	0.3839	1	-11.1574	0.0000	0	I(1)
China	Energy	-2.2641	0.4390	0	-4.8709	0.0005	0	I(1)
	GDP	-2.4655	0.3411	1	-2.3833	0.1555	1	I(2)
Colombia	Energy	-2.3184	0.4107	2	-2.1458	0.2297	3	I(2)
	GDP	-2.7231	0.2355	1	-2.7593	0.0786	3	I(1)
Congo	Energy	-2.3355	0.4031	0	-5.9580	0.0000	0	I(1)
	GDP	-0.9195	0.9400	0	-2.8852	0.0613	3	I(1)

Table 6 continued

Countries	Variables	ADF Test			ADF Test			Results
		Level	P-value*	Lags**	Difference	P-value*	Lags**	
Congo Rep.	Energy	-1.8258	0.6660	0	-5.2478	0.0002	0	I(1)
	GDP	-2.5590	0.3000	2	-4.2607	0.0026	1	I(1)
Costa Rica	Energy	-2.9627	0.1592	0	-5.7277	0.0001	0	I(1)
	GDP	-1.0019	0.9282	0	-3.3672	0.0211	0	I(1)
Cote d'Ivoire	Energy	-1.5630	0.7828	0	-4.9549	0.0004	0	I(1)
	GDP	-1.7757	0.6903	0	-3.2834	0.0255	0	I(1)
Cuba	Energy	-2.1137	0.5171	0	-4.4138	0.0017	0	I(1)
	GDP	-1.8623	0.6469	1	-2.9130	0.0565	0	I(1)
Cyprus	Energy	-2.8059	0.2065	0	-4.5286	0.0013	0	I(1)
	GDP	-2.5954	0.2848	0	-3.9403	0.0055	0	I(1)
Dominican Republic	Energy	-0.7521	0.9589	0	-6.1745	0.0000	0	I(1)
	GDP	-1.3795	0.8457	0	-3.7458	0.0087	0	I(1)
Ecuador	Energy	-1.2909	0.8702	0	-4.7207	0.0008	0	I(1)
	GDP	-4.3814	0.0085	0				I(0)
Egypt	Energy	-2.5118	0.3202	3	-5.4600	0.0001	0	I(1)
	GDP	-1.0308	0.9237	0	-3.2112	0.0299	0	I(1)
El Salvador	Energy	-1.5709	0.7797	0	-5.2217	0.0002	0	I(1)
	GDP	-4.9770	0.0033	7				I(0)
Ethiopia	Energy	-1.8890	0.6343	0	-4.9390	0.0004	0	I(1)
	GDP	-1.9741	0.5905	0	-5.1641	0.0002	0	I(1)
Gabon	Energy	-1.9249	0.6160	0	-4.7846	0.0007	0	I(1)
	GDP	-2.8988	0.1774	0	-3.8561	0.0067	0	I(1)
Ghana	Energy	-1.4832	0.8104	2	-5.0192	0.0004	1	I(1)
	GDP	-1.0917	0.9087	6	-4.0831	0.0039	0	I(1)
Gibraltar	Energy	-2.0685	0.5383	3	-2.9393	0.0545	2	I(1)
	GDP	-2.1901	0.4750	3	-2.8111	0.0710	3	I(1)
Guatemala	Energy	-1.1847	0.8950	0	-4.6889	0.0008	0	I(1)
	GDP	-2.7959	0.2110	3	-1.7888	0.3770	3	I(2)
Haiti	Energy	-1.9667	0.5943	0	-4.9185	0.0005	0	I(1)
	GDP	-1.7539	0.7006	0	-4.8133	0.0006	0	I(1)
Honduras	Energy	-3.8715	0.0272	1	-5.5574	0.0001	1	I(1)
	GDP	-2.3014	0.4201	0	-4.0900	0.0038	0	I(1)

Table 6 continued

Countries	Variables	ADF Test			ADF Test			Results
		Level	P-value*	Lags**	Difference	P-value*	Lags**	
Hong Kong	Energy	-4.7080	0.0062	8				I(0)
	GDP	-1.0416	0.9219	0	-4.3534	0.0020	0	I(1)
India	Energy	-2.0459	0.5528	0	-5.5759	0.0001	0	I(1)
	GDP	-2.5040	0.3239	0	-5.8403	0.0000	0	I(1)
Indonesia	Energy	-2.9675	0.1596	3	-3.8977	0.0063	1	I(1)
	GDP	-1.7832	0.6858	1	-3.7955	0.0078	0	I(1)
Iran	Energy	-4.6108	0.0054	2				I(0)
	GDP	-0.8745	0.9435	4	-3.0391	0.0438	1	I(1)
Iraq	Energy	-1.6020	0.7673	0	-4.2979	0.0023	0	I(1)
	GDP	-1.7948	0.6811	0	-4.2100	0.0028	0	I(1)
Israel	Energy	-1.0112	0.9268	0	-3.1983	0.0308	0	I(1)
	GDP	-2.4903	0.3287	8	-4.6898	0.0008	0	I(1)
Jamaica	Energy	-1.6282	0.7565	0	-5.6173	0.0001	0	I(1)
	GDP	-3.0295	0.1423	1	-5.2891	0.0002	0	I(1)
Jordan	Energy	-1.3429	0.8562	0	-5.1623	0.0003	0	I(1)
	GDP	-2.8031	0.2082	2	-4.4417	0.0016	0	I(1)
Kenya	Energy	-1.7136	0.7192	0	-5.2909	0.0002	0	I(1)
	GDP	0.5674	0.9988	6	-3.1274	0.0363	1	I(1)
Kuwait	Energy	-3.2970	0.0874	1	-5.0663	0.0003	1	I(1)
	GDP	-1.6198	0.7600	0	-4.2772	0.0024	0	I(1)
Lebanon	Energy	-2.8528	0.1923	2	-3.9442	0.0058	2	I(1)
	GDP	-2.0595	0.5457	0	-6.5626	0.0000	0	I(1)
Libya	Energy	-2.6737	0.2553	7	-2.1006	0.2460	2	I(2)
	GDP	-2.0563	0.5456	2	-3.2834	0.0259	1	I(1)
Malaysia	Energy	-2.7288	0.2332	0	-4.8246	0.0006	0	I(1)
	GDP	-2.5158	0.3186	1	-4.2470	0.0026	0	I(1)
Malta	Energy	-3.9189	0.0241	0	-8.8148	0.0000	0	I(1)
	GDP	-8.3491	0.0000	3				I(0)
Morocco	Energy	-2.3260	0.4078	0	-5.3512	0.0002	0	I(1)
	GDP	-2.8484	0.1928	0	-9.2053	0.0000	0	I(1)
Mozambique	Energy	-3.6876	0.0395	8	-6.5758	0.0000	0	I(1)
	GDP	-1.5995	0.7674	1	-2.9501	0.0523	0	I(1)

Table 6 continued

Countries	Variables	ADF Test			ADF Test			Results
		Level	P-value*	Lags**	Difference	P-value*	Lags**	
Myanmar	Energy	-2.1106	0.5187	0	-5.1265	0.0003	0	I(1)
	GDP	-3.2865	0.0907	3	-3.1263	0.0360	0	I(1)
Nepal	Energy	-37.2393	0.0000	8				I(0)
	GDP	-1.4462	0.8230	2	-6.0910	0.0000	1	I(1)
Nicaragua	Energy	-1.5939	0.7706	0	-4.9256	0.0005	0	I(1)
	GDP	-1.2128	0.8889	0	-4.4170	0.0017	0	I(1)
Nigeria	Energy	-1.9567	0.5995	0	-5.9416	0.0000	0	I(1)
	GDP	-3.2370	0.0994	0	-2.2479	0.1956	3	I(2)
Oman	Energy	-3.7567	0.0347	1	-3.7900	0.0081	1	I(1)
	GDP	-2.5363	0.3097	1	-4.1639	0.0032	0	I(1)
Pakistan	Energy	-2.2679	0.4370	0	-5.0568	0.0003	0	I(1)
	GDP	-0.6914	0.9643	0	-5.1313	0.0003	0	I(1)
Panama	Energy	-0.9983	0.9288	0	-4.3358	0.0021	0	I(1)
	GDP	-2.7627	0.2215	1	-3.8408	0.0070	0	I(1)
Paraguay	Energy	-5.0084	0.0023	3				I(0)
	GDP	-2.0002	0.5760	1	-1.3717	0.5779	5	I(2)
Peru	Energy	-1.1880	0.8944	0	-4.2207	0.0027	0	I(1)
	GDP	-2.6902	0.2476	1	-3.7254	0.0092	0	I(1)
Philippines	Energy	-1.8425	0.6578	0	-5.0152	0.0004	0	I(1)
	GDP	-3.0747	0.1315	1	-3.5294	0.0149	1	I(1)
Qatar	Energy	-2.8476	0.1954	5	-6.6065	0.0000	0	I(1)
	GDP	-0.5003	0.9776	0	-4.8321	0.0006	0	I(1)
Romania	Energy	-2.2673	0.4368	1	-3.0639	0.0412	0	I(1)
	GDP	-2.5804	0.2910	1	-2.1754	0.2190	0	I(2)
Saudi Arabia	Energy	-1.3751	0.8470	0	-2.7857	0.0732	0	I(1)
	GDP	-2.9177	0.1718	0	-4.0378	0.0043	0	I(1)
Senegal	Energy	-1.5231	0.7979	0	-5.7903	0.0001	0	I(1)
	GDP	-2.5050	0.3235	0	-5.7881	0.0001	1	I(1)
Singapore	Energy	-1.6829	0.7330	0	-4.0632	0.0040	0	I(1)
	GDP	-3.3648	0.0767	1	-4.9351	0.0005	1	I(1)
Sri Lanka	Energy	-1.9090	0.6241	0	-6.6185	0.0000	0	I(1)
	GDP	-1.2684	0.8751	1	-7.0105	0.0000	0	I(1)

Table 6 continued

Countries	Variables	ADF Test			ADF Test			Results
		Level	P-value*	Lags**	Difference	P-value*	Lags**	
Sudan [a]	Energy	-1.7105	0.7206	0	-6.8386	0.0000	0	I(1)
	GDP	-0.5555	0.9743	0	-3.5051	0.0154	0	I(1)
Taiwan	Energy	-6.0264	0.0002	4				I(0)
	GDP	-1.8211	0.6683	0	-4.5818	0.0011	0	I(1)
Tanzania	Energy	-1.6592	0.7433	0	-5.4113	0.0001	0	I(1)
	GDP	-1.4747	0.8143	1	-3.8356	0.0070	0	I(1)
Thailand	Energy	-1.3133	0.8643	0	-4.2430	0.0026	0	I(1)
	GDP	-2.2103	0.4660	1	-3.0918	0.0388	0	I(1)
Togo	Energy	-1.9225	0.6172	0	-5.8002	0.0000	0	I(1)
	GDP	-2.8857	0.1813	0	-5.5197	0.0001	0	I(1)
Trinidad & Tobago	Energy	-2.4282	0.3585	0	-5.6512	0.0001	0	I(1)
	GDP	-2.6314	0.2705	2	-1.5643	0.4866	1	I(2)
Tunisia	Energy	-2.1734	0.4858	0	-4.5835	0.0011	0	I(1)
	GDP	-3.4946	0.0588	0	-8.4201	0.0000	0	I(1)
United Arab Emirates	Energy	-2.2657	0.4381	0	-7.3463	0.0000	0	I(1)
	GDP	-3.1161	0.1215	0	-4.9864	0.0004	0	I(1)
Uruguay	Energy	-2.0444	0.5528	1	-3.0513	0.0423	0	I(1)
	GDP	-3.1155	0.1222	1	-3.9347	0.0059	2	I(1)
Venezuela	Energy	-3.3248	0.0822	0	-4.3737	0.0019	0	I(1)
	GDP	-1.9141	0.6215	0	-4.8757	0.0005	0	I(1)
Vietnam	Energy	-1.6804	0.7341	0	-4.9794	0.0004	0	I(1)
	GDP	-0.7635	0.9574	1	-4.5692	0.0011	0	I(1)
Yemen	Energy	-1.3213	0.8606	2	-5.0733	0.0003	0	I(1)
	GDP	-2.3018	0.4194	1	-4.1295	0.0034	0	I(1)
Zambia	Energy	-1.5054	0.8043	0	-5.4495	0.0001	0	I(1)
	GDP	-3.6770	0.0404	0	-6.1437	0.0000	1	I(1)
Zimbabwe	Energy	-1.6810	0.7338	0	-5.7088	0.0001	0	I(1)
	GDP	-4.1251	0.0166	3	-3.7329	0.0105	5	I(1)

Note:

Data for most countries covers the period 1971-2000 other than:

[a] where data covers the period 1976-2000.

*MacKinnon (1996) one-sided p-values.

** Based on SIC.

Table 7 : Cointegration Tests for Non-OECD Countries

Countries	Year	Lags	Hyphotheses		Johansen Test statistics						Cointegration	Note
			H0	H1	Trace	5%	1%	Max-eigen	5%	1%	accepted?	
Albania	1971-2000	1	r = 0	r > 0	10.94	15.41	20.04	9.24	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	1.70	3.76	6.65	1.70	3.76	6.65		
Algeria	1971-2000	1	r = 0	r > 0	19.46	15.41	20.04	12.64	14.07	18.63	No	Trace test indicates 2 cointegrating equations at 5% level and no cointegration at 1% level.
			r < or = 1	r > 1	6.82	3.76	6.65	6.82	3.76	6.65		Max-eigenvalue test indicates no cointegration at both 5% and 1% levels.
Angola	1971-2000	1	r = 0	r > 0	11.16	15.41	20.04	10.98	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.18	3.76	6.65	0.18	3.76	6.65		
Argentina	1971-2000	1	r = 0	r > 0	4.91	15.41	20.04	3.84	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	1.07	3.76	6.65	1.07	3.76	6.65		
Bahrain	1971-2000											Not applicable given unit root tests.
Bangladesh	1971-2000	1	r = 0	r > 0	9.67	15.41	20.04	9.13	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.54	3.76	6.65	0.54	3.76	6.65		
Benin	1971-2000	1	r = 0	r > 0	9.02	15.41	20.04	7.97	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	1.05	3.76	6.65	1.05	3.76	6.65		
Bolivia	1971-2000	1	r = 0	r > 0	10.62	15.41	20.04	7.10	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	3.52	3.76	6.65	3.52	3.76	6.65		
Brazil	1971-2000	1	r = 0	r > 0	18.11	15.41	20.04	17.00	14.07	18.63	Yes	Both tests indicate 1 cointegrating equation at 5% level and no cointegration at 1% level.
			r < or = 1	r > 1	1.12	3.76	6.65	1.12	3.76	6.65		
Brunei	1971-2000	1	r = 0	r > 0	9.97	15.41	20.04	6.51	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	3.46	3.76	6.65	3.46	3.76	6.65		
Bulgaria	1971-2000	1	r = 0	r > 0	10.47	15.41	20.04	6.25	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	4.22	3.76	6.65	4.22	3.76	6.65		
Cameroon	1971-2000	1	r = 0	r > 0	5.14	15.41	20.04	4.88	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.26	3.76	6.65	0.26	3.76	6.65		
Chile	1971-2000	1	r = 0	r > 0	18.96	15.41	20.04	18.96	14.07	18.63	Yes	Trace test indicates 1 cointegrating equation at 5% level and no cointegration at 1% level.
			r < or = 1	r > 1	0.00	3.76	6.65	0.00	3.76	6.65		Max-eigenvalue test indicates 1 cointegrating equation at both 5% and 1% levels.

Table 7 : Continued

Countries	Year	Lags	Hyphotheses		Johansen Test statistics						Cointegration	Note
			H0	H1	Trace	5%	1%	Max-eigen	5%	1%	accepted?	
China	1971-2000	1	r = 0	r > 0	7.93	15.41	20.04	7.39	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.54	3.76	6.65	0.54	3.76	6.65		
Colombia	1971-2000	1	r = 0	r > 0	11.82	15.41	20.04	8.64	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	3.18	3.76	6.65	3.18	3.76	6.65		
Congo	1971-2000	1	r = 0	r > 0	9.27	15.41	20.04	6.39	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	2.88	3.76	6.65	2.88	3.76	6.65		
Congo Rep.	1971-2000	1	r = 0	r > 0	9.23	15.41	20.04	9.07	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.16	3.76	6.65	0.16	3.76	6.65		
Costa Rica	1971-2000	1	r = 0	r > 0	13.44	15.41	20.04	13.29	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.15	3.76	6.65	0.15	3.76	6.65		
Cote d'Ivoire	1971-2000	1	r = 0	r > 0	4.76	15.41	20.04	4.26	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.50	3.76	6.65	0.50	3.76	6.65		
Cuba	1971-2000	1	r = 0	r > 0	7.46	15.41	20.04	5.05	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	2.41	3.76	6.65	2.41	3.76	6.65		
Cyprus	1971-2000	1	r = 0	r > 0	14.10	15.41	20.04	14.10	14.07	18.63	No	Trace test indicates no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.00	3.76	6.65	0.00	3.76	6.65		Max-eigenvalue test indicates 1 cointegrating equation at 5% level and no cointegration at 1% level.
Dominican Rep.	1971-2000	1	r = 0	r > 0	11.83	15.41	20.04	10.34	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	1.49	3.76	6.65	1.49	3.76	6.65		
Ecuador	1971-2000											Not applicable given unit root tests.
Egypt	1971-2000	1	r = 0	r > 0	4.06	15.41	20.04	3.04	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	1.01	3.76	6.65	1.01	3.76	6.65		
El Salvador	1971-2000											Not applicable given unit root tests.
Ethiopia	1971-2000	1	r = 0	r > 0	13.78	15.41	20.04	10.95	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	2.83	3.76	6.65	2.83	3.76	6.65		

Table 7 : Continued

Countries	Year	Lags	Hyphotheses		Johansen Test statistics						Cointegration	Note
			H0	H1	Trace	5%	1%	Max-eigen	5%	1%	accepted?	
Gabon	1971-2000	1	r = 0	r > 0	17.36	15.41	20.04	12.49	14.07	18.63	No	Trace test indicates 2 cointegrating equations at 5% level and no cointegration at 1% level.
			r < or = 1	r > 1	4.87	3.76	6.65	4.87	3.76	6.65		Max-eigenvalue test indicates no cointegration at both 5% and 1% levels.
Ghana	1971-2000	1	r = 0	r > 0	18.43	15.41	20.04	13.61	14.07	18.63	No	Trace test indicates 2 cointegrating equations at 5% level and no cointegration at 1% level.
			r < or = 1	r > 1	4.82	3.76	6.65	4.82	3.76	6.65		Max-eigenvalue test indicates no cointegration at both 5% and 1% levels.
Gibraltar	1971-2000	1	r = 0	r > 0	13.68	15.41	20.04	13.63	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.04	3.76	6.65	0.04	3.76	6.65		
Guatemala	1971-2000	1	r = 0	r > 0	24.91	15.41	20.04	18.38	14.07	18.63	No	Both tests indicate 2 cointegrating equations at 5% level.
			r < or = 1	r > 1	6.53	3.76	6.65	6.53	3.76	6.65		Trace test indicates 1 cointegrating equation at 1% level & Max-eigenvalue test indicates no cointegration at 1% level.
Haiti	1971-2000	1	r = 0	r > 0	12.74	15.41	20.04	11.35	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	1.39	3.76	6.65	1.39	3.76	6.65		
Honduras	1971-2000	1	r = 0	r > 0	10.43	15.41	20.04	9.66	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.77	3.76	6.65	0.77	3.76	6.65		
Hong Kong	1971-2000											Not applicable given unit root tests.
India	1971-2000	1	r = 0	r > 0	7.93	15.41	20.04	5.37	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	2.56	3.76	6.65	2.56	3.76	6.65		
Indonesia	1971-2000	1	r = 0	r > 0	4.79	15.41	20.04	3.74	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	1.05	3.76	6.65	1.05	3.76	6.65		
Iran	1971-2000											Not applicable given unit root tests.
Iraq	1971-2000	1	r = 0	r > 0	12.44	15.41	20.04	8.60	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	3.85	3.76	6.65	3.85	3.76	6.65		
Israel	1971-2000	1	r = 0	r > 0	9.75	15.41	20.04	9.23	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.52	3.76	6.65	0.52	3.76	6.65		
Jamaica	1971-2000	1	r = 0	r > 0	18.60	15.41	20.04	13.07	14.07	18.63	No	Trace test indicates 2 cointegrating equations at 5% level and no cointegration at 1% level.
			r < or = 1	r > 1	5.53	3.76	6.65	5.53	3.76	6.65		Max-eigenvalue test indicates no cointegration at both 5% and 1% levels.

Table 7 : Continued

Countries	Year	Lags	Hyphotheses		Johansen Test statistics						Cointegration accepted?	Note
			H0	H1	Trace	5%	1%	Max-eigen	5%	1%		
Jordan	1971-2000	1	r = 0	r > 0	21.11	15.41	20.04	16.64	14.07	18.63	No	Both tests indicate 2 cointegrating equations at 5% level.
			r < or = 1	r > 1	4.47	3.76	6.65	4.47	3.76	6.65		Trace test indicates 1 cointegrating equation at 1% level & Max-eigenvalue test indicates no cointegration at 1% level.
Kenya	1971-2000	1	r = 0	r > 0	3.52	15.41	20.04	3.10	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.42	3.76	6.65	0.42	3.76	6.65		
Kuwait	1971-2000	1	r = 0	r > 0	14.92	15.41	20.04	9.12	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	5.80	3.76	6.65	5.80	3.76	6.65		
Lebanon	1971-2000	1	r = 0	r > 0	6.09	15.41	20.04	4.61	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	1.48	3.76	6.65	1.48	3.76	6.65		
Libya	1971-2000	1	r = 0	r > 0	17.21	15.41	20.04	11.98	14.07	18.63	No	Trace test indicates 2 cointegrating equations at 5% level and no cointegration at 1% level.
			r < or = 1	r > 1	5.23	3.76	6.65	5.23	3.76	6.65		Max-eigenvalue test indicates no cointegration at both 5% and 1% levels.
Malaysia	1971-2000	1	r = 0	r > 0	10.63	15.41	20.04	10.62	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.01	3.76	6.65	0.01	3.76	6.65		
Malta	1971-2000											Not applicable given unit root tests.
Morocco	1971-2000	1	r = 0	r > 0	7.73	15.41	20.04	5.59	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	2.14	3.76	6.65	2.14	3.76	6.65		
Mozambique	1971-2000	1	r = 0	r > 0	11.30	15.41	20.04	8.75	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	2.55	3.76	6.65	2.55	3.76	6.65		
Myanmar	1971-2000	3	r = 0	r > 0	20.59	15.41	20.04	20.59	14.07	18.63	Yes	Bost tests indicate 1 cointegrating equation at both 5% and 1% levels.
			r < or = 1	r > 1	0.00	3.76	6.65	0.00	3.76	6.65		
Nepal	1971-2000											Not applicable given unit root tests.
Nicaragua	1971-2000	1	r = 0	r > 0	10.40	15.41	20.04	8.22	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	2.18	3.76	6.65	2.18	3.76	6.65		
Nigeria	1971-2000	1	r = 0	r > 0	3.98	15.41	20.04	3.22	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.75	3.76	6.65	0.75	3.76	6.65		

Table 7 : Continued

Countries	Year	Lags	Hyphotheses		Johansen Test statistics						Cointegration	Note
			H0	H1	Trace	5%	1%	Max-eigen	5%	1%	accepted?	
Oman	1971-2000	1	r = 0	r > 0	19.35	15.41	20.04	17.28	14.07	18.63	Yes	Both tests indicate 1 cointegrating equation at 5% level and no cointegration at 1% level.
			r < or = 1	r > 1	2.07	3.76	6.65	2.07	3.76	6.65		
Pakistan	1971-2000	1	r = 0	r > 0	14.24	15.41	20.04	11.37	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	2.87	3.76	6.65	2.87	3.76	6.65		
Panama	1971-2000	1	r = 0	r > 0	6.09	15.41	20.04	4.65	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	1.44	3.76	6.65	1.44	3.76	6.65		
Paraguay	1971-2000											Not applicable given unit root tests.
Peru	1971-2000	1	r = 0	r > 0	11.81	15.41	20.04	10.26	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	1.54	3.76	6.65	1.54	3.76	6.65		
Philippines	1971-2000	2	r = 0	r > 0	20.98	15.41	20.04	14.58	14.07	18.63	No	Bost tests indicate 2 cointegrating equations at 5% level.
			r < or = 1	r > 1	6.40	3.76	6.65	6.40	3.76	6.65		Trace test indicates 1 cointegrating equation at 1% level & Max-eigenvalue test indicates no cointegration at 1% level.
Qatar	1971-2000	1	r = 0	r > 0	13.39	15.41	20.04	9.53	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	3.87	3.76	6.65	3.87	3.76	6.65		
Romania	1971-2000	1	r = 0	r > 0	10.27	15.41	20.04	9.31	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.96	3.76	6.65	0.96	3.76	6.65		
Saudi Arabia	1971-2000	1	r = 0	r > 0	24.84	15.41	20.04	15.87	14.07	18.63	No	Trace test indicates 2 cointegrating equations at both 5% and 1% levels.
			r < or = 1	r > 1	8.97	3.76	6.65	8.97	3.76	6.65		Max-eigenvalue test indicates 2 cointegrating equations at 5% level and no cointegration at 1% level.
Senegal	1971-2000	1	r = 0	r > 0	14.88	15.41	20.04	13.48	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	1.40	3.76	6.65	1.40	3.76	6.65		
Singapore	1971-2000	1	r = 0	r > 0	8.34	15.41	20.04	5.79	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	2.54	3.76	6.65	2.54	3.76	6.65		
Sri Lanka	1971-2000	1	r = 0	r > 0	9.33	15.41	20.04	9.09	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.23	3.76	6.65	0.23	3.76	6.65		
Sudan	1976-2000	3	r = 0	r > 0	16.84	15.41	20.04	15.51	14.07	18.63	Yes	Bost tests indicate 1 cointegrating equation at both 5% and 1% levels.
			r < or = 1	r > 1	1.33	3.76	6.65	1.33	3.76	6.65		

Table 7 : Continued

Countries	Year	Lags	Hyphotheses		Johansen Test statistics						Cointegration	Note
			H0	H1	Trace	5%	1%	Max-eigen	5%	1%	accepted?	
Taiwan	1971-2000											Not applicable given unit root tests.
Tanzania	1971-2000	1	r = 0	r > 0	6.43	15.41	20.04	5.16	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	1.27	3.76	6.65	1.27	3.76	6.65		
Thailand	1971-2000	1	r = 0	r > 0	6.97	15.41	20.04	4.51	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	2.47	3.76	6.65	2.47	3.76	6.65		
Togo	1971-2000	1	r = 0	r > 0	8.15	15.41	20.04	6.03	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	2.12	3.76	6.65	2.12	3.76	6.65		
Trinidad &	1971-2000	3	r = 0	r > 0	23.90	15.41	20.04	22.82	14.07	18.63	Yes	Bost tests indicate 1 cointegrating equation at both 5% and 1% levels.
Tobago			r < or = 1	r > 1	1.08	3.76	6.65	1.08	3.76	6.65		
Tunisia	1971-2000	1	r = 0	r > 0	16.32	15.41	20.04	15.79	14.07	18.63	Yes	Bost tests indicate 1 cointegrating equation at 5% level and no cointegration at 1% level.
			r < or = 1	r > 1	0.53	3.76	6.65	0.53	3.76	6.65		
United Arab	1971-2000	1	r = 0	r > 0	14.85	15.41	20.04	12.80	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
Emirates			r < or = 1	r > 1	2.05	3.76	6.65	2.05	3.76	6.65		
Uruguay	1971-2000	1	r = 0	r > 0	12.94	15.41	20.04	8.99	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	3.95	3.76	6.65	3.95	3.76	6.65		
Venezuela	1971-2000	1	r = 0	r > 0	31.78	15.41	20.04	22.58	14.07	18.63	No	Both tests indicate 2 cointegrating equations at both 5% and 1% levels.
			r < or = 1	r > 1	9.20	3.76	6.65	9.20	3.76	6.65		
Vietnam	1971-2000	1	r = 0	r > 0	9.76	15.41	20.04	8.75	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	1.01	3.76	6.65	1.01	3.76	6.65		
Yemen	1971-2000	1	r = 0	r > 0	19.54	15.41	20.04	17.70	14.07	18.63	Yes	Bost tests indicate 1 cointegrating equation at 5% level and no cointegration at 1% level.
			r < or = 1	r > 1	1.84	3.76	6.65	1.84	3.76	6.65		
Zambia	1971-2000	1	r = 0	r > 0	5.86	15.41	20.04	3.55	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	2.31	3.76	6.65	2.31	3.76	6.65		
Zimbabwe	1971-2000	1	r = 0	r > 0	13.89	15.41	20.04	13.50	14.07	18.63	No	Bost tests indicate no cointegration at both 5% and 1% levels.
			r < or = 1	r > 1	0.38	3.76	6.65	0.38	3.76	6.65		

Table 8 :Causality results for non-OECD Countries

Countries	Year	Cointegration Results	Direction of Causality	FPE(m*) [a]	FPE(m*,n*) [a]	T1	T2	m*	n*	SSE(m*)	SSE(m*,n*)	F-HSIAO	F-Restrict	Wald-test	d.f	P-value	t-test(long-run)				Joint F-test (short-run)			Causality Results				Note
																	cof.	st.	t-stat	p-value	F-stat	df.	p-value	E--->Y	Y--->E	E<--->Y	E----Y	
Albania	1971-2000	No	Y = f (E)	0.006569	0.007060	27	27	2	1	0.1419	0.1414	0.0748	0.0748	0.0748	(1, 23)	0.7869												
			E = f (Y)	0.032800	0.031646	28	28	1	1	0.7960	0.7146	2.8461	2.8461	2.8461	(1, 25)	0.1040									√			
Algeria	1971-2000	No	Y = f (E)	0.000762	0.000763	27	27	2	1	0.0165	0.0153	1.7825	1.7825	1.7825	(1, 23)	0.1949												
			E = f (Y)	0.002849	0.002571	28	23	1	6	0.0691	0.0286	3.5414	3.5414	2.7214	(6, 15)	0.0542									√			
Angola	1971-2000	No	Y = f (E)	0.006488	0.005730	28	28	1	1	0.1574	0.1294	5.4205	5.4205	5.4205	(1, 25)	0.0283												
			E = f (Y)	0.072987	0.062262	28	28	1	1	1.7712	1.4059	6.4948	6.4948	6.4948	(1, 25)	0.0173										√		
Agentina	1971-2000	No	Y = f (E)	0.032088	0.031004	28	27	1	2	0.7787	0.6211	2.9181	2.9181	2.9077	(2, 23)	0.0748												
			E = f (Y)	0.001404	0.001373	28	27	1	2	0.0341	0.0275	2.7480	2.7480	1.6715	(2, 23)	0.2100										√			Although tests only accept Y → E causality at 21% level.
Bahrain	1971-2000	No	Y = f (E)	0.003474	0.003708	24	24	5	1	0.0500	0.0488	0.4263	0.4263	0.4263	(1, 17)	0.5225												
			E = f (Y)	0.003392	0.003611	26	26	3	1	0.0647	0.0636	0.3567	0.3567	0.3567	(1, 21)	0.5568											√	
Bangladesh	1971-2000	No	Y = f (E)	0.000247	0.000227	23	23	6	6	0.0030	0.0015	1.8069	1.8069	1.8069	(6, 10)	0.1948												
			E = f (Y)	0.000883	0.000912	28	28	1	1	0.0214	0.0206	1.0109	1.0109	1.0109	(1, 25)	0.3243								√				Although tests only accept E → Y causality at 19% level.
Benin	1971-2000	No	Y = f (E)	0.001315	0.001411	28	28	1	1	0.0319	0.0319	0.0335	0.0335	0.0335	(1, 25)	0.8563												
			E = f (Y)	0.324267	0.345734	28	28	1	1	7.8689	7.8069	0.1985	0.1985	0.1985	(1, 25)	0.6598											√	
Bolivia	1971-2000	No	Y = f (E)	0.001043	0.001104	28	28	1	1	0.0253	0.0249	0.3812	0.3812	0.3812	(1, 25)	0.5425												
			E = f (Y)	0.004546	0.004114	28	25	1	4	0.1103	0.0630	3.5636	3.5636	2.5677	(4, 19)	0.0714									√			
Brazil	1971-2000	Yes	Y = f (E)	0.001633	0.000977	27	24	2	5	0.0353	0.0107	5.7741	5.7741	4.8634	(6, 15)	0.0060	-0.5547	0.1540	-3.6017	0.0026	4.3548	(5, 15)	0.0120					
			E = f (Y)	0.000521	0.000137	28	25	1	4	0.0126	0.0019	19.9554	19.9554	17.7336	(5, 18)	0.0000	-0.0480	0.0075	-6.3790	0.0000	15.8682	(4, 18)	0.0000			√		
Brunei	1971-2000	No	Y = f (E)	0.004955	0.002844	24	24	5	5	0.0713	0.0254	4.7175	4.7175	4.7175	(5, 13)	0.0112												
			E = f (Y)	0.009040	0.008988	28	28	1	1	0.2194	0.2029	2.0234	2.0234	2.0234	(1, 25)	0.1672										√			Although tests only accept Y → E causality at 17% level.
Bulgaria	1971-2000	No	Y = f (E)	0.001976	0.002086	28	28	1	1	0.0479	0.0471	0.4446	0.4446	0.4446	(1, 25)	0.5110												
			E = f (Y)	0.008537	0.005596	28	28	1	1	0.2072	0.1264	15.9848	15.9848	15.9848	(1, 25)	0.0005									√			
Cameroon	1971-2000	No	Y = f (E)	0.004326	0.004586	26	26	3	1	0.0825	0.0808	0.4433	0.4433	0.4433	(1, 21)	0.5128												
			E = f (Y)	0.097313	0.100601	28	28	1	1	2.3615	2.2716	0.9885	0.9885	0.9885	(1, 25)	0.3296											√	
Chile	1971-2000	Yes	Y = f (E)	0.002541	0.002437	25	25	4	1	0.0423	0.0343	2.1220	2.1220	2.1220	(2, 18)	0.1488	-0.3384	0.2824	-1.1982	0.2464	2.2202	(1, 18)	0.1535					
			E = f (Y)	0.001738	0.002012	25	25	4	1	0.0290	0.0283	0.2153	0.2153	0.2153	(2, 18)	0.8083	-0.2463	0.3885	-0.6340	0.5340	0.1401	(1, 18)	0.7125	√				Although tests only accept E → Y causality at 15% level.

Table 8 :Continued

Countries	Year	Cointegration Results	Direction of Causality	FPE(m*) [a]	FPE(m*,n*) [a]	T1	T2	m*	n*	SSE(m*)	SSE(m*,n*)	F-HSIAO	F-Restrict	Wald-test	d.f	P-value	t-test(long-run)				Joint F-test (short-run)			Causality Results				Note
																	cof.	st.	t-stat	p-value	F-stat	df.	p-value	E--->Y	Y--->E	E<--->Y	E----Y	
China	1971-2000	No	Y = f (E)	0.000714	0.000781	24	24	5	1	0.0103	0.0103	0.0001	0.0001	0.0001	(1, 17)	0.9938											√	
			E = f (Y)	0.006076	0.006527	28	28	1	1	0.1475	0.1474	0.0099	0.0099	0.0099	(1, 25)	0.9215												
Colombia	1971-2000	No	Y = f (E)	0.000442	0.000374	28	23	1	6	0.0107	0.0042	3.9502	3.9502	3.3302	(6, 15)	0.0274								√				
			E = f (Y)	0.000686	0.000721	26	26	3	2	0.0131	0.0117	1.1636	1.1636	1.1636	(2, 20)	0.3326												
Congo	1971-2000	No	Y = f (E)	0.004018	0.004315	28	28	1	1	0.0975	0.0974	0.0182	0.0182	0.0182	(1, 25)	0.8937											√	
			E = f (Y)	0.033755	0.036205	28	28	1	1	0.8191	0.8175	0.0486	0.0486	0.0486	(1, 25)	0.8272												
Congo Rep.	1971-2000	No	Y = f (E)	0.003753	0.003654	24	24	5	1	0.0540	0.0481	2.1048	2.1048	2.1048	(1, 17)	0.1650								√				Although tests only accept E → Y causality at 17% level.
			E = f (Y)	0.250694	0.259962	28	28	1	1	6.0835	5.8701	0.9089	0.9089	0.9089	(1, 25)	0.3495												
Costa Rica	1971-2000	No	Y = f (E)	0.001247	0.001337	28	28	1	1	0.0303	0.0302	0.0459	0.0459	0.0459	(1, 25)	0.8321									√			Although tests only accept Y → E causality at 14% level.
			E = f (Y)	0.003399	0.003348	28	28	1	1	0.0825	0.0756	2.2713	2.2713	2.2713	(1, 25)	0.1443												
Cote d'Ivoire	1971-2000	No	Y = f (E)	0.002141	0.002148	28	28	1	1	0.0519	0.0485	1.7785	1.7785	1.7785	(1, 25)	0.1944											√	
			E = f (Y)	0.065013	0.069835	28	28	1	1	1.5777	1.5769	0.0117	0.0117	0.0117	(1, 25)	0.9147												
Cuba	1971-2000	No	Y = f (E)	0.004107	0.004336	28	28	1	1	0.0997	0.0979	0.4475	0.4475	0.4475	(1, 25)	0.5097									√			Although tests only accept Y → E causality at 18% level.
			E = f (Y)	0.006026	0.005997	27	27	2	1	0.1302	0.1201	1.9196	1.9196	1.9196	(1, 23)	0.1792												
Cyprus	1971-2000	No	Y = f (E)	0.000970	0.000691	23	23	6	1	0.0119	0.0077	8.2033	8.2033	8.2033	(1, 15)	0.0118								√				
			E = f (Y)	0.002035	0.002088	24	24	5	2	0.0293	0.0251	1.3565	1.3566	1.3565	(2, 16)	0.2856												
Dominican-Republic	1971-2000	No	Y = f (E)	0.001180	0.000594	27	24	2	5	0.0255	0.0071	8.2432	8.2432	8.0893	(5, 16)	0.0006								√				
			E = f (Y)	0.006224	0.006292	28	28	1	1	0.1510	0.1421	1.5741	1.5741	1.5741	(1, 25)	0.2212												
Ecuador	1971-2000	No	Y = f (E)	0.001605	0.001717	27	27	2	1	0.0347	0.0344	0.1798	0.1798	0.1798	(1, 23)	0.6754											√	
			E = f (Y)	0.002515	0.002571	28	26	1	3	0.0610	0.0453	2.4337	2.4337	2.1115	(3, 21)	0.1292												
Egypt	1971-2000	No	Y = f (E)	0.000518	0.000283	23	23	6	5	0.0063	0.0020	4.6173	4.6173	4.6173	(5, 11)	0.0162								√				
			E = f (Y)	0.003425	0.003632	27	27	2	1	0.0740	0.0728	0.3904	0.3904	0.3904	(1, 23)	0.5382												
El Salvador	1971-2000	No	Y = f (E)	0.001036	0.001087	27	27	2	1	0.0224	0.0218	0.6364	0.6364	0.6364	(1, 23)	0.4332									√			
			E = f (Y)	0.003313	0.002304	28	24	1	5	0.0804	0.0303	5.6134	5.6134	5.3602	(5, 17)	0.0039												
Ethiopia	1971-2000	No	Y = f (E)	0.005062	0.005103	27	27	2	2	0.1093	0.0947	1.6979	1.6979	1.6979	(2, 22)	0.2062									√			
			E = f (Y)	0.373281	0.329574	28	28	1	1	9.0583	7.4420	5.4296	5.4296	5.4296	(1, 25)	0.0282												

Table 8 :Continued

Countries	Year	Cointegration Results	Direction of Causality	FPE(m*) [a]	FPE(m*,n*) [a]	T1	T2	m*	n*	SSE(m*)	SSE(m*,n*)	F-HSIAO	F-Restrict	Wald-test	d.f	P-value	t-test(long-run)				Joint F-test (short-run)			Causality Results				Note
																	cof.	st.	t-stat	p-value	F-stat	df.	p-value	E--->Y	Y--->E	E<--->Y	E----Y	
Gabon	1971-2000	No	Y = f (E)	0.005902	0.006425	23	23	6	1	0.0724	0.0715	0.1892	0.1892	0.1892	(1, 15)	0.6698											√	
			E = f (Y)	0.075011	0.076499	28	28	1	1	1.8203	1.7274	1.3441	1.3441	1.3441	(1, 25)	0.2573												
Ghana	1971-2000	No	Y = f (E)	0.001210	0.001161	23	23	6	3	0.0148	0.0105	1.7790	1.7790	1.7790	(3, 13)	0.2007										√		Although tests only accept E → Y causality at 20% level.
			E = f (Y)	0.001216	0.000671	27	24	2	5	0.0263	0.0081	7.2397	7.2397	6.8577	(5, 16)	0.0013												
Gibraltar	1971-2000	No	Y = f (E)	0.000762	0.000431	23	23	6	4	0.0093	0.0035	5.0139	5.0139	5.0139	(4, 12)	0.0131										√		
			E = f (Y)	0.023985	0.021486	28	24	1	5	0.5820	0.2828	3.5980	3.5980	2.1807	(5, 17)	0.1046												
Guatemala	1971-2000	No	Y = f (E)	0.000233	0.000166	24	24	5	2	0.0034	0.0020	5.4308	5.4308	5.4308	(2, 16)	0.0158										√		Although tests only accept Y → E causality at 17% level.
			E = f (Y)	0.001640	0.001631	28	28	1	1	0.0398	0.0368	2.0144	2.0144	2.0144	(1, 25)	0.1682												
Haiti	1971-2000	No	Y = f (E)	0.002445	0.002522	28	28	1	1	0.0593	0.0570	1.0367	1.0367	1.0367	(1, 25)	0.3183											√	
			E = f (Y)	0.007673	0.008231	28	28	1	1	0.1862	0.1859	0.0430	0.0430	0.0430	(1, 25)	0.8374												
Honduras	1971-2000	No	Y = f (E)	0.001175	0.001189	28	26	1	3	0.0285	0.0209	2.5272	2.5272	0.9456	(3, 21)	0.4364											√	
			E = f (Y)	0.001125	0.001139	27	27	2	1	0.0243	0.0228	1.4987	1.4987	1.4987	(1, 23)	0.2333												
Hong Kong	1971-2000	No	Y = f (E)	0.002212	0.002220	27	27	2	2	0.0478	0.0412	1.7552	1.7552	1.7552	(2, 22)	0.1962											√	
			E = f (Y)	0.006968	0.007584	23	23	6	1	0.0855	0.0844	0.1910	0.1910	0.1910	(1, 15)	0.6683												
India	1971-2000	No	Y = f (E)	0.000995	0.001022	28	28	1	1	0.0242	0.0231	1.1741	1.1741	1.1741	(1, 25)	0.2889											√	
			E = f (Y)	0.032526	0.034665	28	28	1	1	0.7893	0.7828	0.2090	0.2090	0.2090	(1, 25)	0.6515												
Indonesia	1971-2000	No	Y = f (E)	0.001961	0.002034	28	28	1	1	0.0476	0.0459	0.9095	0.9095	0.9095	(1, 25)	0.3494											√	
			E = f (Y)	0.000303	0.000316	27	27	2	1	0.0065	0.0063	0.7119	0.7119	0.7119	(1, 23)	0.4075												
Iran	1971-2000	No	Y = f (E)	0.004694	0.002407	28	23	1	6	0.1139	0.0268	8.1315	8.1315	5.7187	(6, 15)	0.0029										√		
			E = f (Y)	0.003035	0.001882	25	25	4	2	0.0506	0.0265	8.2039	8.2039	8.2039	(2, 18)	0.0029												
Iraq	1971-2000	No	Y = f (E)	0.061925	0.066388	28	28	1	1	1.5027	1.4991	0.0604	0.0604	0.0604	(1, 25)	0.8079											√	
			E = f (Y)	0.014181	0.015188	28	28	1	1	0.3441	0.3430	0.0859	0.0859	0.0859	(1, 25)	0.7719												
Israel	1971-2000	No	Y = f (E)	0.000632	0.000391	23	23	6	1	0.0078	0.0043	11.7657	11.7657	11.7657	(1, 15)	0.0037								√				
			E = f (Y)	0.001907	0.002046	28	28	1	1	0.0463	0.0462	0.0480	0.0480	0.0480	(1, 25)	0.8283												
Jamaica	1971-2000	No	Y = f (E)	0.001205	0.001270	27	27	2	1	0.0260	0.0254	0.5237	0.5237	0.5237	(1, 23)	0.4766											√	
			E = f (Y)	0.012586	0.013058	27	27	2	1	0.2719	0.2616	0.9036	0.9036	0.9036	(1, 23)	0.3517												

Table 8 :Continued

Countries	Year	Cointegration Results	Direction of Causality	FPE(m*) [a]	FPE(m*,n*) [a]	T1	T2	m*	n*	SSE(m*)	SSE(m*,n*)	F-HSIAO	F-Restrict	Wald-test	d.f	P-value	t-test(long-run)				Joint F-test (short-run)			Causality Results				Note
																	cof.	st.	t-stat	p-value	F-stat	df.	p-value	E--->Y	Y--->E	E<--->Y	E----Y	
Jordan	1971-2000	No	Y = f (E)	0.004253	0.003862	24	24	5	5	0.0612	0.0344	2.0254	2.0254	2.0254	(5, 13)	0.1416										√		Although tests only accept E → Y causality at 14% level.
			E = f (Y)	0.007103	0.004292	24	24	5	4	0.1023	0.0424	4.9406	4.9406	4.9406	(4, 14)	0.0107												
Kenya	1971-2000	No	Y = f (E)	0.000199	0.000142	23	23	6	6	0.0024	0.0009	2.8034	2.8034	2.8034	(6, 10)	0.0723								√				
			E = f (Y)	0.086942	0.089870	28	28	1	1	2.1098	2.0293	0.9913	0.9913	0.9913	(1, 25)	0.3290												
Kuwait	1971-2000	No	Y = f (E)	0.036786	0.034843	28	27	1	2	0.8927	0.6980	3.2079	3.2079	3.1045	(2, 23)	0.0640										√		
			E = f (Y)	0.063795	0.057362	27	27	2	1	1.3780	1.1491	4.5811	4.5811	4.5811	(1, 23)	0.0432												
Lebanon	1971-2000	No	Y = f (E)	0.064214	0.060678	23	23	6	1	0.7877	0.6753	2.4969	2.4969	2.4969	(1, 15)	0.1349										√		Although tests only accept E → Y causality at 13% level and Y → E causality at 16% level
			E = f (Y)	0.020812	0.019168	26	25	3	4	0.3968	0.2469	2.5816	2.5816	1.8550	(4, 17)	0.1649												
Libya	1971-2000	No	Y = f (E)	0.004784	0.004879	25	25	4	4	0.0797	0.0574	1.5567	1.5567	1.5567	(4, 16)	0.2337											√	
			E = f (Y)	0.006985	0.006990	23	23	6	2	0.0857	0.0703	1.5269	1.5269	1.5269	(2, 14)	0.2513												
Malaysia	1971-2000	No	Y = f (E)	0.001742	0.001857	28	28	1	1	0.0423	0.0419	0.1971	0.1971	0.1971	(1, 25)	0.6609											√	
			E = f (Y)	0.001440	0.001523	25	25	4	1	0.0240	0.0233	0.5369	0.5369	0.5369	(1, 19)	0.4727												
Malta	1971-2000	No	Y = f (E)	0.000196	0.000203	25	25	4	2	0.0033	0.0029	1.2901	1.2901	1.2901	(2, 18)	0.2995											√	
			E = f (Y)	0.019472	0.020312	27	27	2	1	0.4206	0.4069	0.7742	0.7742	0.7742	(1, 23)	0.3880												
Morocco	1971-2000	No	Y = f (E)	0.001836	0.001616	28	23	1	6	0.0446	0.0180	3.6940	3.6940	1.7849	(6, 15)	0.1697										√		Although tests only accept E → Y causality at 17% level and Y → E causality at 11% level.
			E = f (Y)	0.002154	0.001919	28	23	1	6	0.0523	0.0214	3.6194	3.6194	2.1564	(6, 15)	0.1066												
Mozambique	1971-2000	No	Y = f (E)	0.005324	0.004594	28	26	1	3	0.1292	0.0809	4.1773	4.1773	2.0808	(3, 21)	0.1334										√		Although tests only accept E → Y causality at 13% level.
			E = f (Y)	0.013667	0.007687	23	23	6	2	0.1676	0.0773	8.1721	8.1721	8.1721	(2, 14)	0.0044												
Myanmar	1971-2000	Yes	Y = f (E)	0.001580	0.000206	28	23	1	6	0.0383	0.0021	35.0495	35.0495	31.7063	(7, 14)	0.0000	-0.0690	0.0212	-3.2567	0.0057	36.8678	(6, 14)	0.0000			√		
			E = f (Y)	0.139390	0.133539	28	28	1	1	3.3825	2.8043	2.4742	2.4742	2.4742	(2, 24)	0.1055	-0.1905	0.0863	-2.2076	0.0371	0.5910	(1, 24)	0.4495					
Nepal	1971-2000	No	Y = f (E)	0.000675	0.000623	27	25	2	4	0.0146	0.0088	2.9895	2.9895	2.4777	(4, 18)	0.0810								√				
			E = f (Y)	0.004637	0.004888	28	28	1	1	0.1125	0.1104	0.4910	0.4910	0.4910	(1, 25)	0.4900												
Nicaragua	1971-2000	No	Y = f (E)	0.008106	0.008641	28	28	1	1	0.1967	0.1951	0.2034	0.2034	0.2034	(1, 25)	0.6558											√	
			E = f (Y)	0.001960	0.002106	28	28	1	1	0.0476	0.0475	0.0083	0.0083	0.0083	(1, 25)	0.9283												
Nigeria	1971-2000	No	Y = f (E)	0.002216	0.002388	24	24	5	1	0.0319	0.0314	0.2549	0.2549	0.2549	(1, 17)	0.6201											√	
			E = f (Y)	0.144266	0.154971	28	28	1	1	3.5009	3.4994	0.0108	0.0108	0.0108	(1, 25)	0.9181												

Table 8 :Continued

Countries	Year	Cointegration Results	Direction of Causality	FPE(m*) [a]	FPE(m*,n*) [a]	T1	T2	m*	n*	SSE(m*)	SSE(m*,n*)	F-HSIAO	F-Restrict	Wald-test	d.f	P-value	t-test(long-run)				Joint F-test (short-run)			Causality Results				Note
																	cof.	st.	t-stat	p-value	F-stat	df.	p-value	E--->Y	Y--->E	E<--->Y	E----Y	
Oman	1971-2000	Yes	Y = f (E)	0.002266	0.002080	23	23	6	2	0.0278	0.0188	2.0587	2.0587	2.0587	(3, 13)	0.1553	-0.2515	0.1541	-1.6317	0.1267	2.9808	(2, 13)	0.0860	√				Although tests only accept E → Y causality at 16% level.
			E = f (Y)	0.025318	0.026122	26	26	3	1	0.4827	0.4245	1.3721	1.3721	1.3721	(2, 20)	0.2764	-0.2167	0.1316	-1.6464	0.1153	0.2171	(1, 20)	0.6463					
Pakistan	1971-2000	No	Y = f (E)	0.000398	0.000420	27	27	2	1	0.0086	0.0084	0.4683	0.4683	0.4683	(1, 23)	0.5006											√	
			E = f (Y)	0.000883	0.000912	28	28	1	1	0.0214	0.0206	1.0109	1.0109	1.0109	(1, 25)	0.3243													
Panama	1971-2000	No	Y = f (E)	0.002162	0.002256	27	27	2	2	0.0467	0.0419	1.2634	1.2634	1.2634	(2, 22)	0.3024									√			Although tests only accept Y → E causality at 16% level.
			E = f (Y)	0.001666	0.001649	28	28	1	1	0.0404	0.0372	2.1470	2.1470	2.1470	(1, 25)	0.1553													
Paraguay	1971-2000	No	Y = f (E)	0.001083	0.001121	28	28	1	1	0.0263	0.0253	0.9702	0.9702	0.9702	(1, 25)	0.3341									√			
			E = f (Y)	0.001040	0.000532	23	23	6	2	0.0128	0.0053	9.6973	9.6973	9.6973	(2, 14)	0.0023													
Peru	1971-2000	No	Y = f (E)	0.003532	0.003704	28	28	1	1	0.0857	0.0836	0.6239	0.6239	0.6239	(1, 25)	0.4370									√			
			E = f (Y)	0.001759	0.001560	28	28	1	1	0.0427	0.0352	5.3024	5.3024	5.3024	(1, 25)	0.0299													
Philippines	1971-2000	No	Y = f (E)	0.001060	0.000927	27	25	2	4	0.0229	0.0130	3.4094	3.4094	2.6067	(4, 18)	0.0704								√				
			E = f (Y)	0.001934	0.002073	28	28	1	1	0.0469	0.0468	0.0665	0.0665	0.0665	(1, 25)	0.7986													
Qatar	1971-2000	No	Y = f (E)	0.005522	0.005501	24	24	5	2	0.0795	0.0660	1.6368	1.6368	1.6368	(2, 16)	0.2256										√		Although tests only accept E → Y causality at 23% level.
			E = f (Y)	0.046097	0.025014	28	23	1	6	1.1186	0.2784	7.5455	7.5455	5.0836	(6, 15)	0.0049													
Romania	1971-2000	No	Y = f (E)	0.001958	0.001828	28	28	1	1	0.0475	0.0413	3.7817	3.7817	3.7817	(1, 25)	0.0631										√		
			E = f (Y)	0.007479	0.004593	28	28	1	1	0.1815	0.1037	18.7547	18.7547	18.7547	(1, 25)	0.0002													
Saudi Arabia	1971-2000	No	Y = f (E)	0.003128	0.003359	28	28	1	1	0.0759	0.0758	0.0205	0.0205	0.0205	(1, 25)	0.8872									√			
			E = f (Y)	0.011265	0.008693	28	23	1	6	0.2734	0.0967	4.5640	4.5640	3.3556	(6, 15)	0.0266													
Senegal	1971-2000	No	Y = f (E)	0.001787	0.001898	27	27	2	1	0.0386	0.0380	0.3455	0.3455	0.3455	(1, 23)	0.5624												√	
			E = f (Y)	0.047674	0.049975	28	28	1	1	1.1569	1.1285	0.6299	0.6299	0.6299	(1, 25)	0.4349													
Singapore	1971-2000	No	Y = f (E)	0.000865	0.000929	27	27	2	1	0.0187	0.0186	0.0915	0.0915	0.0915	(1, 23)	0.7650												√	
			E = f (Y)	0.003380	0.003556	28	28	1	1	0.0820	0.0803	0.5379	0.5379	0.5379	(1, 25)	0.4701													
Sri Lanka	1971-2000	No	Y = f (E)	0.000170	0.000176	27	27	2	1	0.0037	0.0035	0.9514	0.9514	0.9514	(1, 23)	0.3395												√	
			E = f (Y)	0.001198	0.001249	28	27	1	2	0.0291	0.0250	1.8648	1.8648	1.8552	(2, 23)	0.1791													
Sudan	1976-2000	Yes	Y = f (E)[#]	0.003786	0.002881	22	19	2	5	0.0633	0.0223	4.0445	4.0445	3.2850	(5, 11)	0.0466											√		
			E = f (Y)	3.257862	0.208291	23	19	1	5	62.9419	1.6123	69.7363	69.7363	64.9979	(6, 11)	0.0000	-0.0399	0.0315	-1.2668	0.2314	62.8612	(5, 11)	0.0000					

Table 8 :Continued

Countries	Year	Cointegration Results	Direction of Causality	FPE(m*) [a]	FPE(m*,n*) [a]	T1	T2	m*	n*	SSE(m*)	SSE(m*,n*)	F-HSIAO	F-Restrict	Wald-test	d.f	P-value	t-test(long-run)				Joint F-test (short-run)			Causality Results				Note
																	cof.	st.	t-stat	p-value	F-stat	df.	p-value	E--->Y	Y--->E	E<--->Y	E----Y	
Taiwan	1971-2000	No	Y = f (E)	0.000581	0.000577	24	24	5	1	0.0084	0.0076	1.7391	1.7391	1.7391	(1, 17)	0.2047										√		Although tests only accept E → Y causality at 20% level and Y → E causality at 16% level.
			E = f (Y)	0.001032	0.000975	24	24	5	3	0.0149	0.0106	1.9863	1.9863	1.9863	(3, 15)	0.1594												
Tanzania	1971-2000	No	Y = f (E)	0.000473	0.000500	28	28	1	1	0.0115	0.0113	0.3705	0.3705	0.3705	(1, 25)	0.5482											√	
			E = f (Y)	0.357694	0.377501	28	28	1	1	8.6800	8.5242	0.4570	0.4570	0.4570	(1, 25)	0.5052												
Thailand	1971-2000	No	Y = f (E)	0.001606	0.001726	28	28	1	1	0.0390	0.0390	0.0022	0.0022	0.0022	(1, 25)	0.9627									√			Although tests only accept Y → E causality at 17% level.
			E = f (Y)	0.003382	0.003362	28	28	1	1	0.0821	0.0759	2.0302	2.0302	2.0302	(1, 25)	0.1666												
Togo	1971-2000	No	Y = f (E)	0.004630	0.004924	28	28	1	1	0.1124	0.1112	0.2613	0.2613	0.2613	(1, 25)	0.6137											√	
			E = f (Y)	0.003852	0.004133	28	28	1	1	0.0935	0.0933	0.0420	0.0420	0.0420	(1, 25)	0.8393												
Trinidad & Tobago	1971-2000	Yes	Y = f (E)	0.001590	0.001333	27	27	2	1	0.0343	0.0247	4.2696	4.2696	4.2696	(2, 22)	0.0271	-0.1394	0.0613	-2.2733	0.0331	2.6036	(1, 22)	0.1209			√		
			E = f (Y)	0.011359	0.010231	26	26	3	1	0.2166	0.1663	3.0271	3.0271	3.0271	(2, 20)	0.0710	-0.0591	0.0308	-1.9172	0.0696	3.1323	(1, 20)	0.0920					
Tunisia	1971-2000	Yes	Y = f (E)	0.000802	0.000694	28	28	1	1	0.0195	0.0146	4.0090	4.0090	4.0090	(2, 24)	0.0315	-0.4119	0.1487	-2.7710	0.0106	1.1512	(1, 24)	0.2940			√		Although tests only accept Y → E causality at 14% level.
			E = f (Y)	0.003328	0.003273	28	28	1	1	0.0808	0.0687	2.1012	2.1012	2.1012	(2, 24)	0.1442	-0.3716	0.1981	-1.8753	0.0730	2.0028	(1, 24)	0.1699					
United Arab Emirates	1971-2000	No	Y = f (E)	0.008278	0.007821	27	26	2	3	0.1788	0.1271	2.7120	2.7120	2.6896	(3, 20)	0.0738										√		
			E = f (Y)	0.016037	0.008859	28	23	1	6	0.3892	0.0986	7.3677	7.3677	3.9301	(6, 15)	0.0146												
Uruguay	1971-2000	No	Y = f (E)	0.001931	0.001682	26	26	3	1	0.0368	0.0296	5.1046	5.1046	5.1046	(1, 21)	0.0346								√				
			E = f (Y)	0.001361	0.001386	28	28	1	1	0.0330	0.0313	1.3792	1.3792	1.3792	(1, 25)	0.2513												
Venezuela	1971-2000	No	Y = f (E)	0.002136	0.002293	28	28	1	1	0.0518	0.0518	0.0334	0.0334	0.0334	(1, 25)	0.8564									√			
			E = f (Y)	0.001544	0.001329	26	26	3	3	0.0294	0.0199	3.0404	3.0404	3.0404	(3, 19)	0.0542												
Vietnam	1971-2000	No	Y = f (E)	0.000835	0.000828	28	28	1	1	0.0203	0.0187	2.0832	2.0832	2.0832	(1, 25)	0.1613								√				Although tests only accept E → Y causality at 16% level.
			E = f (Y)	0.119726	0.124033	28	28	1	1	2.9054	2.8007	0.9339	0.9339	0.9339	(1, 25)	0.3431												
Yemen	1971-2000	Yes	Y = f (E) [#]	0.003228	0.002863	28	28	1	1	0.0783	0.0646	5.2939	5.2939	5.2939	(1, 25)	0.0300										√		
			E = f (Y)	0.007824	0.005968	26	26	3	1	0.1492	0.0970	5.3832	5.3832	5.3832	(2, 20)	0.0135	-0.2655	0.0885	-3.0015	0.0071	4.2729	(1, 20)	0.0519					
Zambia	1971-2000	No	Y = f (E)	0.001773	0.001890	27	27	2	1	0.0383	0.0379	0.2602	0.2602	0.2602	(1, 23)	0.6149											√	
			E = f (Y)	0.068754	0.068868	28	28	1	1	1.6684	1.5551	1.8223	1.8223	1.8223	(1, 25)	0.1891												
Zimbabwe	1971-2000	No	Y = f (E)	0.002699	0.002854	23	23	6	1	0.0331	0.0318	0.6375	0.6375	0.6375	(1, 15)	0.4371									√			
			E = f (Y)	0.036410	0.033598	28	27	1	2	0.8836	0.6731	3.5968	3.5968	3.4494	(2, 23)	0.0490												

Notes:

[#] ECM term has wrong sign so causality is tested by using Hsiao's Granger technique on the standard model.

[a] The maximum lag (m*) and lag(m*,n*) are set at 20% of total observation.

Table 9 : Summary of the integration, cointegration and causality results for non-OECD countries									
Countries	**Stage 1: Integration: I(1)**	**Stage 2: Cointegration**	**Stage 3: Causality**						
	Both energy & GDP	**Between energy & GDP**	**E ---> Y (i)**	**Y ---> E (ii)**	**E <----->Y (iii)**	**E ---- Y (iv)**	**E <==>Y (i+ii+iii)**	**E ==> Y (i+iii)**	**Y ==> E (ii+iii)**
Albania	√			√			√		√
Algeria	√			√			√		√
Angola	√				√		√	√	√
Argentina	√				√		√	√	√
Bahrain						√			
Bangladesh	(√)*		√				√	√	
Benin	√					√			
Bolivia	√			√			√		√
Brazil	√	√			√		√	√	√
Brunei	√				√		√	√	√
Bulgaria	(√)*			√			√		√
Cameroon	√					√			
Chile	√	√	√				√	√	
China	(√)*					√			
Colombia	(√)*		√				√	√	
Congo	√					√			
Congo Republic	√		√				√	√	
Costa Rica	√			√			√		√
Cote d'Ivoire	√					√			
Cuba	√			√			√		√
Cyprus	√		√				√	√	
Dominican Rep.	√		√				√	√	
Ecuador						√			
Egypt	√		√				√	√	
El Salvador				√			√		√
Ethiopia	√			√			√		√
Gabon	√					√			
Ghana	√				√		√	√	√
Gibraltar	√				√		√	√	√
Guatemala	(√)*				√		√	√	√
Haiti	√					√			
Honduras	√					√			
Hong Kong						√			
India	√					√			
Indonesia	√					√			
Iran					√		√	√	√
Iraq	√					√			
Israel	√		√				√	√	
Jamaica	√					√			
Jordan	√				√		√	√	√
Kenya	√		√				√	√	
Kuwait	√				√		√	√	√
Lebanon	√				√		√	√	√
Libya	(√)*					√			
Malaysia	√					√			
Malta						√			

Table 9 : Continued.

Countries	Stage 1: Integration: I(1)	Stage 2: Cointegration	Stage 3: Causality						
	Both energy & GDP	Between energy & GDP	E ---> Y (i)	Y ---> E (ii)	E <-----> Y (iii)	E ----- Y (iv)	E <==> Y (i+ii+iii)	E ==> Y (i+iii)	Y ==> E (ii+iii)
Morocco	√				√		√	√	√
Mozambique	√				√		√	√	√
Myanmar	√	√			√		√	√	√
Nepal			√				√	√	
Nicaragua	√					√			
Nigeria	(√)*					√			
Oman	√	√	√				√	√	
Pakistan	√					√			
Panama	√			√			√		√
Paraguay				√			√		√
Peru	√			√			√		√
Philippines	√		√				√	√	
Qatar	√				√		√	√	√
Romania	(√)*				√		√	√	√
Saudi Arabia	√			√			√		√
Senegal	√					√			
Singapore	√					√			
Sri Lanka	√					√			
Sudan [a]	√	√			√		√	√	√
Taiwan					√		√	√	√
Tanzania	√					√			
Thailand	√			√			√		√
Togo	√					√			
Trinidad & Tobago	(√)*	√			√		√	√	√
Tunisia	√	√			√		√	√	√
United Arab Em.	√				√		√	√	√
Uruguay	√		√				√	√	
Venezuela	√			√			√		√
Vietnam	√		√				√	√	
Yemen	√	√			√		√	√	√
Zambia	√					√			
Zimbabwe	√			√			√		√
Total	**60**	**8**	**14**	**15**	**22**	**27**	**51**	**36**	**37**
%	77%	10%	18%	19%	28%	35%	65%	46%	47%

Data for most countries covers the period 1971-2000 other than:

[a] where data covers the period 1976-2000.

* Either *e* or *y* were found to be I(2) with the other being I(1) or I(2) therefore cointegration was still tested.

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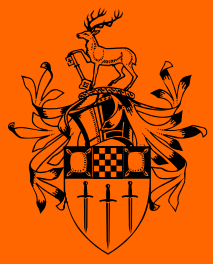

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