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Symmetric and Asymmetric Impacts of Commercial Energy Distribution from Key Sources on Economic Progress in Pakistan

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Abstract: This paper aims to determine the interaction of commercial energy distribution, including the installed capacity of hydroelectric energy, hydroelectric energy generation, the installed capacity of thermal energy, thermal energy generation, the installed capacity of nuclear energy, and nuclear energy generation, with economic progress in Pakistan over the 1970–2019 period. Both linear and non-linear autoregressive distributed lag models were used to ascertain the symmetric and asymmetric short- and long-run effects. The findings from the linear autoregressive distributed lag model analysis revealed evidence that increases in the installed capacity of nuclear energy, alongside higher levels of hydroelectric energy generation and thermal energy generation, have positively affected economic growth in the short run, while a greater installed capacity of nuclear energy has positively affected economic growth in the long run. The findings from the non-linear autoregressive distributed lag model analysis showed that negative shocks to installed capacities related to hydroelectric, thermal, and nuclear energy reduced economic growth, while positive shocks to hydroelectric energy generation and the installed capacity of nuclear energy boosted economic growth in the short run. Furthermore, in the long run, negative shocks to the installed capacities of hydroelectric and thermal energy reduced economic growth, negative shocks to the installed capacity of nuclear energy enhanced economic growth, and positive shocks to hydroelectric energy generation and the installed capacity of nuclear energy have stimulated economic growth in Pakistan.

Keywords: energy supply; thermal energy; economic progress; nuclear energy; symmetric and asymmetric analysis

1. Introduction

Pakistan can effectively handle the country's energy crisis by improving energy production and grid transmission capabilities. Oil scarcity has a knock-on impact on the economy. Because of the recent energy restructure, the energy industry is now suffering a supply shortfall and is seeking solutions to increase production while cutting costs. Pakistan's reliance on fuel mix imports, such as energy, local coal, and re-gasified liquefied natural gas, has reduced in recent years. Pakistan's whole energy balance is shifting away from dependence on natural gas. The shift in the energy balance might be attributed to a reduction in natural gas reserves and liquefied gas primer [1]. Pakistan's power sector is in a slump and has experienced a number of challenges in recent years. The cyclical debt, the unstable financial situation of energy providers, a strong reliance on gas and oil, the diminishing availability of natural gas, the reduced usage of inexpensive hydel and coal resources, and the undeveloped potential to produce electricity all present little or no substantial restraint on energy shortages. In addition to changing global petroleum prices, Pakistan's rising reliance on thermal energy production has a negative impact on energy production costs and may aggravate the country's energy constraint [2–4].

To gain a better understanding of how energy affects human activities and development, it is necessary to examine each country's energy use. With an increasing global population and changes in residents' material lifestyle, energy resources are rapidly decreasing. Furthermore, the surge in global energy consumption has had a significant influence on the planet's temperature and ecosystems. Because they are used to generate energy, fossil fuels are a significant source of pollution. The rise in oil production and use indicates that energy will be one of the world's most significant issues in the future. Sustainable and renewable energy sources are required to meet this demand, while also addressing unfavorable environmental challenges. Renewable energies, such as solar and wind, will bridge the energy gap without emitting greenhouse gases or adversely hurting the environment [5–8]. Massive population increase has led to deforestation, and Pakistan is the Asian country with the most serious deforestation issues. Economic expansion and power consumption play a major role in boosting productivity and contributing to environmental devastation. Pakistan has a high energy demand, and conventional oil is utilized to fulfill the country's ever-increasing energy need. The use of traditional energy sources emits carbon dioxide, which contributes to environmental damage [9,10].

In recent years, maintaining an efficient economy and a clean environment have been two sides of the same coin. We may create a better environment while still ensuring economic progress, or we can seek growth while reducing the use of non-renewable resources. There is also a link between a sustainable environment and economic development, because growth is tied to resource utilization. Understanding the relationship between energy usage and economic growth is an important goal in environmental policy formulation [11–13]. Some feel that global warming is a real hazard, and that, as a result, fast economic progress will be hampered. Furthermore, the world's dependence on economically, monetarily, and politically dependent nations, energy-rich oil, and the peak oil hypothesis contribute to local energy supply and resource scarcity issues. This is backed by resource use and renewable energy, as well as evidence demonstrating a causal relationship with development [14–16].

Many investigates and analyses have been conducted which demonstrate the link between energy use and CO_2 emissions, urbanization, energy consumption, financial development, renewable energy, trade, health expenditures, and natural resources [17–24], but this study makes a unique contribution to the previous literature by investigating the impact of commercial energy distribution, including hydroelectric, thermal, and nuclear energy, on economic progress in Pakistan by utilizing annual data for the period of 1970–2019. Linear (ARDL) and non-linear (NARDL) techniques have been employed with the help of long- and short-run analysis to investigate the interactions among the variables. The study is important for a developing country, such as Pakistan, that relies mainly on fossil fuel energy and thus risks significant environmental deterioration in its race for achieving economic growth. The research question focuses on investigating the existence of a positive or negative relationship between the clean energy sources and economic growth in Pakistan.

The paper is structured as follows: Section 2 presents the findings of the previous studies on this specific topic; Section 3 presents methods and data; Section 4 presents and discuss the results; and Section 5 concludes the paper and outlines some policy recommendations.

2. Eco-Energy: Related Literature

Over the last two decades, several researchers have investigated the correlation between energy demand and macroeconomic issues. Numerous studies have been conducted to investigate the underlying causes of energy consumption with a random effects model, focusing on a range of factors, such as industrial expansion, economic advancement, employment, and population. Energy is recognized as one of the most important instruments for social and economic progress, acting as the lifeblood of an economy. Not only is energy crucial to the market, but it is also important to its supply. Moreover, it is a geopolitical resource that has an impact on conflict outcomes, which itself boosts and impedes economic progress, and which pollutes and cleans the environment. In the era of globalization, the rapidly increasing oil supply and each nation's dependency on energy demonstrate that energy will be a serious concern for the globe in the next century [25–27]. The high intensity of carbon pollution as a result of rapid economic development and increased fossil fuel consumption is important to researchers and policymakers. If we were to reduce greenhouse gas emissions via energy consumption methods, economic production would be adversely affected, since energy supply is a critical contributor to productivity [28–30].

The causal relationship between oil, environmental emissions, and economic growth is now being studied, focusing on a variety of procedures, methodologies, factors, and countries. However, the analytical results of this research are discordant. Some researchers believe that a two-way causal connection exists between energy consumption and economic development, whereas others believe that the relationship between energy and economic growth is unique, and vice versa. From an environmental and economic standpoint, the relationship between these variables is a highly fascinating concept [31]. National firms are establishing operations in their host countries to increase their energy consumption in the manufacturing sector. The expansion of economic practices leads to increased energy consumption, which may have a detrimental impact on environmental quality. Furthermore, the phenomena related to globalization have resulted in the transfer of new technology and experience, which not only decreases traditional energy usage but also often lowers energy demand. Foreign enterprises use new technologies to reduce fuel consumption in order to establish companies that can take advantage of current investment opportunities. New developments have also led to the introduction of ground-breaking manufacturing processes that reduced energy consumption [32–34].

In recent years, both theoretical and analytical research have focused on the relationship between energy use and economic advancement. Economic development and capital accumulation are important sources of energy. Increasing economic activity needs additional resources in order to further develop goods and services. Because of the economy's heterogeneity, the path of this relationship is not always clear. This matter has lately received a lot of attention in case studies on oil-rich countries. As energy consumers and exporters, their markets face challenges not just in supporting sustainable industrial growth, but also in manufacturing. They also face fluctuations in their product prices. One of the most often discussed subjects is the utilization of energy. Because of its importance, it should be examined from a variety of perspectives, examining changes in global structures, assessing the energy potential of a variety of nations, and assessing their national economic and policy priorities [35–38]. There is a close correlation between economic growth and energy use. Most countries have now shifted from low income to middle income in their stages of development. Energy consumption in such nations is rising as the growth paradigm evolves. Because industrialized nations rely on fossil fuels for the bulk of their energy usage, and energy assistance in distant places is unneeded, these governments confront a twofold energy dilemma: can they provide vital energy supplies while also ensuring energy efficiency [39–41]?

Renewable energy is a critical component of long-term success. The world's population has increased dramatically in recent years, and so the need for energy generation from non-stop conventional sources has increased. As a result, the future of sustainable growth is jeopardized by environmental issues and rising oil prices. Green technology, on the other hand, is designed to improve energy efficiency by augmenting natural capital and reacting to climate change and global warming. Renewable energy is an essential component for achieving long-term economic prosperity. Energy is the most important component of the production procedure; it is the cornerstone of the manufacturing industry. The acceleration of economic growth would increase energy consumption since neither would go ahead at the same time without the use of energy [42–44]. Growing demand for electricity promotes economic growth, yet energy usage often contributes to greenhouse gas emissions. Over the last decade, much attention has been paid to global warming and climate change, as well as the connection between air pollution, resource consumption, and economic growth. Many nations are attempting to minimize greenhouse gas emissions. The world's biggest energy consumer has addressed the need for greenhouse gas reductions and proposed more sustainable policy actions to create a renewable roadmap for economic development [45–47].

Energy can also help with economic growth. Energy is a significant driver of economic growth since it is required for many industrial activities. On the other hand, more economic growth would result in an increased demand for goods and services, notably for more oil [48]. The environmental implications of growing oil consumption have resulted in climate change and global warming. Climate change and the acceleration of global warming do not benefit the natural world or human life on Earth. Governments and legislators in high-polluting nations want to reduce energy usage by increasing energy production and creation, and they want to look into the link between energy growth and global warming mitigation [49]. Furthermore, energy is required for domestic cooking, power storage, transportation, lighting, and routine duties, such as fuel and technology cleaning. The industrial sector demands greater resources in order to create economic activity and employ power for mass production. The role of energy is to fulfill the supply–demand connection of the market economy and to establish economic comparability in export commodities with greater returns and revenue. Directly used sources of energy include fossil fuels, such as gasoline, coal, and natural gas. Removing greenhouse pollutants would improve air quality and mitigate the consequences of global warming, and would promote the use of green energy [50–52].

3. Material and Methods

This assessment has used annual time series data from 1970–2019, collected from two main sources, WDI (World Development Indicators) (https://data.worldbank.org/country/pakistan (accessed on 10 August 2021)) and the Economy Survey of Pakistan (http://www.finance.gov.pk/survey_1920.html (accessed on 10 August 2021)), in order to analyze interactions between the variables. The main research variables are GDP growth, the installed capacity of hydroelectric energy, hydroelectric energy generation, the installed capacity of thermal energy, thermal energy generation, the installed capacity of nuclear energy, and nuclear energy generation. The tendencies of each variable are clearly seen in Figure 1.

3.1. The Specifications of the Model

We used the subsequent model to show the interaction between GDP growth, the installed capacity of hydroelectric energy, hydroelectric energy generation, the installed capacity of thermal energy, thermal energy generation, the installed capacity of nuclear energy, and nuclear energy generation, and stated this as:

$$GDPG_t = f(HIC_t, HG_t, TIC_t, TG_t, NIC_t, NG_t) \quad (1)$$

The testing technique can be introduced, and Equation (1) may be expanded as follows:

$$GDPG_t = \theta_0 + \theta_1 HIC_t + \theta_2 HG_t + \theta_3 TIC_t + \theta_4 TG_t + \theta_5 NIC_t + \theta_6 NG_t + \varepsilon_t \quad (2)$$

In addition, the logarithmic expression of Equation (2) might be structured as follows:

$$\begin{gathered} GDPG_t = \theta_0 + \theta_1 Ln(HIC_t) + \theta_2 Ln(HG_t) + \theta_3 Ln(TIC_t) + \theta_4 Ln(TG_t) \\ + \theta_5 Ln(NIC_t) + \theta_6 Ln(NG_t) + \varepsilon_t \end{gathered} \quad (3)$$

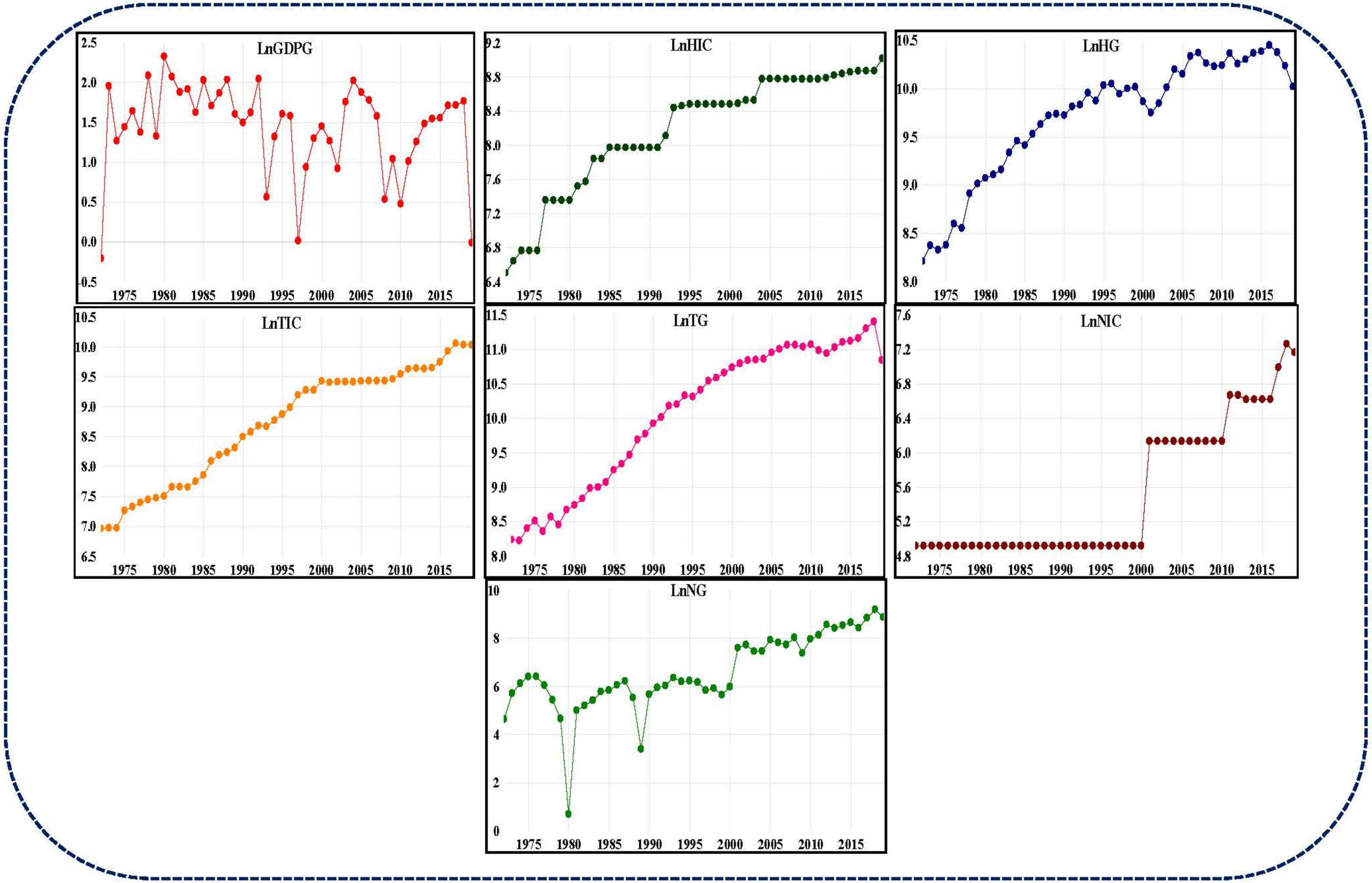

Figure 1. Plot of the analysis variables.

Equation (3) presents the logarithmic demonstration of the variables, including economic progress, the installed capacity of hydroelectric energy, hydroelectric energy generation, the installed capacity of thermal energy, thermal energy generation, the installed capacity of nuclear energy, and nuclear energy generation in Pakistan; ε_t designates error term, t is the measurement of time, and θ_1 to θ_6 represent the long-run model's exponents.

3.2. Linear (ARDL) and Non-Linear (NARDL) Techniques

Moreover, in order to correct the association among variables in long- and short-run periods, we used the ARDL model, following Pesaran et al. [53] and Pesaran and Shin (1998) [54], the latter of whom further extended the technique. The ARDL technique has many benefits compared to other one-time integer approaches. The model has no compulsory assumptions, which other integrated procedures do, while all factors in the study must be used in the same sequence. That is, the ARDL procedure is used irrespective of the separation in the order of the simple return scheme in I(2), while the cointegration series is in I(0) or I(1). The linear ARDL technique is also more suitable when working with limited data. The model's sample size is highly adjustable. For short- and long-term use, the version of the ARDL approach that it is best to use is the UECM model. Here, the long- and short-term trends are defined separately. The general classification of the relationships between variables is as follows:

$$\begin{aligned}\Delta LnGDPG_t = \pi_0 \quad & + \sum_{f=1}^{p} \pi_{1f}\Delta LnGDPG_{t-i} + \sum_{f=1}^{p} \pi_{2f}\Delta LnHIC_{t-i} + \sum_{f=1}^{p} \pi_{3f}\Delta LnHG_{t-i} \\ & + \sum_{f=1}^{p} \pi_{4f}\Delta LnTIC_{t-i} + \sum_{f=1}^{p} \pi_{5f}\Delta LnTG_{t-i} + \sum_{f=1}^{p} \pi_{6f}\Delta LnNIC_{t-i} \\ & + \sum_{f=1}^{p} \pi_{7f}\Delta LnNG_{t-i} + \omega_1 LnGDPG_{t-1} + \omega_2 LnHIC_{t-1} \\ & + \omega_3 LnHG_{t-1} + \omega_4 LnTIC_{t-1} + \omega_5 LnTG_{t-1} + \omega_6 LnNIC_{t-1} \\ & + \omega_7 LnNG_{t-1} + \varepsilon_t\end{aligned} \tag{4}$$

The long-run link description for variables can be seen as:

$$\begin{aligned}\Delta LnGDPG_t = \vartheta_0 \quad & + \sum_{f=1}^{g} \vartheta_{1f}\Delta LnGDPG_{t-i} + \sum_{f=1}^{g} \vartheta_{2f}\Delta LnHIC_{t-i} + \sum_{f=1}^{g} \vartheta_{3f}\Delta LnHG_{t-i} \\ & + \sum_{f=1}^{g} \vartheta_{4f}\Delta LnTIC_{t-i} + \sum_{f=1}^{g} \vartheta_{5f}\Delta LnTG_{t-i} + \sum_{f=1}^{g} \vartheta_{6f}\Delta LnNIC_{t-i} \\ & + \sum_{f=1}^{g} \vartheta_{7f}\Delta LnNG_{t-i} + \varepsilon_t\end{aligned} \tag{5}$$

In addition, the representation of short-term interactions for the variables may be written as follows:

$$\begin{aligned}\Delta LnGDPG_t = \rho_0 \quad & + \sum_{f=1}^{u} \rho_{1f}\Delta LnGDPG_{t-i} + \sum_{f=1}^{u} \rho_{2f}\Delta LnHIC_{t-i} + \sum_{f=1}^{u} \rho_{3f}\Delta LnHG_{t-i} \\ & + \sum_{f=1}^{u} \rho_{4f}\Delta LnTIC_{t-i} + \sum_{f=1}^{u} \rho_{5f}\Delta LnTG_{t-i} + \sum_{f=1}^{u} \rho_{6f}\Delta LnNIC_{t-i} \\ & + \sum_{f=1}^{u} \rho_{7f}\Delta LnNG_{t-i} + \alpha ECM_{t-1} + \varepsilon_t\end{aligned} \tag{6}$$

Equation (6) shows the short-term analysis of variables. Furthermore, it is better suited for use with small samples than for most traditional recursion progressions compared to the short- and long-run dynamic relationships that are assessed using the asymmetric (NARDL) techniques. Pesaran et al. [53] projected that F-tests would take into consideration the widespread implications of adding long-term variables in order to validate long-term estimates.

In addition, drawing on the study of Shin et al. [55], an asymmetric technique (NARDL) can also be used, which represents the decomposition of the installed capacity of hydroelectric energy, hydroelectric energy generation, the installed capacity of thermal energy, thermal energy generation, the installed capacity of nuclear energy, and nuclear energy generation with consistent positive (($HIC^{+}{}_{t}$; $HG^{+}{}_{t}$), ($TIC^{+}{}_{t}$; $TG^{+}{}_{t}$), and ($NIC^{+}{}_{t}$; $NG^{+}{}_{t}$)) and negative (($HIC^{-}{}_{t}$; $HG^{-}{}_{t}$), ($TIC^{-}{}_{t}$; $TG^{-}{}_{t}$), and ($NIC^{-}{}_{t}$; $NG^{-}{}_{t}$)) processes, and can be stated as:

$$HIC^{+}{}_{t} = \sum_{e=1}^{t} \Delta HIC^{+}{}_{t} = \sum_{e=1}^{t} \max\left(\Delta HIC^{+}{}_{t},\ 0\right) \tag{7}$$

$$HIC^{-}{}_{t} = \sum_{e=1}^{t} \Delta HIC^{-}{}_{t} = \sum_{e=1}^{t} \min\left(\Delta HIC^{-}{}_{t},\ 0\right) \tag{8}$$

$$HG^{+}{}_{t} = \sum_{e=1}^{t} \Delta HG^{+}{}_{t} = \sum_{e=1}^{t} \max\left(\Delta HG^{+}{}_{t},\ 0\right) \tag{9}$$

$$HG^{-}{}_{t} = \sum_{e=1}^{t} \Delta HG^{-}{}_{t} = \sum_{e=1}^{t} \min\left(\Delta HG^{-}{}_{t},\ 0\right) \tag{10}$$

$$TIC^{+}{}_{t} = \sum_{e=1}^{t} \Delta TIC^{+}{}_{t} = \sum_{e=1}^{t} \max\left(\Delta TIC^{+}{}_{t},\ 0\right) \tag{11}$$

$$TIC^{-}{}_{t} = \sum_{e=1}^{t} \Delta TIC^{-}{}_{t} = \sum_{e=1}^{t} \min\left(\Delta TIC^{-}{}_{t},\ 0\right) \tag{12}$$

$$TG^{+}{}_{t} = \sum_{e=1}^{t} \Delta TG^{+}{}_{t} = \sum_{e=1}^{t} \max\left(\Delta TG^{+}{}_{t},\ 0\right) \tag{13}$$

$$TG^{-}{}_{t} = \sum_{e=1}^{t} \Delta TG^{-}{}_{t} = \sum_{e=1}^{t} \min\left(\Delta TC^{-}{}_{t},\ 0\right) \tag{14}$$

$$NIC^{+}{}_{t} = \sum_{e=1}^{t} \Delta NIC^{+}{}_{t} = \sum_{e=1}^{t} \max\left(\Delta NIC^{+}{}_{t},\ 0\right) \tag{15}$$

$$NIC^{-}{}_{t} = \sum_{e=1}^{t} \Delta NIC^{-}{}_{t} = \sum_{e=1}^{t} \min\left(\Delta NIC^{-}{}_{t},\ 0\right) \tag{16}$$

$$NG^{+}{}_{t} = \sum_{e=1}^{t} \Delta NG^{+}{}_{t} = \sum_{e=1}^{t} \max\left(\Delta NG^{+}{}_{t},\ 0\right) \tag{17}$$

$$NG^{-}{}_{t} = \sum_{e=1}^{t} \Delta NG^{-}{}_{t} = \sum_{e=1}^{t} \min\left(\Delta NG^{-}{}_{t},\ 0\right) \tag{18}$$

The NARDL model requirements can be defined for positive and negative shocks with Equations (7)–(18). Equation (4) can then be written as an asymmetric model:

$$\begin{aligned} \Delta GDPG_{t} = \pi_{0} + & \sum_{x=1}^{t} \psi_{x} \Delta GDPG_{t-x} + \sum_{x=0}^{t} \tau_{x} \Delta HIC^{+}{}_{t-x} + \sum_{x=0}^{t} \theta_{x} \Delta HG^{-}{}_{t-x} \\ & + \sum_{x=0}^{t} \lambda_{x} \Delta TIC^{+}{}_{x-v} + \sum_{x=0}^{t} \phi_{x} \Delta TG^{-}{}_{t-x} + \sum_{x=0}^{t} \eta_{x} \Delta NIC^{+}{}_{t-x} \\ & + \sum_{x=0}^{t} \beta_{x} \Delta NG^{-}{}_{t-x} + \alpha_{1} GDPG_{t-1} + \alpha_{2} HIC^{+}{}_{t-1} + \alpha_{3} HG^{-}{}_{t-1} \\ & + \alpha_{4} TIC^{+}{}_{t-1} + \alpha_{5} TG^{-}{}_{t-1} + \alpha_{6} NIC^{+}{}_{t-1} + \alpha_{7} NG^{-}{}_{t-1} + \varepsilon_{t} \end{aligned} \tag{19}$$

The asymmetric (NARDL) technique is described in Equation (19). In addition, the Wald estimation is often used for analyzing short-run asymmetries and long-run asymmetries as follows: $[\frac{\alpha_2{}^{+}}{\alpha_1} \neq \frac{\alpha_3{}^{-}}{\alpha_1}]$, $[\frac{\alpha_4{}^{+}}{\alpha_1} \neq \frac{\alpha_5{}^{-}}{\alpha_1}]$, and $[\frac{\alpha_6{}^{+}}{\alpha_1} \neq \frac{\alpha_7{}^{-}}{\alpha_1}]$. The ECM (error correction model) description can be stated as:

$$\begin{aligned}\Delta GDPG_t = \eta_0 + & \sum_{z=1}^{s} \eta_1 \Delta GDPG_{t-v} + \sum_{z=0}^{s} \eta_2 \Delta HIC^{+}{}_{t-v} + \sum_{z=0}^{s} \eta_3 \Delta HG^{-}{}_{t-v} \\ & + \sum_{z=0}^{s} \eta_4 \Delta TIC^{+}{}_{t-v} + \sum_{z=0}^{s} \eta_5 \Delta TG^{-}{}_{t-v} + \sum_{z=0}^{s} \eta_6 \Delta NIC^{+}{}_{t-v} \\ & + \sum_{z=0}^{s} \eta_7 \Delta NG^{-}{}_{t-v} + \delta ECM_{t-1} + \varepsilon_t\end{aligned} \tag{20}$$

The nonlinear ARDL model often calculates the multiplier impact of the study variables' asymmetric form, and the following are listed:

$$[x_e^{+} = \sum_{b=0}^{e} \frac{\tau GDPG_{t+b}}{\tau HIC_b^{+}},\ x_e^{+} = \sum_{b=0}^{e} \frac{\tau GDPG_{t+b}}{\tau HIC_b^{+}}],\ [x_e^{+} = \sum_{b=0}^{e} \frac{\tau GDPG_{t+b}}{\tau HG_b^{+}};\ x_e^{+} = \sum_{b=0}^{e} \frac{\tau GDPG_{t+b}}{\tau HG_b^{+}}]$$

$$[x_e^{+} = \sum_{b=0}^{e} \frac{\tau GDPG_{t+b}}{\tau TIC_b^{+}};\ x_e^{-} = \sum_{b=0}^{e} \frac{\tau GDPG_{t+b}}{\tau TIC_b^{-}}];\ [x_e^{+} = \sum_{b=0}^{e} \frac{\tau GDPG_{t+b}}{\tau TG_b^{+}},\ x_e^{-} = \sum_{b=0}^{e} \frac{\tau GDPG_{t+b}}{\tau TG_b^{-}}]$$

$$[x_e^{+} = \sum_{b=0}^{e} \frac{\tau GDPG_{t+b}}{\tau NIC_b^{+}},\ x_e^{-} = \sum_{b=0}^{e} \frac{\tau GDPG_{t+b}}{\tau NIC_b^{-}}];\ [x_e^{+} = \sum_{b=0}^{e} \frac{\tau GDPG_{t+b}}{\tau NG_b^{+}},\ x_e^{-} = \sum_{b=0}^{e} \frac{\tau GDPG_{t+b}}{\tau NG_b^{-}}]$$

where e = 1, 2, 3 . . . . and $[x_e^{+} \to L_{xi^{+}}$ as $e \to \infty$, and $x_e^{-} \to L_{xi^{-}}]$.

The multiplier effect is a long term equilibrium alteration when calculating the unit shocks of HIC, HG, TIC, TG, NIC, and NG.

4. Results and Discussion

4.1. Study Summary Statistics and Correlation Outcomes

The summary statistics for each variable are shown in Table 1. It can be seen that all of the variables apart from LnNIC are negatively skewered. Moreover, the kurtosis outcomes show that all of the variables are platykurtic as well. Furthermore, the statistical significance of the Jarque–Bera statistics affirms the normal distributions of these variables. Table 2 shows the results of the correlation analysis for the variables used in this study. It can be seen that all of the explanatory variables are correlated with the dependent variable.

Table 1. Summary statistics.

	LnGDPG	LnHIC	LnHG	LnTIC	LnTG	LnNIC	LnNG
Mean	1.439	8.167	9.705	8.702	10.062	5.526	6.574
Median	1.576	8.481	9.871	8.930	10.372	4.919	6.213
Maximum	2.323	9.016	10.452	10.058	11.403	7.265	9.198
Minimum	−0.206	6.502	8.210	6.964	8.226	4.919	0.693
Std. Dev.	0.568	0.698	0.635	0.963	1.025	0.794	1.593
Skewness	−1.220	−0.897	−0.958	−0.384	−0.502	0.722	−0.877
Kurtosis	2.147	2.743	2.837	1.754	1.741	1.936	5.211
Jarque-Bera	14.543	6.569	7.402	4.283	5.183	6.435	15.937
Probability	0.000	0.037	0.024	0.017	0.074	0.040	0.000

4.2. Stationarity Test for the Variables

Firstly, we used the two stationary tests for unit root testing, namely the ADF [56] and the P-P [57] tests. The analysis first examines the unit root features of the investigative variables. Therefore, the inclusion order is very crucial in the decision of the regression estimator, which is used to estimate long-term coefficients, for the increased confidence in the variables. However, the consequence of using these two unit root analytical techniques is that procedural disruption of the data is not taken into account. However, systemic defects are very critical to consider, since preventing this key issue leads to partial forecasts of the resort assets. The test results are revealed in Table 3. The estimates from both tests reveal a mixed order of integration among the variables at level and at first difference. Hence, the choice of using the ARDL and NARDL models in this study is justified. Besides, the confirmation of the stationarity of the variables nullifies the probability of estimating spurious regression outcomes.

Table 2. Correlation among study variables.

	LnGDPG	LnHIC	LnHG	LnTIC	LnTG	LnNIC	LnNG
LnGDPG	1.000						
LnHIC	−0.349	1.000					
LnHG	−0.717	0.975	1.000				
LnTIC	−0.223	0.959	0.936	1.000			
LnTG	−0.208	0.962	0.951	0.989	1.000		
LnNIC	−0.365	0.700	0.647	0.784	0.747	1.000	
LnNG	−0.425	0.667	0.607	0.738	0.717	0.829	1.000

Table 3. Outcomes of unit root testing.

ADF Tests (at Level)							
	LnGDPG	**LnHIC**	**LnHG**	**LnTIC**	**LnTG**	**LnNIC**	**LnNG**
t-Statistic values	−5.742	−2.688	−3.076	−1.789	−2.098	0.231	1.119
(*p*-values)	(0.000)	(0.083)	(0.035)	(0.381)	(0.246)	(0.971)	(0.997)
At first difference							
t-Statistic values	−5.141	−6.950	−6.008	−5.623	0.017	−6.741	−11.670
(*p*-values)	(0.000)	(0.000)	(0.000)	(0.000)	(0.954)	(0.000)	(0.000)
P-P test (at level)							
t-Statistic values	−5.881	−6.436	−3.240	−1.620	−2.221	0.516	−2.173
(*p*-values)	(0.000)	(0.000)	(0.023)	(0.464)	(0.201)	(0.985)	(0.218)
At first difference							
t-Statistic values	−16.385	−6.955	−6.041	−5.614	−5.982	−6.750	−14.210
(*p*-values)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

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

4.3. Symmetric and Asymmetric Bounds Testing for the Presence of Cointegration

The symmetric and asymmetric long-run connections between variables was analyzed using bounds testing. The following Table 4 shows the results of a symmetrical and asymmetrical cointegration test with F-statistical values 8.493856 and 5.290013 signifying levels of 10%, 5%, 2.5%, and 1%, with a lower and a higher bound signifying a cointegrated verdict.

Table 4. Symmetric and asymmetric bounds test for the presence of cointegration results.

Specified Model	Symmetric Bounds Test for the Presence of Cointegration					Conclusion
GDPG/(HIC, HG, TIC, TG, NIC, NG)	**F-bounds testing**		**N-Hypoth.: found no relationship level**			Cointegrated
	T-stat	Values	Signif. Level	I(0)	I(1)	
	F-stat	(8.493856)	At the 10% level	(1.99)	(2.94)	
	k	6	At the 5% level	(2.27)	(3.28)	
			At the 2.5% level	(2.55)	(3.61)	
			At the 1% level	(2.88)	(3.99)	
	Asymmetric bounds test for the presence of cointegration					
	F-bounds testing		**N-Hypoth.: found no relationship level**			
	T-stat	Value	Signif. Level	I(0)	I(1)	
	F-stat	(5.290013)	At the 10% level	(1.76)	(2.77)	
	k	12	At the 5% level	(1.98)	(3.04)	
			At the 2.5% level	(2.18)	(3.28)	
			At the 1% level	(2.41)	(3.61)	

4.4. Cointegration Technique for the Variables

The interface between the variables of interest is described as critical after the assurance of the order of incorporation into the testing parameters. This research mostly utilizes the simplified moment's procedure to approximate the connections between the sample variables. This process requires the integration of the testing variables if the predicted statistical values are higher than those below, and over the critical values. The reliability and the results are interpreted in Table 5. Variable intervention may be evaluated with the process of cointegration used by Johansen [58].

4.5. Symmetric (ARDL) Model Results

The results of the linear autoregressive distributed lag technique with long- and short-run analyses are shown in Table 6.

In the Table 6, the outcomes of Panel A show that, in the short-run, economic growth had a positive relationship with hydroelectric energy generation, the installed capacity of thermal energy, and the installed capacity of nuclear energy, with probability values of 0.282, 0.561, and 0.024, respectively. The results also show that the installed capacity of hydroelectric energy, thermal energy generation, and nuclear energy generation had the opposite link to economic growth in Pakistan. Moving on to Panel B, the symmetric long-run analysis shows that hydroelectric energy generation, the installed capacity of thermal energy, and the installed capacity of nuclear energy were positively associated with economic progress, with coefficients of 0.681, 0.357, and 0.404 and probability values of 0.275, 0.562, and 0.024, respectively. Similarly, the installed capacity of hydroelectric energy, thermal energy generation, and nuclear energy generation were negatively associated with economic growth in Pakistan. Increased global rivalry between the emerging and industrialized world in the near future, will bring countries closer not only socially, but politically and economically.

Table 5. Outcomes of cointegration technique.

T-Test Statistics				
Hypo- No. of CE(s)	**Eigenvalue**	**T-Statistic**	**C-Values (0.05)**	**Prob. ****
None *	0.707	159.063	125.615	0.000
At most 1 *	0.631	102.553	95.753	0.015
At most 2	0.417	56.642	69.818	0.352
At most 3	0.261	31.768	47.856	0.624
At most 4	0.211	17.805	29.797	0.580
At most 5	0.127	6.869	15.494	0.592
At most 6	0.013	0.607	3.841	0.435
Max-Eigenvalue Statistics				
Hypo- No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**C-Values (0.05)**	**Prob. ****
None *	0.707	56.509	46.231	0.002
At most 1 *	0.631	45.911	40.077	0.009
At most 2	0.417	24.873	33.876	0.393
At most 3	0.261	13.963	27.584	0.825
At most 4	0.211	10.935	21.131	0.653
At most 5	0.127	6.262	14.264	0.579
At most 6	0.013	0.607	3.841	0.435

* Signifies hypothesis rejection at the 0.05 level; ** show the *p*-values of MacKinnon–Haug–Michelis (1999).

The competition between developed and developing countries is becoming fiercer. It is well known that this growth is accompanied with a significant increase in energy consumption as a result of economic development. The environmental implications of increasing oil consumption have resulted in climate change and global warming. Global warming and the intensification of climate change do not benefit the natural world or human life on Earth. Governments and officials in high-polluting economies want to reduce energy demand by increasing energy innovation and production in order to minimize global warming and investigate the relationship between energy usages. Many longitudinal studies on energy development linkages have been carried out [59–61]. The ongoing movement from conventional to alternative energy is happening. As traditional energy generation and consumption, as well as increased conventional energy use, have negative environmental consequences, the demand for renewable energies is growing more pressing. Furthermore, there was data that revealed a short-term, two-way relationship between conventional energy usage and GDP growth. Based on these results, renewables are a potential choice for energy and climate change protection, while removing fossil fuels supports a clean energy economy [62–64]. The connection between growth in energy consumption and its effect on environmental deterioration, as well as its inherent influence on greenhouse gas emissions, has been thoroughly studied. Economic progress has a significant impact on standards of living, but also a negative environmental impact. Economic growth could simultaneously increase the consumption of energy. Some experts are concerned in this respect with the causal connection between these factors. However, economic development can also lead to emissions of greenhouse gases, which led some investigators to incorporate environmental predictors in the correlation analysis outlined above [65–67]. The ecosystem is highly interconnected with sustainable development. Given the energy supply and environmental issues, such as globalization, air contamination, industrial pollution, ozone degradation, and loss of forests, as well as environmental quality pressures from energy transmission to the economy, it is clear that if a society does not take heed, sustainable development cannot be achieved by using energy. Furthermore, the relationship between energy efficiency and environmental impact is strong because of the increase in efficiency which leads to the reduced use of resources and pollution. Furthermore, as more or less all energy supplies have certain environmental effects, environmental constraints and the resulting negative impacts on sustainable growth can be at least partly resolved with energy quality improvements [68–70].

Table 6. Symmetric short- and long-run examination outcomes.

Panel A: Symmetric short-run dynamics (conditional error correction regression)				
Variables	**Coefficient**	**S-E**	**T-S**	**Prob.**
C	−0.015	1.643	−0.009	0.992
GDPG(−1)	−0.972	0.135	−7.175	0.000
HIC	−0.376	0.559	−0.674	0.504
HG(−1)	0.662	0.607	1.090	0.282
TIC	0.348	0.593	0.585	0.561
TG(−1)	−0.660	0.591	−1.116	0.271
NIC	0.392	0.167	2.346	0.024
NG	−0.095	0.075	−1.265	0.213
D(HG)	2.278	0.646	3.527	0.001
D(TG)	1.387	0.644	2.150	0.038
CointEq(−1)	−0.972	0.108	−8.989	0.000
Panel B: Symmetric long-run dynamics				
Variables	**Coefficient**	**S-E**	**T-S**	**Prob.**
HIC	−0.387	0.587	−0.659	0.513
HG	0.681	0.615	1.106	0.275
TIC	0.357	0.612	0.584	0.562
TG	−0.679	0.589	−1.153	0.256
NIC	0.404	0.171	2.354	0.024
NG	−0.098	0.080	−1.229	0.226
C	−0.016	1.690	−0.009	0.992
Panel C: Symmetric diagnostics tests				
(R^2)	(0.488)	(Mean-D var)		(1.474)
(Adjusted R^2)	(0.363)	(S.D. D var)		(0.519)
(S.E. of regression)	(0.414)	(AIC)		(1.262)
(Sum-S resid)	(6.357)	(SC)		(1.656)
(Log likelihood)	(−19.678)	(HQC)		(1.411)
(F-statistic)	(3.921)	(Durbin–Watson stat)		(2.028)
(Prob(F-statistic))	(0.001)			

Furthermore, Pakistan is a growing country with a manufacturing sector that is heavily reliant on energy. The connection between energy use and fiscal success has been investigated in the most current results that utilize national or integrated information. However, the presence of the aviation sector at the industrial levels does not support the energy development connotation, since energy utilization might be stringent in specific industries. Every year, Pakistan's energy consumption rises. In order to close the supply–demand gap, Pakistan's government must take urgent action to make use of key energy sources, such as solar and wind energy. In the current conditions of modern development, energy is not only the backbone of economic growth, but also an essential strategic reserve for a country, such as Pakistan, which confronts the relentless danger of energy shortages [71,72]. As the use of renewable energy grows, more researchers at the national, regional, and global levels are examining the fundamental elements of green energy generation to minimize pollution. Many recent studies have shown that renewable energy has a good environmental impact [73,74]. The outcomes of the Panel C show that the value of R^2 and adj-R^2 are 0.488 and 0.363, respectively. Likewise, the values for the F-statistic and DW are 3.921 and 2.028, respectively.

4.6. Asymmetric (NARDL) Model Outcomes

The results of the non-linear (NARDL) technique with long-and short-run examination are shown in Table 7.

Table 7. Outcomes of asymmetric short- and long-run examination.

Panel D: Asymmetric short-run dynamics (error correction regression)				
Variables	**Coefficients**	**S-E**	**T-S**	**Prob.**
C	1.905	0.361	5.265	0.000
GDPG(−1)	−1.284	0.165	−7.745	0.000
HIC_POS	−0.220	0.692	−0.318	0.752
HIC_NEG(−1)	533.784	132.084	4.041	0.000
HG_POS	1.820	0.780	2.331	0.027
HG_NEG	−1.006	1.526	−0.659	0.515
TIC_POS	−0.431	0.932	−0.462	0.647
TIC_NEG(−1)	64.704	23.793	2.719	0.011
TG_POS	−0.541	1.085	−0.499	0.621
TG_NEG	2.042	1.471	1.387	0.176
NIC_POS(−1)	1.184	0.504	2.347	0.026
NIC_NEG(−1)	−15.985	6.544	−2.442	0.021
NG_POS	−0.048	0.084	−0.572	0.571
NG_NEG	−0.135	0.093	−1.457	0.156
D(HIC_NEG)	126.686	145.216	0.872	0.390
D(TIC_NEG)	29.601	19.379	1.527	0.137
D(NIC_POS)	0.670	0.481	1.392	0.174
D(NIC_NEG)	−2.953	8.587	−0.343	0.733
CointEq(−1)	−1.284	0.123	−10.413	0.000
Panel E: Asymmetric long-run dynamics				
Variables	**Coefficients**	**S-E**	**T-S**	**Prob.**
HIC_POS	−0.171	0.540	−0.318	0.752
HIC_NEG	415.565	91.734	4.530	0.000

Table 7. *Cont.*

Panel E: Asymmetric long-run dynamics				
Variables	**Coefficients**	**S-E**	**T-S**	**Prob.**
HG_POS	1.417	0.607	2.333	0.027
HG_NEG	−0.783	1.177	−0.665	0.511
TIC_POS	−0.335	0.713	−0.470	0.641
TIC_NEG	50.374	17.873	2.818	0.008
TG_POS	−0.421	0.854	−0.493	0.625
TG_NEG	1.590	1.150	1.382	0.177
NIC_POS	0.922	0.393	2.344	0.026
NIC_NEG	−12.445	4.764	−2.612	0.014
NG_POS	−0.037	0.066	−0.565	0.576
NG_NEG	−0.105	0.074	−1.419	0.166
C	1.483	0.218	6.786	0.000
Panel F: Asymmetric diagnostics tests				
(R^2)	(0.699)	(Mean-D var)		(1.463)
(Adjusted R^2)	(0.517)	(S.D. D var)		(0.520)
(S.E. of regression)	(0.361)	(AIC)		(1.088)
(Sum-S resid)	(3.658)	(SC)		(1.804)
(Log likelihood)	(−7.042)	(HQC)		(1.356)
(F-statistic)	(3.839)	(Durbin–Watson stat)		(2.097)
(Prob(F-statistic))	(0.000)			

Table 7 shows the results of the asymmetric (NARDL) technique analysis, with Panel D showing the results of the short-run interactions between variables. The results show that the positive and negative shocks caused by the changes to the installed capacity of hydroelectric energy has both adversative and productive relationships to economic growth, with probability values of 0.752 and 0.000. The positive and negative shocks of hydroelectric energy generation have both constructive and adverse associations with economic progress, with probability values of 0.027 and 0.515. Similarly, the positive and negative shocks caused by changes to the installed capacity of thermal energy had an adverse and constructive association to economic growth, with *p*-values of 0.647 and 0.011. The positive and negative shocks of thermal energy generation had both a detrimental and beneficial association with economic progress, with *p*-values of 0.621 and 0.176. Furthermore, the positive and negative shocks caused by changes to the installed capacity of nuclear energy had both a positive and adversative connection with economic progress, with *p*-values of 0.026 and 0.021. The positive and negative shocks of nuclear energy generation had an adversative connection, with probability values of 0.571 and 0.156, respectively.

Proceeding to the Panel E, findings from the long-term exploration reveal that the positive and negative shocks caused by changes in the installed capacity of hydroelectric energy had an adversative and productive connection, with coefficients of −0.171 and 415.565 and *p*-values of 0.752 and 0.000. The positive and negative shocks of hydroelectric energy generation had both a constructive and undesirable association with economic growth, with coefficients of 1.417 and −0.783 and *p*-values of 0.027 and 0.511. Similarly, the positive and negative shocks caused by changes in the installed capacity of thermal energy had both an adverse and constructive connection, with coefficients of −0.335 and 50.374 and *p*-values of 0.641 and 0.008. The positive and negative shocks of thermal energy generation had a negative and positive relationship with economic progress, with coefficients of −0.421 and 1.590 and *p*-values of 0.625 and 0.177. Furthermore, the positive and negative shocks caused by changes in the installed capacity of nuclear energy had both a constructive and adverse relationship with economic progress, with coefficients of 0.922 and −12.445 and *p*-values of 0.026 and 0.014. The positive and negative shocks of nuclear energy generation had an adversative linkage to economic progress, with coefficients of −0.037 and −0.105 and *p*-values of 0.166 and 0.000, respectively.

The impact on income indicates that globalization, which decreased quality of the atmosphere by increasing greenhouse gases, raised the amount of production and exchange within an economy. Improvements in technology mean that countries will achieve energy-saving innovations faster because of development. To increase the environmental standards by reducing carbon dioxide, use energy-efficient technology. This effect reveals that the move to green capitalism, by shifting the economic system, influences the capital–labor ratio. The economy is also likely to shift from production to manufacturing and services. Interestingly, these sectoral shifts are likely to have distinct environmental effects. The transition to manufacturing from farming has deteriorated the sustainability of the atmosphere with increased carbon emissions. On the contrary, by reducing emissions of pollutants, the transition from farming to services improves the standard of temperature [75–77]. Because of several factors, such as increasing industrialization, increasing world population, shifting living conditions, and rising energy demand, the threat of global warming has risen in the past few decades. Decision makers may also be recommending energy-saving technology since energy use has a major influence on environmental pollution and appropriate strategies are therefore needed to address the impact of carbon emissions. Moreover, if globalization exacerbates environmental destruction, lawmakers could develop enabling strategies for globalization [78,79].

Economic development and the use of resources are, moreover, the primary sources of energy transfer and are seen as the main culprits of environmental degradation. Economic growth strategies must therefore be moderate to reduce the mechanism of environmental deterioration, and policymakers view the environmental pollution process as a major challenge for the economy and for growth. The reality is that industrialization, urbanization, and development in trade depend to a significant degree on the consumption of fossil fuels, such as oil and coal, and this is due to recent rapid economic development. Oil and coal were used for mining activities, electricity production, and transport. High energy use is, on the one hand, a key factor in fast economic growth, industrialization, and development. In turn, the intake of oil causes emissions of carbon [80–82]. The global mean temperature has increased in recent years, natural disasters and swelling weather have repeatedly occurred, air contamination is extremely severe, and environmental questions are becoming a key problem for civilization as a whole. Air pollution has become extremely dangerous, threatening human health and limiting the sustained growth of the global economy and civilization with the development of industrialization and urbanization across countries [83].

Energy is essential for economic growth. Furthermore, the rise in productivity continues to raise energy demand owing to the increase in energy use. There is a strong correlation between a country's energy use and its total economic development. A country's development and socio-economic advancement may therefore be gauged by looking at its per capita energy intake (PEI). Pakistan, similar to other developing nations, is seeing an increase in energy consumption due to the country's growing population. Because of its high dependency on oil and gas, decreased power levels, circulatory debt, energy safety and challenges, and low governance, Pakistan is in the face of an acute energy shortage. Oil crisis management requires policies that reduce debt to a minimum and discourage financing investment [84,85]. Various nations around the globe have worked tirelessly to curb global emissions and to prevent dangerous climate change effects. Since fossil fuel is being used, much attention has been paid to greenhouse gas pollution resulting from combustion. In order to reduce greenhouse gas emissions while also generating cheaper and more efficient energy, the challenge is to increase the sector of energy procurement. If fossil fuel oil cannot yet be replaced, every effort must be made to discover an alternative source of energy. Nuclear and renewable energy may provide solutions to energy conservation and climate change [86–88]. The ultimate global task is to achieve environmental sustainability, and development is moving at a rapid pace in this field. Pollution is on the rise, and as a result of these factors, as well as rising global energy demand, there is now more need for cleaner surroundings and greener energy solutions. Industrialization and human activities pollute the environment today by releasing toxic gases from conventional fossil fuels, including coal, oil, and natural gas. However, nuclear power and renewable energy have received a lot of attention in the last several decades as ways to cut carbon dioxide emissions. There has been a great deal of investigation on what causes carbon dioxide emissions [89,90]. The results of Panel F show that the value of R^2 and adj-R^2 are 0.699 and 0.517. Similarly, the F-statistic and DW values are 3.839 and 2.097. The plotted results of the symmetric and asymmetric cumulative sum and cumulative sum of squares at the level of 5% are illustrated in Figure 2.

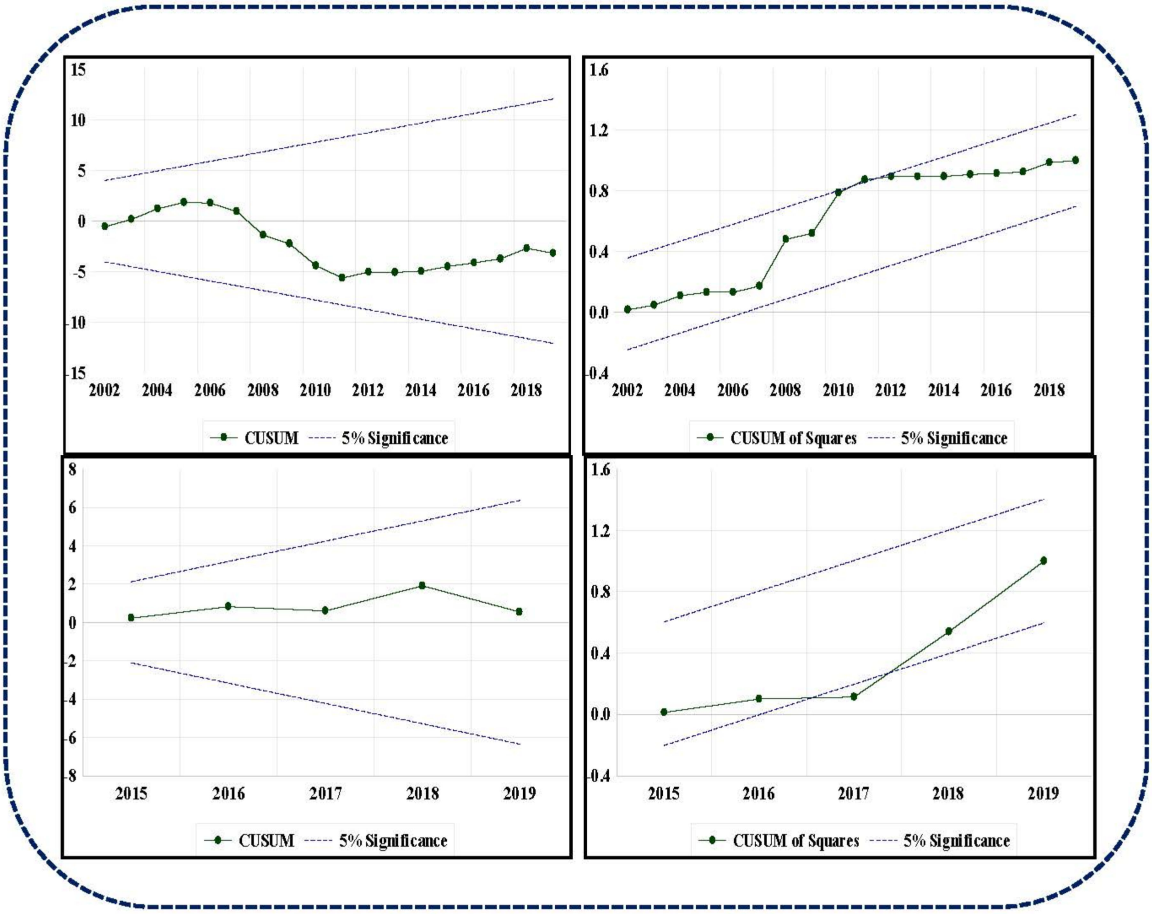

Figure 2. Symmetric and asymmetric plot of CUSUM and CUSUM of squares.

Figure 3 shows an asymmetric multiplier graph of (+ve) and (−ve) shocks caused by changes in the installed capacity of hydroelectric energy, hydroelectric energy generation, the installed capacity of thermal energy, thermal energy generation, the installed capacity of nuclear energy, and nuclear energy generation.

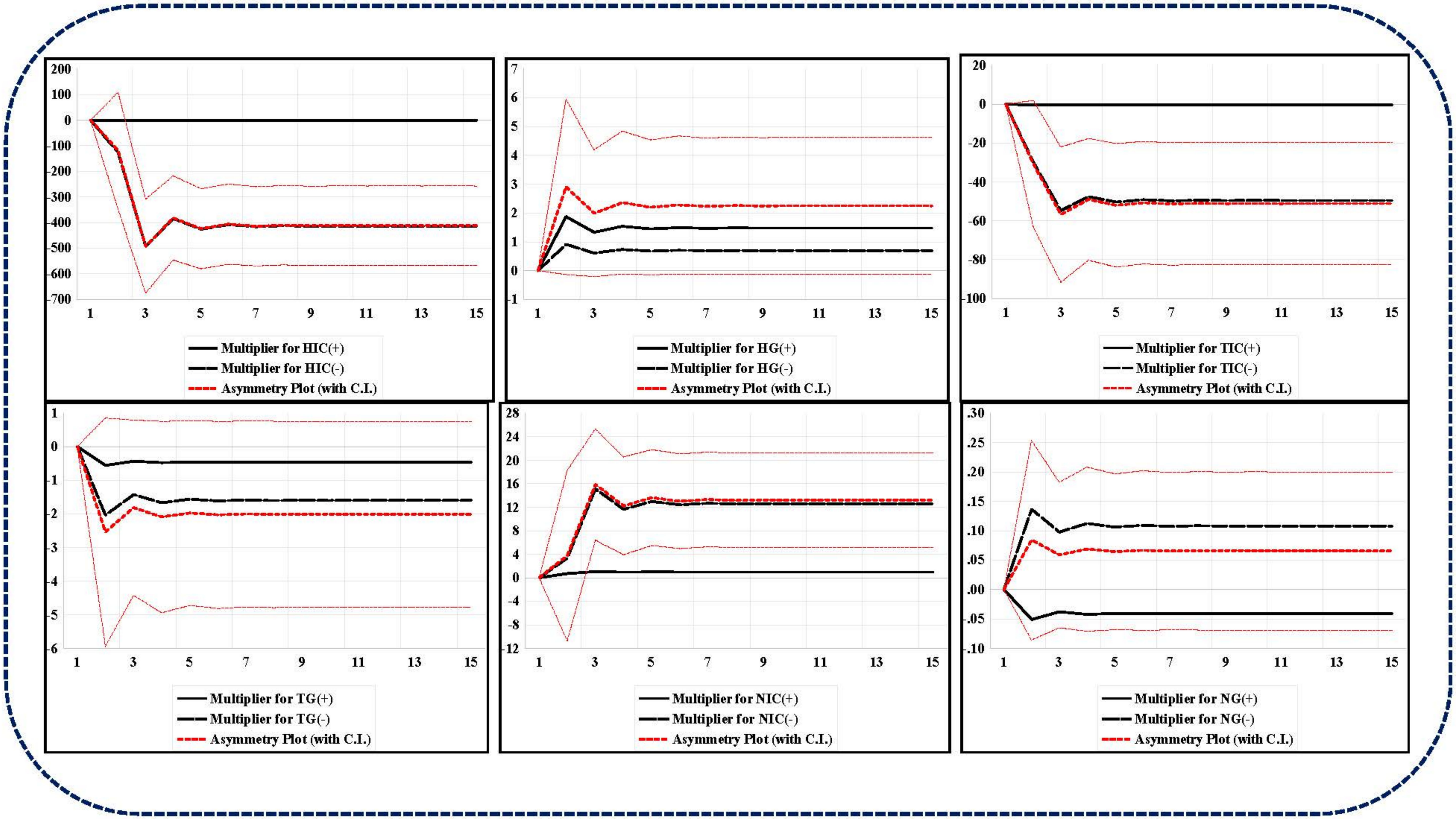

Figure 3. Asymmetric multiplier graph of positive and negative shocks of variables.

5. Conclusions and Policy Directions

The major intension of this analysis was to determine the interaction of commercial energy distribution, including the installed capacity of hydroelectric energy, hydroelectric energy generation, the installed capacity of thermal energy, thermal energy generation, the installed capacity of nuclear energy, and nuclear energy generation, with the economic growth of Pakistan by taking annual data for the period 1970–2019. We have used two unit root tests to assess the stationarity of the variables. Symmetric (autoregressive distributed lag) and asymmetric (non-linear autoregressive distributed lag) methods were employed to check the interaction among the study variables. The consequences of the linear ARDL model reveal that, in the long run, hydroelectric energy generation, thermal energy from installed capacity, and nuclear energy from installed capacity had a dynamic connection with economic growth, while the installed capacity of hydroelectric energy, thermal energy generation, and nuclear energy generation had an adversative link with economic progress in Pakistan. Furthermore, the results of the nonlinear (NARDL) model show that, in the long-run, the installed capacity of hydroelectric energy, when suffering positive and negative shocks, had both an adversative and productive connection to economic growth. Positive and negative shocks to hydroelectric energy generation had both productive and adversative links to economic growth in Pakistan. Moreover, the positive and negative shocks caused by changes in the installed capacity of thermal energy had an adversative and productive association with economic growth in Pakistan. Likewise, positive and negative shocks to thermal energy generation had an adverse and productive linkage to economic growth. The positive and negative shocks caused by changes in the installed capacity of nuclear energy had a constructive and adversative relation to economic development. Lastly, the positive and negative shocks of nuclear energy generation had an adversative relative to economic growth. In addition, the symmetric and asymmetric short-run exploration also displays the constructive and adversative relationships to economic growth in Pakistan.

The Pakistani government is expected to address the energy crisis in the country which has disrupted the other performing sectors by pursuing the findings of this report. New investment schemes that deliver cheap energy, such as renewables, must be introduced. The Government of Pakistan stresses the usage of renewable energies from indigenous sources and the Pakistani ecosystem. In this respect, promoting green and alternative energy is a top priority for the government. A number of measures have been undertaken to establish a sustainable development framework for the clean energy industry of Pakistan to reap the benefits of the promise of domestic alternative energy sources. The challenge lies in the transfer of fuel to satisfy domestic energy requirements. Every new government builds new power stations and raises energy, but no one focuses on the enhancement of power transmission and distribution. The energy dilemma in Pakistan can be easily solved if specialists are empowered to develop power supply and distribution and if the government handles this question seriously and fairly. It is easier to rely on electricity transmission rather than relying on constructing further power plants. Once Pakistan becomes clearer, its economy will grow and this will attract more international investors. Furthermore, other economic sectors are affected by crises, and a certain kind of oil shortage is causing several recessions. The energy market in Pakistan has been a big economic player. Power shortages and energy subsidies' budgetary effects hamper development. Energy subsidies are transferred from more profitable industries to more needed services.

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