International Journal of Contemporary Issues in Social Sciences
Volume 3, Issue 2, 2024 ISSN(P):2959-3808 | 2959-2461

TESTING VALIDITY OF GROWTH, CONSERVATION, FEEDBACK AND NEUTRALITY HYPOTHESES FOR SELECTED SOUTH ASIAN, EAST AND PACIFIC REGION COUNTRIES

Saira Bibi*[1], Rehmat Ullah Awan[2], Falak Sher[3], Jehanzaib Khan[4]

*[1]Post-Graduate Student, Department of Economics, University of Sargodha, Sargodha, Pakistan
[2]Professor, Department of Economics, University of Sargodha, Sargodha, Pakistan
[3]Lecturer, Department of Economics, University of Sargodha, Sargodha, Pakistan
[4]Graduate Student, Department of Economics, University of Sargodha, Pakistan

Corresponding Author: *[1] sairamumtaz24@gmail.com

Received: 01 March, 2024 **Revised:** 30 March, 2024 **Accepted:** 11 April, 2024 **Published:** 25 April, 2024

ABSTRACT

Current endeavor attempts to explore the relationship of Gross Domestic Product (GDP), Gross Capital Formation(GCF), labor force(LF)and Energy Consumption(EC)in Selected South Asian; East Asian and Pacific Region for time span 1990 to 2021. Results of Breusch-Pagan LM test confirms cross-sectional dependence for lower middle income countries, upper middle income countries and high income countries. Results of co-integration tests confirms long run relationship between GDP, GCF, Labor Force and EC in selected countries. Results of FMOLS, DOLS and ARDL suggests positive and significant effect of GCF, LF and EC on GDP for Selected countries in long run. Pairwise Dumitrescu Hurlin's Panel Causality test shows Unidirectional Causality running from EC to GDP, LF to EC, Bidirectional Causality running from GCF to GDP, EC to GCF while remaining variables show neutral causality in LMIC. Pairwise Dumitrescu Hurlin's Panel causality test shows Unidirectional Causality running from Labor Force to EC while the remaining variables show neutral causality in UMIC. Pairwise Dumitrescu Hurlin's Panel causality shows Unidirectional Causality running from GDP to EC and LF, GCF to EC while the remaining variables show neutral causality in HIC. Present study suggests that government should take measures to increase labor productivity in energy sector of economy in order to promote economic growth (EG)and to improve human capital in the form of labor participation in energy sector of economy.

Key words: Gross Domestic Product, Gross Capital Formation, Labor Force, Energy Consumption
JEL Codes: Q430, J210, E1

1. INTRODUCTION

Researchers have been motivated to investigate the causes of environmental deterioration and to find the solutions of environmental degradation (Adeel-Farooq, Bakar, & Raji, 2020; Asongu & Odhiambo, 2020; Ehigiamusoe & Lean, 2019; Husaini, Lean, & Ab-Rahim, 2021). Environmental Kuznets Curve (EKC) hypothesis, developed by (Grossman & Krueger, 1991), was used in several studies. According to EKC, environmental degradation and energy growth are interlinked. This hypothesis tells that environmental deterioration tends to rise during early stages of economic expansion and decline after crossing a certain point (Ehigiamusoe & Lean, 2019; Shahbaz, Lean, & Shabbir, 2012; Tang, Shahzad, Ahmed, Ahmad, & Abbas, 2022).

Global climate change is becoming a serious threat to human health and survival. In addition to natural factors, CO_2 emissions caused by human activities are also a major driver of global warming. The best way for global community to tackle climate change has become biggest environmental problem. Developed countries were required according to Kyoto Protocol to reduce greenhouse gas emissions, and this requirement was reaffirmed at 2009 Copenhagen Climate Change Conference. effects of energy use, EG, and carbon emissions has increased globally in recent years. There exists controversy

over whether or not developing countries should bear the cost of emission reductions in context of efforts to reduce global climate deteriorations and also this issue has a significant impact on international relations (Shahbaz, Lean et al. 2012).

Energy sector is considered as a powerful natural monopoly due to its crucial contribution to economic expansion. industrial revolution has led to massive EC worldwide (Luo et al., 2019). According to concept of resource endowment, each country has a wealth of different resources that can affect the approach used to achieve desired level of economic development and progress. According to (Afia, 2019), EC is considered an essential element of human happiness since it allows us to improve our living conditions while satisfying all our essential needs. Nations have made development in their energy sector to maintain their competitiveness (Liu, Yin, & Yan, 2019). The question of relationship between energy and growth has been investigated since late 1970. Four ideas on cause and effect between energy use and EG have been explored Arminen & Menegaki(2019).

Up till the late 1980, economists paid some attention to environmental issues, but interest has recently increased. The environment in which we live is impacted by many forms of economic activity. (Du, Hanley, & Zhang, 2016). Environment is seen as a valuable resource that is necessary for efficient process of economy. It is possible that more economic activity can greatly improve people quality of life, using resources more efficiently (Barbier, 2011)

Energy is an important component for sustainable EG and sustainable development. The investigation for alternative energy sources has increased as supply of fossil fuels continue to decrease and is unable to keep up with rapidly increasing energy demand (Apaydin, Ursavaş, & Koç, 2021). According to Schiffer(2016) Efforts are being made worldwide to ensure usage of renewable energy sources, which will reducing electricity price volatility and environmental degradation. The rapid expansion of renewable energy market, new capacity, growth rates in developing countries has altered climate for the energy sector. In developing countries, fossil fuels are often used as an energy source, resulting in dual energy problem given that important energy use and maintaining energy sustainability (Ahmed et al.2019)

Natural resources are becoming scarce, so it is essential to consider how to leave original and protected environment for future generations. important research by (Grossman & Krueger, 1991) which suggested negative U-shaped relationship between income and environmental pollution, has revealed new target area for attention to environmental deprivation awareness.

Government regulatory actions, initiatives, and policies won't be sufficient to encourage environment friendly behavior and achieve environmental advantages if they are not conducted by education. By increasing awareness and inspiring individuals to maintain environment, education may influence it. It enable individuals to effectively use resources and get a deeper understanding of environmental concerns by encouraging them to reevaluate their environmentally harmful practices. Over the past 10 years, there has been a noticeable rise of interest in renewable energy. Since the late 2000's, worldwide growth of renewable energy has been at its highest rate (Apergis & Payne, 2012). Climate change is fundamental issue motivating development of renewable energy. Scientists agree that GHG emissions are the primary root of global warming, and are significantly influenced by production of fossil fuels. As a result, using fossil fuels may contribute to climate change.

Present research adds to existing literature in two regards: it, first and foremost, will be premier a work to experimentally break down connection between energy and economic development as far as testing legitimacy of previously mentioned four growth hypothesis for chose countries. Besides, concentrate likewise adds to growth hypothesis by bringing energy utilization into neoclassical growth hypothesis alongside capital and LF, particularly for chose nations.

Rest of the paper is organized as follows: Section two gives brief overview of theoretical background which covers theories on connection between energy, growth, and environmental degradation. Data and methodology is given in section 3. Section 4 consists of results and discussion. Conclusions and policy suggestions are given in section 5.

2. LITERATURE REVIEW

Theoretically, the relationship between energy and EG is described through four most current ideas such as: "growth hypothesis,

conservation hypothesis, feedback hypothesis, and neutrality hypothesis". The "growth hypothesis" is first hypothesis in which EC is a direct cause of rising GDP. The growth hypothesis assumes that there's a unidirectional causal relation between energy use and EG.

The alternate hypothesis, known as "conservation hypothesis" supposed that volume of energy employed is a result of GDP expansion. It holds that causes of EC are EG and unidirectional reason. Third is "feedback hypothesis" suggests a two-way causal link between growth and energy use. The feedback thesis states there's a bidirectional causal link between EG and energy use. The "neutrality hypothesis" is not a statistically significant link between operation of energy and growth. It holds that there's no relationship between energy use and GDP expansion.

The work that followed will be distributed and epitomized using these presuppositions. Since the publications also take into consideration different econometric approaches, but the factual results are different (Huang, Hwang, & Yang, 2008; Kasman & Duman, 2015). The empirical literature (Apergis & Payne, 2010; Aslan, Apergis, & Yildirim, 2014) supported the growth hypothesis. The feedback hypothesis which contends that growth and energy are causally in lined in both directions is also supported by (Belke, Dobnik, & Dreger, 2011). The growth hypothesis is determined by panel data analysis of 38 countries that use renewable electricity. (Apergis & Payne, 2010; Bekun, Alola, & Sarkodie, 2019; Inglesi-Lotz & Dogan, 2018) have all done research at the challenge, with mixed problems.

Arminen & Menegaki, 2019) used the simultaneous equations to observe relation among GDP, energy use, and carbon dioxide emissions in sixty seven HIC & UMIC for 1985-2011. The study considered important due to several studies on linking among energy and GDP increase which have been carried out. Bidirectional relationship confirmed in the study. The findings of (Afia, 2019) panel information used which covered forty seven specific countries among 2001 and 2014 showed that EC has enormous direct effect on GDP and significant impact on development. (Marques, Fuinhas, & Tomás, 2019) conducted a worldwide analysis for span 1970 – 2016 and in lined to North America and Asia Pacific (neutral hypothesis), Central Asia and Europe, as well as Africa and Middle East (conservation hypothesis) using ARDL.

Shahbaz, Nasir, Hille, & Mahalik, 2020) examined association between worthwhile improvements, energy use, oil costs and labor in 157 countries among 1960 and 2014. results showed that variables cointegration are significant. (Bhattacharya, Paramati, Ozturk, & Bhattacharya, 2016) tested top 38 nations that utilized renewable energy from 1991 to 2012 for panel estimate test. Results showed long- time period relationship in fifty-seven of countries studied.

Sharma, 2010 used dynamic panel information tables to examined impacts of energy and non-power elements in sixty-six nations between 1986 and 2005 and installation an advantageous link between (C.-C. Lee, 2005) energy variables and GDP increase.

First time Kraft and Kraft (1978) exactly tracks down preservation speculation in event of the US. Like, Oh and Lee (2004) in short run find unbiased hypothesis and preservation theory over time in event that investigation of Korea. Besides, a similar theory for India is likewise proved by Paul and Bhattacharya (2004) by utilizing information in time series. In like manner, Lee, (2005) explores similar causal relationship for eighteen Asian nations tracks down preservation theories in short run as well as in long run. In this association, Lee and Chang (2008) re-examines similar relationship for 16-Asian countries and tracks down co-integration.

Khan and Qayyum (2007) explore the energy use impact on economic development in chosen nations from SAARC region and track down preservation speculation around here. Similarly, Jamil and Ahmad (2011) dissect effect of energy cost and GDP on energy utilization in case of Pakistan and furthermore confirms causality between GDP to energy utilization. There are numerous observational findings that proved neutral hypothesis (Huang et al., 2008; Kasman and Duman, 2015; Narayan et al., 2010; Shahbaz and Feridun, 2012).

Exact writing additionally upholds the development hypothesis (Apergis and Payne (2009), Aslan and Yildirim (2014), Ouedraogo(2013), Ozturk et al.(2010)). There is bidirectional cointegration found between energy utilization and result of concrete Indian industry (Mandal and Madheswaran (2010). Additionally, a few investigations assist feedback hypothesis which implies bidirectional causal relationship found

between energy and growth (Belke *et al*., 2011). Zhang *et al*. (2011) track down feedback hypothesis at modern degree for Beijing. The feedback hypothesis investigates for Belgium (Dogan *et al*. 2016). Streimikiene and Kasperowicz, (2016) investigated growth hypothesis in panel information examination of 38 sustainable power purchaser states. Finally, scarcely any specialists examine neutral effect and contend for the neutral hypothesis (Kahsai *et al*. 2012).

There are two sorts of growth hypothesis in writing, endogenous and exogenous development hypothesis (Romer, 2018). The two speculations attempt to make sense of variables of development of this present reality. When their attention on total degree of investment funds as well as innovation. In this association, two schools thoroughly overlook the significance of energy in production procedure (Lee *et al*., 2005). Be that as it may, later oil emergency of 1970s, there is valid discussion among economic specialists just about worth of energy. Since oil shock hurt development cycle of oil imported countries. It was Stern, (1993) who presented energy as an extra factor in creation process. As per Stern, efficiency of energy matters for development instead of energy utilization. The economy wide not entirely settled by its workforce and accessible energy assets (Pokrovski, 2003). From writing; we can infer that strength and headings of connection among energy and economic development shift over society and over time frame. In general, writing of energy and financial development shows a few comparable outcomes by screening the time frame from 19070 to 2014. Thusly, possible justification behind this sort of results can present a few predispositions by taking on a similar procedure. Subsequently, this inventive work broadened this discussion by presenting new factors and new econometric tables on the grounds that these factors are significant for SAARC countries.

3. DATA AND METHODOLOGY

3.1 Data Sources

present study used panel data for selected South Asia, East & Pacific region countries which are: Pakistan, India, Sri Lanka, Bangladesh, China, Malaysia, Thailand, Fiji, Australia, Japan, Korean Republic, and New Zealand. These countries are divided into groups according to their income level such as HIC, UMIC and LMIC. The time span of the current study was from 1990-2021. Data for variables considered in the study has been extracted from World Development Indicator (WDI). The countries for present study analysis have been selected on the basis of EC, CO_2, and Income distribution which has to be divided by WDI. Panel data set used for analysis. Panel analysis adjusting for individual heterogeneity, Panel provide data that is more informative, more varied, less correlated, have high degrees of freedom, and more efficient. Multicollinearity is a problem that plagues time-series investigations.

Following (Ullah & Mahmood, 2020) present study proposed economic model as follows:

$$GDP = f\ (GCF, LF, EC) \quad (1)$$

The econometric model could be rewritten as follows:

$$lnGDP_{it} = \beta_0 + \beta_1 lnGCF_{it} + \beta_2 lnLF_{it} + \beta_2 lnEC_{it} + \mu_{it} \quad (2)$$

where $\ln GDP_{it}$ is natural log of real GDP per capita constant 2015 US$; $\ln EC_{it}$ is natural log of EC in million tons of oil equivalent; $\ln GCF_{it}$ is natural log GCF constant 2015 US$; $\ln LF_{it}$ is natural log of total LF; i is taken as cross-sections; t is taken as time period and μ_{it} is error term.

It is anticipated that there would be at least be a one-sided or unidirectional causal link between the two series in case of the four-growth hypothesis model (Engle & Granger, 1987). It could be growth hypothesis if the only direction of causation is through energy to economic expansion. It would be conservation hypothesis if this causal link is reversible. It would be feedback hypothesis if both contribute to one another. It would be neutral hypothesis if neither causes the other.

3.2 Methodology

Relationship between GDP and energy use the panel unit root tests. In a panel context, those tests have been proposed as an alternative to examine the causal hyperlink among electricity use and economic improvement. Because the asymptotic distribution is popular as opposed to non-ordinary, this estimation method is considered valid (Baltagi & Li, 2004). As a primary level in empirical analysis, cross-sectional dependence checked. Breusch and Pagan's Lagrange multiplier (LM) test, which has benefits over the observation in examples when there is large sample period applied in test. consequences of energy use, EG, LF and GCF are tested with cointegration. Pedroni, Kao, and Fisher's cointegration tests are

used to verify the long-term relationship between the variables. There are seven statistics for the cointegration as validated by (Pedroni, 1999). Finding reliable and unbiased estimators of outcomes subsequent after Pedroni, Kao, and Fisher Johanson's cointegration tests have shown long-term deterministic link and short-term directional convergence. At the end, use of Dumitrescu Hurlin panel method for causality supported by (Dumitrescu & Hurlin, 2012) panel dynamic causal relationship between the variables has been examined. It is idea that because the same old causality test assumes homogeneity a few of panel data sets, it overlooks the slope heterogeneity.

4. RESULTS AND DISCUSSION

Table 1 reports summary statistics of the variables. Correlation matrix of variables of the study is given in table 2. pairwise correlation coefficients reveal that most variables are positively related, except log of GCF log of LF, and log of EC which are negatively correlated with log of GDP, log of GCF and log of LF respectively.

Table 1: Summary Statistics

Variables	Mean	Median	SD	Skewness	Obs
log of GDP	7.124	7.124	0.534	0.463	128
log of GCF	5.704	5.498	0.702	0.558	128
log of LF	17.80	17.78	1.423	0.115	128
log of EC	5.877	6.076	0.459	-1.035	128
For UMIC					
log of GDP	8.455	8.456	0.517	-0.771	128
log of GCF	10.66	7.494	5.843	1.1303	128
log of LF	16.70	16.90	2.770	-0.125	128
log of EC	7.142	7.291	0.585	-0.220	128
For HIC					
log of GDP	10.373	10.41	0.382	-0.962	128
log of GCF	12.849	9.211	6.517	1.150	128
log of LF	16.450	16.601	1.264	-0.314	128
log of EC	8.3785	8.362	0.197	-0.631	128

Note: Author's own calculations

The results of correlation matrix are presented in Table 2 which indicates linear relationship among variables. In case of LMIC a strong positive correlation occurs between GDP and GCF is found. In case of UMIC there's negative correlation found between GCF and GDP. In case of HIC weak but positive correlation found between GCF and GDP. In case of LF (LF) negative and weak correlation found between LF and GDP while strong correlation found between LF and GCF. In case of EC positive and weak correlation found between EC and GDP, and EC and LF while negative and weak correlation found between EC and GCF.

Table 2: Correlation Matrix Table

Correlation LMIC UMIC HIC	log of GDP	log of GCF	log of LF	log of EC
log of GDP	1.000			
	1.000			
	1.000			
log of GCF	0.9130	1.000		
	-0.0370	1.000		
	0.1054	1.000		
log of LF	-0.4997	-0.3166	1.000	
	-0.1345	-0.8325	1.000	
	-0.1702	-0.8537	1.000	

log of EC	0.5798	0.5039	0.1283	1.000
	0.6684	-0.7328	0.5129	1.000
	0.7182	-0.0577	-0.2239	1.000

Note: Author's own calculations

Results of cross-sectional dependence are reported in table 3. Aggregated panel data showed the dependency of cross-section between the selected economies based on all tests except Pesaran CD test. This demands to apply second generation unit root test, rather than focusing on the first order unit root tests.

Table 3: Cross-Sectional Dependence Results

	For LMIC		For UMIC		For HIC	
Test type	**Statistics**	**Prob.**	**Statistics**	**Prob.**	**Statistics**	**Prob.**
Breusch-Pagan	35.238	0.0000	23.467	0.0007	43.879	0.0000
Pesaran scaled LM	8.4404	0.0000	5.0425	0.0000	10.934	0.0000
Bias-corrected scaled LM	8.3759	0.0000	4.9780	0.0000	10.870	0.0000
Pesaran CD	1.5583	0.1191	1.6523	0.0985	0.8302	0.4064

Note: Author's own calculations

Table 4: Unit Root Results

	For LMIC		For UMIC		For HIC	
Variables	**At level**	**At 1st diff**	**At level**	**At 1st diff**	**At level**	**At 1st diff**
lnGDP	-1.0714 (>=0.10)	-3.869*** (<0.01)	-1.867 (>=0.10)	-4.099*** (<0.01)	-2.875** (<0.05)	
lnGCF	-0.7874 (>=0.10)	-6.6269*** (<0.01)	-0.3798 (>=0.10)	-4.4028*** (<0.01)	-1. 3329 (>=0.10)	-4.9696*** (<0.01)
lnLF	-2.9025** (<0.05)		-1.9787 (>=0.10)	-3.7574*** (<0.01)	-2.6280 (>=0.10)	-3.4426*** (<0.01)
lnEC	-2.042 (>=0.10)	-2.990** (<0.05)	-0.62443 (>=0.10)	-4.509*** (<0.01)	-1.77847 (>=0.10)	-4.112*** (<0.01)

Note: Author's own calculations. *, **, *** shows significance level at 10%, 5% and at 1%.

Table 5: Johanson Cointegration Test (log GDP Dependent Variable)

	For LMIC		For UMIC		For HIC	
Test Statistics	**t-statistic**	**p-value**	**t-statistic**	**p-value**	**t-statistic**	**p-value**
Panel v-statistic	1.387	0.0827	1.040	0.1492	-0.522	0.5513
Panel rho-statistic	-2.254	0.0121	-1.551	0.0604	-3.274	0.0005
Panel PP-statistic	-5.315	0.0000	-3.533	0.0002	-7.145	0.0000
Panel ADF-statistic	-5.334	0.0027	-3.567	0.0002	-5.936	0.0000
Group rho-statistic	-1.300	0.0968	-0.770	0.2204	-2.893	0.0019
Group PP-statistic	-7.931	0.0000	-3.170	0.0008	-7.918	0.0000
Group ADF-statistic	-5.846	0.0000	-3.192	0.0007	-6.977	0.0000

Note: Author's own calculations

The unit root results are presented in table 4. log of GDP is stationary at level for HIC while log of LF is stationary at level in case of LMIC sample. All remaining series are stationary at 1st difference.

Johanson Cointegration Test results are shown in table 5. It is clear from table 5 that panel rho-statistic, panel PP -statistic, panel ADF-statistic, group PP-statistic, and group ADF-statistic are significant for LMIC sample. For UMIC sample, panel PP -statistic, panel ADF-statistic, group PP-statistic, and group ADF-statistic are found to be significant. For HIC panel PP -statistic, panel ADF-statistic, group PP-statistic, and group ADF-statistic are significant. All the long run test results confirm cointegration relationship between the series.

Fisher Cointegration Test results are reported in table 6, respectively. Results of test confirm long-run and significant cointegration relationship among all variables.

Table 6: Fisher Cointegration Test (log GDP Dependent Variable)

	For LMIC		For UMIC		For HIC	
Hypothesized No of CE(s)	**Fisher stat (from trace stat)**	**Fisher stat (from max-eigen test**	**Fisher stat (from trace stat)**	**Fisher stat (from max-eigen test**	**Fisher Stat (from trace stat)**	**Fisher stat (from max-eigen test**
None	53.67	28.12	53.38	47.78	43.43	24.38
At most 1	32.00	15.73	18.47	10.28	25.10	14.82
At most 2	24.21	19.03	14.53	6.595	17.15	8.710
At most 3	19.30	19.30	24.08	24.08	26.18	26.18

Note: Author's own calculations

Kao Cointegration Test results are reported in table 7 respectively. Results of test confirm long-run and significant cointegration relationship among all variables.

Table 7: Kao Cointegration Test (log GDP Dependent Variable)

Kao Test	t-statistics	Prob.
ADF for LMIC	-4.381	0.0000
ADF for UMIC	-2.478	0.0066
ADF for HIC	-2.756	0.0029

Note: Author's own calculations

Results of FMOLS and DOLS are presented in table 8 and suggest positive and significant effect of lnGCF, lnLF, lnEC on lnGDP in case of LMIC sample. in case of UMIC, results of FMOLS and DOLS suggest positive and significant effect of lnGCF, lnLF, lnEC on lnGDP. Results of FMOLS and DOLS suggests positive and significant effect of lnGCF, lnLF, lnEC on lnGDP in case of HIC.

Table 8: FMOLS & DOLS Test (log GDP Dependent Variable)

	For LMIC		For UMIC		For HIC	
Variable	**FMOLS Pooled coef. (t-stats)**	**DOLS Pooled coef. (t-stats)**	**FMOLS Pooled coef. (t-stats)**	**DOLS Pooled coef. (t-stats)**	**FMOLS Pooled coef. (t-stats)**	**DOLS Pooled coef. (t-stats)**
lnGCF	0.129 (5.851)*	0.151 (3.960)*	0.228 (4.798)*	0.287 (4.094)*	0.170 (5.371)*	0.187 (3.569)*
lnLF	0.029 (2.522)*	0.039 (2.739)*	0.697 (2.347)*	0.532 (1.850)***	0.656 (4.688)*	0.589 (3.639)*
lnEC	0.232 (3.377)*	0.328 (2.814)*	0.448 (3.419)*	0.4430 (3.040)*	0.447 (6.201)*	0.490 (5.071)*

*Note: Author's own calculations. *, **, *** shows significance level at 10%, 5% and at 1%.*

Table 9: Auto Regressive Distributive Lag (ARDL) Long run Results (log GDP Dependent Variable)

Variable	For LMIC Coefficients	t-stats	For UMIC Coefficients	t-stats	For HIC Coefficients	t-stats
log of GCF	0.176	6.421	0.143	3.738	0.207	5.335
log of LF	0.000	5.607	0.687	3.406	0.322	2.564
log of EC	0.292	2.934	0.291	2.254	0.158	1.410
Coint.Eq01	-0.705	-2.797	-0.499	-2.969	-0.458	-3.100

Note: Author's own calculations

Table 10: Auto Regressive Distributive Lag (ARDL) Short run Test Results (dlog GDP Dependent Variable)

Variable	For LMIC Coefficients	t-stats	For UMIC Coefficients	t-stats	For HIC Coefficients	t-stats
dlog of GCF	0.051	0.642	1.99	1.000	0.107	2.475
dlog of LF	0.219	1.106	0.788	1.372	0.271	1.672
dlog of EC	0.007	0.086	0.037	0.369	0.047	1.055

Note: Author's own calculations

Table 11: Dumitrescu Hurlin's Panel causality Test (log GDP Dependent Variable)

Null Hypothesis	For LMIC Z bar stat	p value	For UMIC Z bar stat	p value	For HIC Z bar stat	p value
log ofGCF does not homogeneously cause log of GDP	1.85454	0.0637	-0.01076	0.9914	1.57536	0.1152
log of GDP does not homogeneously cause log of GCF	2.74738	0.0060	0.88776	0.3747	1.41991	0.1556
log of EC does not homogeneously cause log of GDP	4.67532	0.0000	0.75164	0.4523	0.36552	0.7147
log of GDP does not homogeneously cause log of EC	1.55888	0.1190	0.41197	0.6804	3.04075	0.0024
log of LF does not homogeneously cause log of GDP	0.02459	0.9804	0.40366	0.6865	-0.54596	0.5851
log of GDP does not homogeneously cause log of LF	-0.67694	0.4984	-0.47605	0.6340	2.41506	0.0157
log of EC does not homogeneously cause log of GCF	4.17673	0.0000	0.09671	0.9230	1.83189	0.0670
log of GCF does not homogeneously cause log of EC	2.03017	0.0423	0.29450	0.7684	2.31893	0.0204
log of LF does not homogeneously cause log of GCF	0.41634	0.6772	0.33468	0.7379	1.52326	0.1277
log of GCF does not homogeneously cause log of LF	1.53514	0.1248	-0.34490	0.7302	0.98837	0.3230

Note: Author's own calculations

Results of ARDL are shown in table 9 and indicates that in long run. There is positive and significant impact of log GCF, log LF and log EC on log of GDP for all three samples of countries i.e. Lower Middle-Income Countries, LMIC and High Income Countries.

Results of ARDL are shown in table 10 and indicates in short run. There is positive and significant impact of log GCF, log LF and log EC on log of GDP for all three samples of countries i.e. LMIC, UMIC and HIC.

Pairwise Dumitrescu Hurlin's Panel causality test results are reported in table 11. Results

in case of LMIC sample indicate unidirectional causality running from log of EC to log of GDP; log of LF to log of EC; bidirectional causality running from log of GCF to log of GDP; log of EC to log of GCF while in remaining cases, neutral causality is found. Pairwise Dumitrescu Hurlin's Panel causality test show unidirectional causality running from log of LF to log of EC while remaining shows neutral causality in UMIC sample. Pairwise Dumitrescu Hurlin's Panel causality test show unidirectional causality running from log of GDP to log of EC, log of LF, log of GCF to log of EC while remaining shows neutral causality in case of HIC. These results are consistent with (Omri, 2013., Apergis & Payne, 2009., Ullah and Mehmood., 2020).

5. CONCLUSION AND POLICY RECOMMENDATIONS

The main objective of study was to find out the relationship between log GDP, log GCF, log LF and log EC in selected South Asian, East Asian and pacific region countries. These countries are divided in three samples based on income levels. Analysis covers time span of 1990 to 2021. results of Breusch-Pagan LM test indicated existence of cross-sectional dependence in data for LMIC, UMIC and HIC. Results of unit root test exhibit that log LF in LMIC, UMIC and log GDP in HIC are stationary at level while other variables are stationary at first difference. results of co-integration tests explored the existence of long run relationship between log GDP, log GCF, log LF and log EC in selected LMIC, UMIC & HIC countries. The outcome of FMOLS, DOLS and PMG suggests positive and significant effect of log GCF, log LF, log EC on log GDP for selected LMIC, UMIC & in HIC in long run. Pairwise Dumitrescu Hurlin's Panel causality test show unidirectional causality running from log EC to log GDP; log LF to log EC; bidirectional causality running from log GCF to log GDP; log EC to log GCF while remaining shows neutral causality in LMIC. Pairwise Dumitrescu Hurlin's Panel causality test shows unidirectional causality running from log LF to log EC while remaining shows neutral causality in UMIC. Pairwise Dumitrescu Hurlin's Panel causality test shows unidirectional causality running from log GDP to log EC; log GCF to log EC while remaining shows neutral causality in HIC. results are consistent with (Omri, 2013, Apergis & Payne, 2009., Ullah and Mehmood., 2020).

Present study suggests that government should take measures to increase labor productivity in energy sector of economy to promote EG and it should take measures to improve human capital in form of labor participation in different sectors of economy where EC and production occurs.

REFERENCES

Adeel-Farooq, R. M., Bakar, N. A. A., & Raji, J. O. (2020). Financial sector development and economic growth: a co-integration analysis for ASEAN countries. *International Journal of Economic Policy in Emerging Economies, 13*(3), 195-208.

Afia, N. B. (2019). The relationship between energy consumption, economic growth and happiness. *Journal of Economic Development, 44*(3), 41-57.

Ahmed, M. M., & Shimada, K. (2019). The effect of renewable energy consumption on sustainable economic development: Evidence from emerging and developing economies. *Energies, 12*(15), 2954.

Apaydin, Ş., Ursavaş, U., & Koç, Ü. (2021). The impact of globalization on the ecological footprint: do convergence clubs matter? *Environmental Science and Pollution Research, 28*(38), 53379-53393.

Apergis, N., & Payne, J. E. (2009). CO2 emissions, energy usage, and output in Central America. Energy Policy, 37(8), 3282-3286.

Apergis, N., & Payne, J. E. (2010). The emissions, energy consumption, and growth nexus: evidence from the commonwealth of independent states. *Energy policy, 38*(1), 650-655.

Apergis, N., & Payne, J. E. (2012). Renewable and non-renewable energy consumption-growth nexus: Evidence from a panel error correction table. *Energy Economics, 34*(3), 733-738.

Arminen, H., & Menegaki, A. N. (2019). Corruption, climate and the energy-environment-growth nexus. *Energy Economics, 80*, 621-634.

Aslan, A., Apergis, N., & Yildirim, S. (2014). Causality between energy consumption and GDP in the US: evidence from wavelet analysis. *Frontiers in Energy, 8*, 1-8.

Asongu, S. A., & Odhiambo, N. M. (2020). Governance, CO2 emissions and inclusive human development in sub-Saharan Africa. *Energy Exploration & Exploitation, 38*(1), 18-36.

Azam, M., & Khan, A. Q. (2016). Urbanization and environmental degradation: Evidence from four SAARC countries—Bangladesh, India, Pakistan, and Sri Lanka. Environmental progress & sustainable energy, 35(3), 823-832.

Barbier, E. (2011). *The policy challenges for green economy and sustainable economic development.* Paper presented at the Natural resources forum.

Belke, A., Dobnik, F., & Dreger, C. (2011). Energy consumption and economic growth: New insights into the cointegration relationship. Energy Economics, 33(5), 782-789.

Bekun, F. V., Alola, A. A., & Sarkodie, S. A. (2019). Toward a sustainable environment: Nexus between CO2 emissions, resource rent, renewable and nonrenewable energy in 16-EU countries. *Science of the Total Environment, 657*, 1023-1029.

Bhattacharya, M., Paramati, S. R., Ozturk, I., & Bhattacharya, S. (2016). The effect of renewable energy consumption on economic growth: Evidence from top 38 countries. *Applied energy, 162*, 733-741.

Dogan, E., & Seker, F. (2016). An investigation on the determinants of carbon emissions for OECD countries: empirical evidence from panel models robust to heterogeneity and cross-sectional dependence. Environmental Science and Pollution Research, 23, 14646-14655.

Du, L., Hanley, A., & Zhang, N. (2016). Environmental technical efficiency, technology gap and shadow price of coal-fuelled power plants in China: A parametric meta-frontier analysis. *Resource and Energy Economics, 43*, 14-32.

Ehigiamusoe, K. U., & Lean, H. H. (2019). Effects of energy consumption, economic growth, and financial development on carbon emissions: evidence from heterogeneous income groups. *Environmental Science and Pollution Research, 26*(22), 22611-22624.

Grossman, G. M., & Krueger, A. B. (1991). Environmental impacts of a North American free trade agreement: National Bureau of economic research Cambridge, Mass., USA.

Huang, B.-N., Hwang, M. J., & Yang, C. W. (2008). Causal relationship between energy consumption and GDP growth revisited: a dynamic panel data approach. *Ecological Economics, 67*(1), 41-54.

Husaini, D. H., Lean, H. H., & Ab-Rahim, R. (2021). The relationship between energy subsidies, oil prices, and CO2 emissions in selected Asian countries: a panel threshold analysis. *Australasian Journal of Environmental Management, 28*(4), 339-354.

Jalil, A., & Feridun, M. (2011). The impact of growth, energy and financial development on the environment in China: a cointegration analysis. *Energy Economics, 33*(2), 284-291.

Kahsai, M. S., Nondo, C., Schaeffer, P. V., & Gebremedhin, T. G. (2012). Income level and the energy consumption–GDP nexus: Evidence from Sub-Saharan Africa. Energy Economics, 34(3), 739-746.

Kasman, A., & Duman, Y. S. (2015). CO2 emissions, economic growth, energy consumption, trade and urbanization in new EU member and candidate countries: a panel data analysis. *Economic tableling, 44*, 97-103.

Lee, C.-C. (2005). Energy consumption and GDP in developing countries: a cointegrated panel analysis. *Energy Economics, 27*(3), 415-427.

Lee, C. C., & Chang, C. P. (2008). Energy consumption and economic growth in Asian economies: a more comprehensive analysis using panel data. Resource and energy Economics, 30(1), 50-65.

Liu, J., Yin, Y., & Yan, S. (2019). Research on clean energy power generation-energy storage-energy using virtual enterprise risk assessment based on fuzzy analytic hierarchy process in China. *Journal of Cleaner Production, 236*, 117471.

Luo, J., Zhang, S., Sun, M., Yang, L., Luo, S., & Crittenden, J. C. (2019). A critical review on energy conversion and environmental remediation of photocatalysts with retableing CS countries with a new policy perspective. *Renewable energy, 164*, 419-432.

Mandal, S. K. (2010). Do undesirable output and environmental regulation matter in energy efficiency analysis? Evidence from Indian cement industry. Energy policy, 38(10), 6076-6083.

Marques, A. C., Fuinhas, J. A., & Tomás, C. (2019). Energy efficiency and sustainable growth in industrial sectors in European Union countries: A nonlinear ARDL approach. *Journal of Cleaner Production, 239*, 118045.

Narayan, P. K., & Narayan, S. (2010). Carbon dioxide emissions and economic growth: Panel data evidence from developing countries. Energy policy, 38(1), 661-666.

Oh, W., & Lee, K. (2004). Energy consumption and economic growth in Korea: testing the causality relation. Journal of policy modeling, 26(8-9), 973-981.

Ozturk, I., & Acaravci, A. (2010). CO2 emissions, energy consumption and economic growth in Turkey. Renewable and Sustainable Energy Reviews, 14(9), 3220-3225.

Ouedraogo, N. S. (2013). Energy consumption and economic growth: Evidence from the economic community of West African States (ECOWAS). Energy economics, 36, 637-647.

Pokrovski, V. N. (2003). Energy in the theory of production. Energy, 28(8), 769-788.

Paul, S., & Bhattacharya, R. N. (2004). Causality between energy consumption and economic growth in

India: a note on conflicting results. Energy economics, 26(6), 977-983.

Romer, D. (2018). Macroeconomic theory. University of California, Berkeley.

Stern, D. I. (1993). Energy and economic growth in the USA: a multivariate approach. Energy economics, 15(2), 137-150.

Schiffer, A. (2016). Empowered, excited, or disenfranchised? Unveiling issues of energy access inequality and resource dependency in The Gambia. *Energy Research & Social Science*, *18*, 50-61.

Shahbaz, M., Lean, H. H., & Shabbir, M. S. (2012). Environmental Kuznets curve hypothesis in Pakistan: cointegration and Granger causality. *Renewable and Sustainable Energy Reviews*, *16*(5), 2947-2953.

Shahbaz, M., & Feridun, M. (2012). Electricity consumption and economic growth empirical evidence from Pakistan. Quality & Quantity, 46, 1583-1599.

Streimikiene, D., & Kasperowicz, R. (2016). Review of economic growth and energy consumption: A panel cointegration analysis for EU countries. Renewable and Sustainable Energy Reviews, 59, 1545-1549.

Shahbaz, M., Nasir, M. A., Hille, E., & Mahalik, M. K. (2020). UK's net-zero carbon emissions target: Investigating the potential role of economic growth, financial development, and R&D expenditures based on historical data (1870–2017). *Technological Forecasting and Social Change, 161*, 120255.

Tang, T., Shahzad, F., Ahmed, Z., Ahmad, M., & Abbas, S. (2022). Energy transition for meeting ecological goals: Do economic stability, technology, and government stability matter? *Frontiers in Environmental Science, 10*, 955494.