Vol. 6(2), 29-35

Journal of Energy & Environmental Policy Options

The Impact of Energy Consumption on Economic Growth in Selected Emerging Economies

Zaheer Iqbal[a]
Mustafa Noor[b]

Abstract
The significance of energy, its demand, consumption patterns, and the types of energy policies required for sustainable growth are crucial concerns worldwide, particularly in developing and emerging economies over the past decades. As emerging economies undergo transitional phases involving structural, political, or policy reforms, energy assumes a vital role in achieving the objective of growth. Our GDP-energy consumption model indicates that GDP is significantly and positively influenced by increased energy consumption. This finding underscores the integral role of energy in driving economic growth in emerging economies. The results from the causality analysis reveal a unidirectional causality running from energy consumption to GDP per capita. This supports the energy-headed-growth hypothesis, which posits that energy consumption is a crucial driver of economic growth. Emerging economies require substantial energy to power their productive sectors, which in turn boosts employment and productivity levels. The relationship between energy consumption and economic growth is evident, highlighting that energy is not merely a facilitator but a prerequisite for growth in these nations. As industries expand and urbanization progresses, the demand for energy escalates, necessitating robust energy policies that ensure a stable and sustainable supply. The empirical findings of this study suggest that emerging economies are highly dependent on energy. Any disruptions in energy supply, such as energy shocks, could have detrimental effects on income levels and overall economic stability. This dependency underscores the vulnerability of these economies to fluctuations in energy supply and prices, further emphasizing the need for comprehensive energy policies that can mitigate such risks. To foster sustainable growth, emerging economies must focus on diversifying their energy sources and investing in renewable energy. Such strategies can reduce the reliance on any single energy source and enhance energy security. Additionally, improving energy efficiency can help these economies maximize the benefits of their energy consumption, ensuring that growth is not only robust but also sustainable in the long run.
Keywords: Energy Consumption, Economic Growth, Emerging Economies
JEL Codes: Q43, O13, O44

1. INTRODUCTION

Agtmael (1981) was the first to use the term “Emerging Economies” to describe developing countries undergoing rapid transitions. According to the International Monetary Fund (IMF), 152 countries are classified as emerging and developing economies, based on specific criteria. Political scientist Ian Bremmer defines an emerging economy as "a country where economics matter more than politics, to the markets." The BRIC countries—Brazil, Russia, India, and China—are considered highly emerging economies, followed by the Next-11, a group of countries identified for their significant growth potential.

Energy is a crucial factor in the production process. Classical economists regard materials and energy as secondary factors of production because they are derived from the primary inputs of land, labor, and capital. The availability and efficient use of energy resources are essential for economic development, as they drive industrial activity, support transportation, and facilitate communication and other vital services. The evolving dynamics of emerging economies highlight the critical role of energy in sustaining economic growth and development. According to Kummel (2007), energy should be considered a distinct factor of production alongside land, labor, and capital, possessing a higher elasticity of production compared to labor. This high productivity and relative affordability make energy a critical driver in the transition process of economies towards industrialization. The significant role of energy implies a strong relationship between energy consumption and economic growth.

The causal link between GDP and energy consumption has been a topic of extensive global debate, particularly in emerging economies. As these economies strive for industrialization and economic development, understanding the dynamics between energy use and economic performance becomes increasingly vital. The debate centers around whether energy consumption drives economic growth or whether economic growth stimulates increased energy consumption. This relationship is crucial for formulating policies that balance economic development with sustainable energy use. Over the past two decades, there

[a] Department of Economics, Government College University, Faisalabad, Pakistan
[b] Department of Economics, Government College University, Faisalabad, Pakistan

has been growing concern about the increasing share of GDP allocated to energy expenditure, a trend primarily driven by real GDP growth. This correlation highlights the integral role energy plays in economic expansion. However, energy consumption is also closely linked to environmental changes, as the conversion of natural resources into economic goods often results in negative externalities. These externalities, such as pollution and greenhouse gas emissions, have become significant issues that economists and policymakers are increasingly concerned about. Nevertheless, advancements in the production of energy from low-cost, environmentally friendly sources have helped mitigate some of these concerns. The development and adoption of renewable energy technologies, such as wind, solar, and hydroelectric power, have contributed to reducing the environmental impact of energy consumption. These technologies offer a cleaner alternative to fossil fuels, which are major contributors to environmental degradation. By leveraging these advancements, economies can strive to achieve a balance between sustained economic growth and environmental sustainability, ensuring that the benefits of development do not come at the expense of the planet's health. Since the mid-1980s, South Asian and Central Asian countries have witnessed significant growth alongside increased energy consumption. From 1981 to 2009, while the average growth rates of output were around 4.5% per annum, the growth rate of energy consumption in South Asian economies was approximately 3.0% (Das, Chowdhury, & Akhtaruzzaman, 2012). Considering these figures, it can be stated that energy consumption is a critical driver for achieving economic growth. Thus, a policy that discourages high energy consumption could potentially halt the growth process by limiting economic activity. In the existing literature, four different views are found regarding the causal relationship between GDP and energy consumption. The first view posits that growth and economic development boost energy use rather than the opposite. This perspective suggests that as economies grow, their energy demands naturally increase to support expanding industrial and service activities. The second view argues that energy is a crucial factor for production, alongside labor, capital, and other inputs, driving the economy towards higher growth rates. This perspective highlights energy's role as a foundational element in economic expansion. The third view states that economic growth and energy consumption are mutually reinforcing, i.e., an increase in economic growth leads to higher energy consumption, which in turn fuels further economic growth. This bidirectional causality implies a cyclical relationship where each factor propels the other. The fourth view suggests that there is no causal relationship between economic growth and energy consumption. Studies by Denison (1985), Cheng (1995), and Asafu and Adjaye (2000) highlight that the impact of energy consumption on GDP growth varies depending on factors such as country size, stage of development, industry size, and economic structure. As economies mature, they often shift towards a service-oriented production structure, which is generally less energy-intensive compared to manufacturing and heavy industries.

These diverse perspectives underscore the complexity of the relationship between energy consumption and economic growth, emphasizing the need for nuanced and context-specific energy policies. As countries evolve economically, understanding the interplay between these factors becomes crucial for sustainable development strategies. Kraft and Kraft (1978) conducted a seminal study on the causal relationship between energy consumption and economic growth in the United States, examining the period from 1947 to 1974. Their findings indicated that causality ran from income to energy consumption, suggesting that the U.S. could implement energy conservation policies without adversely impacting income growth. This study set a precedent for further research into the energy-GDP nexus, particularly in the context of policy implications. Masih and Masih (1996), Glasure and Lee (1998), and Asafu and Adjaye (2000) extended this line of inquiry to various developing countries using Granger causality tests and error-correction techniques. Their results highlighted the complex and varied nature of the relationship between energy consumption and GDP across different contexts. For instance, Masih and Masih (1996) found unidirectional causality from income to energy consumption in India, indicating that economic growth drove energy consumption. Conversely, in Indonesia, they found causality running from energy consumption to income, while in Pakistan, they observed bi-directional causality, where each factor influenced the other. Similarly, Glasure and Lee (1998) reported bi-directional causality between energy consumption and GDP for South Korea and Singapore, suggesting a mutually reinforcing relationship. Asafu and Adjaye (2000) also provided mixed results, with unidirectional causality from energy to GDP for India and Indonesia, implying that energy consumption was a driver of economic growth in these countries. However, they found bi-directional causality for Thailand and the Philippines, indicating a more intricate interplay where energy consumption and economic growth were interdependent. These varied findings underscore the importance of context when examining the energy-GDP relationship. Factors such as the stage of economic development, energy infrastructure, industrial composition, and policy environments can significantly influence the dynamics between energy consumption and economic growth. As such, these studies highlight the necessity for tailored energy policies that consider the specific economic and energy contexts of each country.

Aqeel and Butt (2001) studied the effects of energy consumption on employment and income levels in Pakistan from 1955 to 1996. Their findings indicated that an increase in electricity consumption led to higher employment and income levels, thus promoting economic growth. They concluded that energy consumption and GDP exert an exogenous impact on each other. Soytas and Sari (2003) focused their research on G-7 countries and found mixed results regarding the causality between energy consumption and economic growth. Their findings showed uni-directional, bi-directional, and no causality between energy consumption and economic growth. They also argued that the energy absorption capacity of the economic structure determines the extent of economic growth. Ouedraogo and Diarra (2010) emphasized that energy-dependent countries must have careful energy consumption policies, as any negative disturbance in energy supply or demand can significantly impact economic growth. Nayan et al. (2013) used difference GMM and system GMM estimators to investigate the causality direction between energy consumption and GDP for 23 developing countries from 2000 to 2011. Their results suggested that there is a one-way causality running from GDP per capita to energy consumption, indicating that energy consumption is influenced by changes in income patterns. Nasreen and Sofia (2014) examined the causal links between energy consumption, economic growth, and trade openness across 16 Asian countries. Their findings indicate a positive long-term relationship between energy consumption and both growth and trade openness, suggesting bi-directional causality. Despite extensive research, there remains no clear consensus on the causality direction between energy consumption and economic growth. Masih and Masih (1998), Jumbe (2004), and Lee (2005) suggested that if energy consumption drives GDP per capita, it signifies an energy-dependent economy. In such cases, energy is crucial for income generation, and shortages can negatively impact economic performance. Conversely, if income influences energy consumption, the economy is less reliant on energy, implying that energy conservation policies might have minimal or no negative effects on income. Numerous studies have explored the economic growth-energy consumption nexus, yielding mixed or contradictory results due to varying regional contexts, time periods, and methodologies. This study, after confirming co-integration using system and difference GMM estimators, investigates the direction of causality between energy consumption and GDP with panel Granger causality tests. Pooled OLS and Dynamic Fixed Effects (DFE) models are also employed to ensure the robustness and rigor of the analysis.

2. METHODOLOGY

The data used in this study is taken for 23 emerging economies[c]. The time period from 2000-2020, taken from the world development indicators (World Bank). The model used for estimation of energy consumption effects on GDP, is formulated as follows:

$$GDP_{it}=\beta_1 GDP_{it-1} + \beta_2 EC_{it} + \beta_3 CAPITAL_{it} + \beta_4 POP_{it} + \varepsilon_{it}$$

Where,

GDP = real GDP per capita in U.S dollars based on the 2005 constant price

EC = energy consumption measured by kilograms (kg), of oil equivalent of energy use per capita

CAPITAL= gross capital formulation to show the level of investment

POP= total population in millions

Here, population and capital are control variables, which also affect the GDP. It is normally thought that capital formation in an economy can drives to economic growth, as it can create employment activities; hence increases level of income. Whereas, population size might affect the real GDP per capita negatively or positively, depending upon the stage of development and nature of human capital a country endowed with. However, main motive of this model is to estimate the causal relation of energy consumption and GDP.

This study employs two types of GMM estimators to analyze the GDP-energy consumption model. The first is the difference GMM estimator, developed by Arellano and Bond (1991). The second is the system GMM estimator, initially introduced by Arellano and Bover (1995) and subsequently refined by Blundell and Bond (1998). Bond et al. (2001) argue that system GMM is more efficient due to its capacity to address unobserved country-specific effects, measurement errors, omitted variable bias, and endogeneity, which can otherwise lead to misleading results. The reliability of both difference GMM and system GMM estimates hinges on the validity of the instruments used in the models. To ensure this, the Hansen-Sargan test for over-identifying restrictions is applied. This test's null hypothesis posits that all instruments are collectively exogenous. Additionally, the Arellano-Bond test is utilized to check for serial correlation between the error terms of the differenced equation. The null hypothesis for this test asserts that the error term of the differenced equation is not serially correlated, particularly at the second order (AR(2)). This is crucial because the error term of the differenced equation becomes serially correlated at the first order (AR(1)) even if the original error term is not. Both null hypotheses were not rejected, ensuring the robustness of the results.

3. RESULTS AND DISCUSSION

The table 1 presents the coefficients and statistical significance of various explanatory variables in the regression model of GDP as a function of energy consumption, using different estimation methods. In the Pooled OLS model, the constant term is estimated at 0.136, which is statistically significant at the 0.05 significance level. Energy consumption has a coefficient of 0.0082, although its statistical significance is marginal with a p-value of 0.074. Real GDP per Capita in the previous period (lagged variable) shows a strong positive relationship with GDP, with a coefficient of 0.945 and a highly significant p-value of 0.000. Population and capital formation also exhibit statistically significant effects on GDP, with coefficients of -0.033 and 0.038, respectively. Moving to the Fixed Effect model, the constant term increases substantially to 0.887, indicating a significant impact on GDP. Energy consumption becomes more significant, with a higher coefficient of 0.186 and a p-value of 0.000. Real GDP per Capita, population, and capital formation maintain their strong positive or negative effects on GDP, with consistent statistical significance across models. In the Difference GMM model, the constant term decreases to 0.489, with energy consumption exhibiting a notable impact on GDP, with a coefficient of 0.342 and a p-value of 0.007. Real GDP per Capita, population, and capital formation also maintain their significance and direction of influence on GDP. Lastly, in

[c] Argentina, Bangladesh, Brazil, Bulgaria, China, Chile, Egypt, Hungary, India, Iran, Mexico, Morocco, Nigeria, Pakistan, Peru, Russia, South Africa, Malaysia, Thailand, Turkey, UAE, Ukraine and Venezuela.

the System GMM model, the constant term is estimated at 0.109, with energy consumption showing a significant effect on GDP, albeit with a slightly lower coefficient of 0.0982 and a p-value of 0.020. Real GDP per Capita, population, and capital formation remain significant determinants of GDP, consistent with the other models. Overall, while the coefficients and statistical significance may vary across estimation methods, there is a consistent pattern indicating the importance of energy consumption, real GDP per Capita, population, and capital formation in explaining variations in GDP.

Table 1
Model: GDP = *f* (Energy consumption)

Variables	Pooled OLS	Fixed effect	Difference GMM	System GMM
Constant	0.136 *	0.887**	0.489	0 .109
	(0.000)	(0.024)	(0.564)	(0.719)
Energy consumption	0.0082***	0.186*	0.342*	0.0982**
	(0.074)	(0.000)	(0.007)	(0.020)
Real GDP per Capita(-1),	0.945*	0.672*	0.570*	0.835*
	(0.000)	(0.000)	(0.000)	(0.000)
Population	-0.033*	-0.252*	-0.253*	-0.067***
	(0.009)	(0.000)	(0.009)	(0.104)
Capital formation	0.038*	0.135*	0.149*	0. 0761*
	(0.001)	(0.000)	(0.000)	(0.008)

In the panel Granger causality analysis presented in Table 2, the focus is on examining the direction of causality between energy consumption and GDP. The findings reveal that while there is evidence to suggest that energy consumption Granger causes GDP, indicating a potential influence of energy consumption on economic growth, the reverse relationship is not supported. Specifically, the F-statistic for energy causing GDP is 2.6725, with a corresponding p-value of 0.033, indicating statistical significance. This suggests that changes in energy consumption patterns may have a meaningful impact on the fluctuations observed in GDP. Conversely, the analysis does not find significant evidence to support the notion that GDP Granger causes energy consumption. The F-statistic for this relationship is notably low at 0.2552, and the associated p-value is 0.906, well above conventional significance levels. This implies that variations in GDP are not likely to be predictive of changes in energy consumption levels. Overall, these results provide valuable insights into the dynamic relationship between energy consumption and economic growth, suggesting a unidirectional influence from energy consumption to GDP. However, further research may be warranted to explore additional factors and potential mechanisms underlying this relationship.

Table 2: Causality Analysis

Panel Granger Causality Results

Causality	F-Stat	p-value	Remarks
ENERGY does not Granger Cause GDP	2.6725	0.033	Energy causes Economic Growth
GDP does not Granger Cause ENERGY	0.2552	0.906	

These results stand in contrast to Abosedra and Baghestani (1991), where they contradicted the growth hypothesis and indicated the presence of the conservation hypothesis for the USA. In their study, they found that GNP causes an increase in energy consumption in the USA. Cheng (1997) supports the conservation hypothesis, arguing that energy consumption has a negative effect on GDP. Ghali and El-Sakka (2004) supported the feedback hypothesis, indicating bidirectional causality between energy consumption and economic growth. Oh and Lee (2004) found that economic growth drives energy consumption in Korea. Wolde-Rufael (2005) concluded that the direction of causality for developing countries is running from economic growth to energy consumption. Nayan et al. (2013) also revealed that income was affecting energy consumption, i.e., an increase in income causes an increase in the consumption of energy. However, the results of this study are in accordance with Asafu and Adjaye (2000), which found unidirectional causality running from energy to GDP for India and Indonesia. Alam and Butt (2002) concluded that energy consumption, economic growth, capital, and labor are co-integrated and that causality runs from energy consumption to economic growth in the short as well as long runs. Wolde-Rufael (2004) argued that hydrocarbons along with electricity collectively help to boost economic performance. Lee (2005) investigated the causal relationship between energy consumption and economic growth and found the existence of the growth hypothesis in 18 developing countries. Alam (2006) found that energy not only serves as a factor of production; it also acts as a booster to economic growth. Kalar and Khilji (2011) also conducted their study to investigate the causal relationship between energy consumption and economic growth in Pakistan for the period of 1980-2009. Their results suggested that unidirectional causality runs from energy consumption to economic growth.

4. CONCLUSIONS

This study delves into the intricate relationship between GDP and energy consumption within emerging economies, leveraging dynamic panel data techniques, specifically difference GMM and system GMM. The empirical findings underscore a significant and positive impact of increased energy consumption on GDP per capita. This highlights the critical role of energy as a driving force behind economic growth in these regions. Conversely, population growth exhibits a negative effect on economic growth, which could be attributed to various factors such as increased pressure on resources and infrastructure. On the other hand, capital formation, reflecting investments in physical assets, shows a positive and significant impact on economic growth, emphasizing the importance of capital investments in fostering economic development. The application of the Panel Granger causality test further elucidates the dynamics between energy consumption and economic growth, affirming the growth hypothesis.

The test reveals a unidirectional causality running from energy consumption to GDP per capita, implying that energy consumption is a prerequisite for economic growth in the studied emerging economies. This finding is particularly significant as it underscores the energy-dependent nature of these economies. It suggests that policies aimed at enhancing energy availability and efficiency could play a pivotal role in sustaining and accelerating economic growth. Furthermore, the study highlights the necessity for these economies to adopt a multifaceted approach to energy policy. While increasing energy consumption is crucial for economic growth, it is equally important to address the sustainability and environmental impact of such growth. Given the global emphasis on sustainable development, emerging economies must balance their energy consumption with efforts to adopt cleaner and more efficient energy sources. This balance is essential not only for economic growth but also for mitigating environmental degradation and ensuring long-term sustainability. The findings of this study have several policy implications. Firstly, there is a clear need for increased investment in energy infrastructure to support the growing energy demands of emerging economies. Secondly, policymakers should focus on diversifying the energy mix to include more renewable and sustainable energy sources. This diversification can help mitigate the risks associated with over-reliance on fossil fuels, such as price volatility and environmental concerns. Thirdly, enhancing energy efficiency across various sectors can contribute to economic growth while minimizing environmental impact. Moreover, the study's results suggest that targeted policies aimed at capital formation could further bolster economic growth. Investments in infrastructure, technology, and human capital are essential for sustaining long-term economic development. A decrease in energy consumption can significantly harm income levels by stalling the growth process of economies. Energy serves as the lifeline of an economy, essential for sustaining and enhancing growth, particularly during the critical transitional phase that emerging economies are currently experiencing. In this transition, the agricultural, manufacturing, and services sectors all exhibit a profound dependence on energy.

In the agricultural sector, energy is vital for powering machinery, irrigation systems, and processing facilities. The modernization and mechanization of agriculture, crucial for increasing productivity and ensuring food security, rely heavily on a stable and adequate energy supply. Without sufficient energy, agricultural outputs can decline, affecting food supply and prices, which in turn can have broad economic and social implications. The manufacturing sector, often regarded as the backbone of economic development in emerging economies, requires energy for the operation of machinery, production lines, and transportation of goods. Energy shortages or high energy costs can lead to reduced industrial output, lower competitiveness, and potential job losses. As manufacturing plays a key role in driving exports and generating employment, disruptions in energy supply can hinder industrial growth and overall economic performance.

The services sector, encompassing a wide range of activities from retail and finance to education and healthcare, also depends on reliable energy. For instance, the proliferation of digital services and information technology, which are increasingly significant for economic development, requires uninterrupted power supply. Energy is also critical for the functioning of essential services such as hospitals, schools, and public transportation systems. Inadequate energy supply can lead to service disruptions, impacting productivity and quality of life. Furthermore, as economies transition and develop, the demand for energy typically increases due to urbanization, industrialization, and improved living standards. Emerging economies, therefore, face the dual challenge of meeting this rising energy demand while transitioning to more sustainable and efficient energy sources. Energy policies must address both the immediate needs for economic growth and the long-term goals of sustainability and environmental protection. Most emerging and developing economies are undergoing a significant transformation in their production structures, shifting from agriculture to mass industrialization. Concurrently, there is an increasing use of technology within the agricultural sector. This technological advancement has led to enhanced value addition through reduced input costs, increased production, and higher returns. Importantly, these technological improvements in agriculture are energy-dependent, underscoring the critical role of energy in economic development. The adoption of advanced technology in agriculture not only benefits those directly involved in the sector but also boosts the overall economy through its backward and forward linkages. Improved technology leads to increased agricultural production and higher-quality products, making these economies more competitive in international markets and enhancing their terms of trade. Backward linkages refer to the increased demand for inputs and services that support agricultural production, such as fertilizers, machinery, and energy. As agriculture becomes more productive, the demand for these inputs grows, stimulating sectors that provide these goods and services. This creates jobs, spurs innovation, and fosters economic diversification. Forward linkages involve the movement of agricultural outputs through the value chain, including processing, packaging, transportation, and marketing. Enhanced agricultural productivity ensures a steady supply of raw materials for agro-industries, promoting industrial growth and creating additional employment opportunities. For instance, increased production of crops can lead to the development of food processing industries, which add value to the raw products and generate further economic activities. The integration of technology in agriculture also enhances product quality, enabling producers to meet international standards and compete in global markets. This competitive edge can lead to better terms of trade, as higher-quality exports command higher prices and gain greater market access. Improved terms of trade contribute to national income growth, supporting broader economic development goals. Furthermore, the increased productivity and income in the agricultural sector can have positive spill-over effects on other sectors of the economy.

Higher agricultural incomes boost rural spending power, which can stimulate demand for goods and services in rural areas, thereby promoting economic diversification and reducing regional disparities. In summary, the technological transformation of agriculture in emerging and developing economies is pivotal for economic growth. It not only enhances agricultural productivity and product quality but also drives industrialization and competitiveness in global markets. The energy-dependent nature of these technological advancements highlights the critical importance of reliable and sustainable energy supply in supporting this transformative process. Therefore, policies that promote energy access and efficiency, alongside investments in agricultural technology, are essential for fostering inclusive and sustained economic growth. Undoubtedly, advancements in the industrial sector are heavily reliant on an efficient energy sector. Energy use in the industrial sector drives value addition by minimizing input costs, maximizing profits, and boosting production. This sector significantly contributes to economic growth in emerging economies due to the additional value-added tax levied by the government, which increases public revenues. Moreover, the process of industrialization also enhances employment levels through job creation.

The industrial sector is highly dependent on technology, which typically requires more capital but less labor compared to traditional sectors. However, the income and skill levels of workers involved in the industrial sector are generally higher than those in agriculture. This higher income indirectly stimulates demand for goods and services in other sectors, fostering overall economic growth. As workers in the industrial sector earn more, their increased purchasing power drives consumption and investment in other areas of the economy, creating a positive feedback loop that supports broader economic development. Furthermore, a robust energy production system is crucial for preventing disruptions in industrial production. The transition from labor-intensive agricultural work to more capital-intensive industrial production also brings about significant socio-economic changes. It leads to the development of new skills and higher wages for workers, contributing to a better standard of living. Additionally, the industrial sector's demand for energy-efficient technologies and practices promotes innovation and can lead to the adoption of cleaner and more sustainable energy sources. The services sector plays a pivotal role in driving economic growth, but its effectiveness is heavily contingent upon a robust communication infrastructure. Energy is a fundamental requirement for the operation of communication systems, which serve as the lifeline of the services sector. This sector offers the potential for the highest returns to individuals involved in it, with highly skilled labor driving innovation, research, and development, and facilitating spillover effects that benefit other sectors of the economy. Therefore, it can be concluded that the energy sector serves as the lifeblood of the economy, contributing to all sectors. Recognizing the critical importance of the energy sector, it becomes evident that it is crucial for greasing the wheels of economic activity. Furthermore, the energy sector itself contributes to economic growth by creating employment opportunities across its various segments, including extraction, transformation, and distribution channels. Given the significance of the energy sector, it is imperative for emerging economies to formulate careful energy policies and prioritize increased energy production. This study suggests that the energy sector should be provided with formal incentives to bolster its role as the backbone of highly emerging economies. Additionally, it is advisable for other developing economies to invest in their energy sectors to capitalize on the rapid benefits of industrialization. In essence, a strong and efficient energy sector is indispensable for driving economic growth and development, serving as the linchpin that sustains and propels progress across all sectors of the economy. By prioritizing investments and policy interventions in the energy sector, countries can lay a solid foundation for sustained economic advancement and prosperity.

REFERENCES

Abosedra, S. and Baghestani, H. (1991), New Evidence on the Causal Relationship between United States Energy Consumption and Gross national product. *The Journal of Energy and Development*, 14(2), 285-292

Alam, M. S (2006). Economic growth with energy. *Retrieved on the 20th November 2006*

Aqeel, A., and Butt, M. S., (2001). The Relationship between Energy Consumption and Economic Growth in Pakistan. *Asia-Pacific Development Journal*, 8(2), 101-109

Arellano, M. and Bond, S., (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies*, 58, 277-297

Arellano, M., Bover, O., (1995). Another look at the instrumental variables estimation of error-components models. *Journal of Econometrics* 68, 29-51

Asafu, J. and Adjaye. (2000). The relationship between energy consumption, energy prices and economic growth: Time series evidence from Asian developing countries. *Energy Economics*, 22, 615–625

Blundell, R., Bond, S., (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics* 87, 115-143.

Cheng B., (1995). An investigation of cointegration and causality between energy consumption and economic growth. *Journal of Energy Development,* 21, 73–84

Cheng, B. S. (1997), Energy Consumption and Economic Growth in Brazil, Mexico and Venezuela: A Time Series Analysis. *Applied Economics Letters,* 4, 671-674

Das, A. Chowdhury. M. and Akhtaruzzam. M. (2012). Revisiting energy and output in South-Asian countries. *Journal of Economics and Behavioral Studies,* 4(5), 277-286

Denison, E. (1985). Trends in American economic growth. *Washington, DC: Brookings Institution*, 1929-1982

Ghali, K.H., and El-Sakka, M.I.T. (2004). Energy use and output growth in Canada: a multivariate cointegration analysis. *Energy Economics*, 26(2), 225-238

Glasure, Y. U., and Lee, A.R. (1998). Cointegration, error-correction, and the relationship between GDP and energy: The case of South Korea and Singapore. *Resource and Energy Economics*, *20*(1), 17-25.

Jumbe, C. B. L. (2004). Cointegration and Causality between Electricity Consumption and GDP: Empirical Evidence from Malawi. *Energy Economics,* 26, 61-68

Kalar, Z-H. and Khilji, B. A. (2011),. Energy Consumption and Economic Growth in Pakistan, *Journal of International Academic Research*, 11(1), 33-36

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

Kummel R. (2007). The Productive Power of Energy and its Taxation. Talk presented at the *4th European Congress Economics and Management of Energy in Industry, Porto, Portugal*, 27-30 November 2007

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

Masih, A. and Masih, R., (1998). A multivariate cointegrated modeling approach in testing temporal causality between energy consumption, real income and prices with an application to two Asian LDCs. *Applied Economics, 30* (1), 1287–1298

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

Nasreen S., and Sofia S., (2014). Causal relationship between trade openness, economic growth and energy consumption: A panel data analysis of Asian countries**.** *Energy Policy*69, 82–91

Nayan et al. (2013). Revisiting Energy Consumption and GDP: Evidence from Dynamic Panel Data Analysis. *Energy Economics*, MPRA Paper No. 48714

Oh, W., and Lee, K. (2004a). Causal relationship between energy consumption and GDP revisited: the case of Korea in 1970-1999. *Energy Economics,* 26(1): 51-59

Ouedraogo, I. M. and Diarra, M., (2010). Electricity consumption and economic growth in Burkina Faso: A cointegration analysis. *Energy Economics,38 (2), 425-534*

Soytas, U., Sari, R. (2003). Energy Consumption and GDP: Causality Relationship in G-7 Countries and Emerging Markets. *Energy Economics,* 25, 33-37

Wolde and Rufael, Y. (2004), Disaggregated Industrial Energy Consumption and GDP: The Case of Shanghai, 1952-1999. *Energy Economics,* 26, 69-75

Wolde-Rufael, Y. (2005), Energy Demand and Economic Growth: The African Experience. *Journal of Policy Modeling,* 27, 891-903.