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Renewable Energy Consumption, Trade Openess, and Climate Change in Asia Emerging Market Countries

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ABSTRACT

Renewable energy plays an essential role in reducing carbon emissions, which can be detrimental to climate change and pose a threat to our lives. Therefore, this study aims to examine the nexus between renewable energy consumption, trade openness, and climate change. The data used consist of panel data for emerging Asian countries from 2010 to 2021. The Granger Causality Test and Vector Error Autoregressive Model were employed to investigate the relationship among the variables. The findings indicate a unidirectional relationship between renewable energy and inflation, as well as between renewable energy consumption and CO2 emissions. These findings suggest that carbon dioxide emissions can drive renewable energy consumption, signaling that low-carbon development benefits from globalization and that globalization stimulates renewable energy growth, aiding in mitigating climate change. The research results also confirm a bidirectional relationship between trade openness and inflation. The impulse response analysis supports the notion of a robust negative correlation between a country's trade openness and its inflation rate, both in the short and long term.

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1. INTRODUCTION

Energy holds utmost significance in the lives of people worldwide, as it is closely linked to the development of a nation. However, the world still relies on non-renewable sources of energy, with fossil fuels being the most widely used. Notably, these non-renewable energy sources release harmful emissions that can cause climate change and damage to the planet and its inhabitants, such as floods, heatwaves, droughts, wildfires, and rising sea levels. Switching from non-renewable sources of energy is a highly effective method to decrease climate change. The demand for renewable energy is increasing as a result of its ability to reduce greenhouse gas emissions and alleviate the impacts of climate change. The scientific community affirms that climate change is a reality largely caused by human activities, and it is crucial to take prompt action to address it. Governments, corporations, and individuals are taking measures to limit greenhouse gas emissions, move towards renewable energy, and adapt to the changing climate.

The impact of globalization on both developed and developing economies encompasses a rise in energy consumption and greenhouse gas emissions. Available studies indicate a notable and statistically significant correlation between globalization and energy usage. (Marques et al., 2017) state that globalization plays a significant role in driving both economic growth and energy consumption over the long term. However, in the short term, only political globalization appears to influence energy consumption. On the other hand, (Saud et al., 2018) revealed that globalization exerts a notable and negative influence on energy demand. Meanwhile, economic growth and urbanization are identified as further determinants that stimulate energy consumption.

As the financial development increases, the consumption of energy is on the rise due to enhanced accessibility to financing (Sadorsky, 2011), The direct effect, the business effect, and the wealth effect are the impacts of financial development on energy consumption. The direct effect is related to consumers, who can easily access resources through efficient financial intermediation, allowing them to purchase

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durable products and increasing the demand for energy. The improved financial access provided by financial development drives the business effect, enabling companies to secure more affordable financial resources for expanding their activities, resulting in an increase in demand for energy. Lastly, the wealth effect is produced by the confidence enterprises and households have in the developed stock market. All three effects play a necessary role in the relationship between energy consumption and financial development.

Several findings including (Shahbaz et al., 2022), (Habiba & Xinbang, 2023), (Anton & Afloarei Nucu, 2020), (Çoban & Topcu, 2013) illustrate a positive correlation between the use of renewable energy and financial development. Furthermore, a study conducted across 30 provinces in China using the GMM panel VAR approach revealed that financial development, as assessed by indicators such as the comprehensive index, credit, stock turnover, and money supply, was able to significantly reduce energy utilization throughout the region.

Surveying the literature to understand renewable energy is no easy task, given the numerous studies on the subject. The economy experiences a rise in energy demand due to the interplay of various macroeconomic factors, including economic growth. According to the Environmental Kuznets Theory, there is an assumed relationship between environmental degradation indices and per capita income. In the early stages of economic growth, there is an increase in pollution emissions and a decrease in environmental quality. However, after reaching a certain level of per capita income (which varies by indicator), the pattern shifts, resulting in a reversal where, at higher income levels, economic expansion leads to environmental consequences. Therefore, the relationship between environmental impact, or emissions per capita, and income per capita takes the shape of an inverted U-curve.

The nexus of renewable energy consumption and economic growth has been investigated by several studies, while others have examined the reverse relationship. (Eren et al., 2019) examined India's financial development and the growth of the economy through Dynamic Ordinary Least Square (DOLS). His study revealed a bidirectional relationship between consumption of renewable energy and the growth of the economy. The growth in economics can impact renewable energy demand, and vice versa. Although higher economic growth rates can lead to increased funding for renewable energy projects, the consumption of renewable energy is able to stimulate economic growth by increasing renewable energy investment, such as wind power, hydroelectric power, solar power, and other renewable energy sources.

By utilizing various methods such as conventional granger, wavelet coherence approach, and the Toda Yamamoto causality technique, (Adebayo & Akinsola, 2020) investigated the connection between CO2 emissions, growth of the economy, and consumption of energy in Thailand. The outcomes of the study indicate a two-way causal link between emissions of carbon dioxide and energy use. Moreover, a direct connection is observed between carbon dioxide emissions and energy usage over both short and extended timeframes. Furthermore, there is a notable link between the increase in GDP and the emission of carbon dioxide during the corresponding time frame.

The outcome of the unidirectional causality examination demonstrates that energy consumption exerts a constructive and noteworthy influence on economic expansion. Elevated energy consumption fosters economic growth in both immediate and prolonged periods, highlighting energy efficiency as a key factor propelling economic advancement. Conversely, reduced energy consumption can detrimentally affect economic growth. Therefore, energy is crucial in stimulating economic progress, and a shortage of or reduction in energy can hinder development (Pata & Terzi, 2017).

In the last three decades, numerous economies have witnessed significant growth in economic trade, income, and energy usage. However, only a limited number of research studies directly examines the consequence of trade openness on consumption of renewable energy (Zhang et al., 2021). (Sadorsky, 2011) stated that in theory, there are several explanations of how exports and imports can influence energy consumption. Machinery and equipment are necessary for loading and transporting commodities to various destinations, such as seaports, airports, or docking stations. These processes consume energy. As the volume of exports and imports increases, it implies an expansion of economic activity, which leads to an increase in demand for energy.

An important aspect of this study is its examination of how renewable energy consumption interacts with trade openness, inflation, and climate change, with a particular focus on emerging countries in Asia. While previous research has looked into similar connections in various contexts, there is a noticeable gap in studies specifically addressing this relationship within the context of emerging Asian economies. By analyzing this relationship within the distinct economic landscapes of these regions, this research enhances our understanding of the different relationships between renewable energy, trade openness, and climate change in areas undergoing rapid economic growth and transformation. This emphasis on emerging Asian countries offers a fresh perspective to the existing literature on renewable energy and financial development, providing valuable insights customized for policymakers, investors, and stakeholders operating within these regions.

According to the findings of (Tiwari et al., 2022), there is no substantial correlation between the development of the stock market and the consumption of renewable energy in the Asian region. Additionally, the study indicates that increased trade activity and economic expansion can dramatically lower energy use through technical impacts. Moreover, foreign direct investment (FDI) can promote renewable energy consumption in a low-income Asian country where capital is still rare.

The literature above demonstrates that numerous studies have examined the variables that determine the demand for renewable energy. This research aims to supplement existing literature by including various macroeconomic factors, such as openness to trade, inflation, and carbon dioxide emissions, which impact the demand for renewable energy. To analyze the relationship between these variables in Asian Emerging Market countries in both the short and long term, we will employ the VECM approach. Additionally, this paper makes a significant contribution to existing literature by providing a holistic analysis of the factors influencing renewable energy consumption and offering methodological advancements for future research in this field. Its insights are valuable for advancing our understanding of the nexus between renewable energy, economics, and sustainable development.

2. MATERIALS AND METHODS

2.1 Data

This study discusses renewable energy, international trade, inflation, and greenhouse gas emissions in emerging countries. It utilized a quantitative approach spanning from 2010 to 2021, primarily due to data limitations. The data was taken from the World Bank's, World Development Index.

Table 1. Data Descriptions

Variables	Description	Frequency	Source
Renewable Energy	Log of renewable energy consumption (% of total final energy consumption	year, 2010-2021	WDI, World Bank
Trade Openness	The percentage of total export and import contribution to GDP (%)	year, 2010-2021	WDI, World Bank
Inflation	The consumer price index (CPI) represents the yearly percentage fluctuation in the expenses incurred by an average consumer's spending when purchasing a preset array of goods and services	year, 2010-2021	WDI, World Bank
CO2 Emission	Total carbon dioxide emissions (metric tons per capita)		WDI, World Bank

2.2 Research Model

The analysis of unit roots is necessary to determine whether the data used in a stationary study is valid. Data is deemed stationary if it does not undergo significant changes, or if fluctuations remain around the average value. In this investigation, the Augmented Dickey Fuller (ADF) and Phillips-Peron unit root tests were utilized. Gujarati explains that to assess the stationarity of our data, we can employ the unit root test method by computing the disparity between Y_t and its regression with Y_{t-1}. If the coefficient slope in this regression equals zero, it suggests that Y_t lacks stationarity. Conversely, if the coefficient slope is negative, it implies the data is stationary.

a) The null hypothesis for the unit root test, $H_0 = 0$, posits the existence of a unit root or non-stationarity in the time series, or the presence of a stochastic trend.
b) The alternative hypothesis, $H_0 < 0$, asserts the stationarity of the time series, potentially alongside a deterministic trend.

Furthermore, the cointegration test is applied to determine whether there are two or more variables that have equilibrium in the long run. This study utilized the Johansen test (Johansen, 1988), which compares each trace statistic value and the maximum eigenvalue with a critical value corresponding to a 5 percent significance level. If the critical value is less than the trace statistic or maximum eigenvalue, then there is evidence of cointegration and a long-term link between these variables (Engle and Granger, 1987). If the model is integrated in the long term, the next step is to estimate Panel VECM in both the short and long term. The subsequent test to be conducted in this study is the Granger Panel VECM causality test (Eq.1 and Eq.2).

$$\boldsymbol{Y_{t,i} = \sum_{i=1}^{p} \alpha_i Y_{t-i} + \sum_{i=1}^{p} \beta_i X_{t-i} + \mu_t} \quad (1)$$
$$\boldsymbol{X_{t,i} = \sum_{i=1}^{p} \alpha_i X_{t-i} + \sum_{i=1}^{p} \beta_i Y_{t-i} + \mu_t} \quad (2)$$

This test will estimate the correlation between renewable energy, trade openness, emissions of carbon dioxide, and inflation. If there is a long-term relationship, then panel VECM will be applied to capture the short-term and long-term relationships among variables.

$$(1-L)\begin{bmatrix} RE \\ \text{TO} \\ \text{Inflation} \\ CO2 \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{bmatrix} + \sum_{i=1}^{p}(1-L)\begin{bmatrix} \alpha_{11i}\alpha_{12i}\alpha_{13i}\alpha_{14i} \\ \beta_{21i}\beta_{22i}\beta_{23i}\beta_{24i} \\ \gamma_{31i}\gamma_{32i}\gamma_{33i}\gamma_{34i} \\ \delta_{41i}\delta_{42i}\delta_{33i}\delta_{34i} \end{bmatrix} x \begin{bmatrix} RE_{t-i} \\ \text{TO}_{t-j} \\ \text{Inflation}_{t-k} \\ \text{CO2}_{t-m} \end{bmatrix} + \begin{bmatrix} \delta \\ \rho \\ \varphi \\ \mu \end{bmatrix} ECT_{t-1} + \begin{bmatrix} \rho_{1t} \\ \rho_{2t} \\ \rho_{3t} \\ \rho_{4t} \end{bmatrix}$$

The difference operator, denoted by (1-L); ECT_{t-1}, is a lagging error correction term, which comes from a long-term cointegration relationship. Long-term causes are shown by the t-statistical significance of the lagging error correction term (Engle and Granger, 1987). The presence of a notable correlation when observing the initial changes in these variables offers support for determining the direction of short-term causation. The combined $\chi 2$ statistic for the first differences of the remaining independent variables is used to determine the causality among these variables.

3. RESULT AND DISCUSSION

3.1. Descriptive statistic

Table 1 displays the descriptive statistics for each variable in this study. The Jarque-Bera results show that each variable is normally distributed.

Table 1. Descriptive Statistics

Descriptive	RE	TO	INFLASI	CO2
Mean	31.81491	77.74756	4.514885	3.209782
Median	27.91500	68.21992	3.784001	1.931324
Maximum	90.66000	210.4000	59.21974	18.61885
Minimum	0.000000	22.77218	-4.298475	0.059765
Std. Dev.	22.68872	37.75663	5.139372	3.564205
Skewness	0.861439	0.859039	6.509857	2.307569
Kurtosis	3.156759	3.290156	64.68221	8.889954
Jarque-Bera	41.15212	41.74475	54645.36	769.8770
Probability	0.000000	0.000000	0.000000	0.000000
Sum	10498.92	25656.69	1489.912	1059.228
Sum Sq. Dev.	169362.0	469010.3	8689.926	4179.470
Obs	330	330	330	330

The variable for renewable energy has a maximum value of 90,660, a minimum value of 0.000, a mean value of 31.814, and a standard deviation value of 22.688. This indicates that the mean value is higher than the standard value, suggesting low data deviation, resulting in an even distribution of values.

The trade openness variable has a maximum value of 210.400, a minimum value of 22.772, and a mean value of 77.74, with a standard deviation value of approximately 37.756. Similar to the renewable energy variable, the mean value surpasses the standard value, implying low data deviations and an even spread of values.

Inflation variables exhibit a range of values, with a maximum of 59.219, a minimum of -4.298, and a mean of 4.514, accompanied by a standard deviation of about 5.139. This suggests a high level of data variation within these variables.

Likewise, the CO2 emission variables show significant data variation, with a maximum value of 18.618, a minimum of 0.059, a mean of 3.209, and a standard deviation of 3.564. In this case, the mean value is smaller than the standard value, indicating considerable data dispersion.

3.2. Empirical Analysis

Based on the stationary test results in Table 2, it is evident that the data on renewable energy, trade openness, and CO2 emissions are not stationary at a significance level of $p > 0.05$. The data on renewable energy becomes stationary after taking the first difference. Additionally, the inflation variable shows stationarity at the level with a p-value > 0.05. The current test demonstrates a tendency to excessively reject the null hypothesis, even when it is true, while erroneously accepting the null hypothesis when it is incorrect. However, the panel unit root test offers a solution to this issue by mitigating the problem of excessive null hypothesis rejection and effectively applying it to small sample sizes.

Table 2. Stationary Test Results

Variables	Test	Statistics	
		Level	First Difference
Renewable Energy (RE)	ADF – Fisher Chi-square	68.9156	118.768
	Levin, Lin & Chu t**	-3.88675	-10.7040
	Lm Pesaran and Shin W-Stat	0.47012	-3.45382
	PP-Fisher Chi-square	75.9778	173.419
Trade Openness (TO)	ADF – Fisher Chi-square	89.4977	99.873
	Levin, Lin & Chu t**	-5.27911	-2.526
	Lm Pesaran and Shin W-Stat	-0.74010	-2.350
	PP-Fisher Chi-square	45.5652	175.699
Inflasi	ADF – Fisher Chi-square	136.213	177.873
	Levin, Lin & Chu t**	-9.70327	-10.526
	Lm Pesaran and Shin W-Stat	-4.40954	-6.450
	PP-Fisher Chi-square	133.485	186.679
CO2 Emission	ADF – Fisher Chi-square	67.1559	108.236
	Levin, Lin & Chu t**	-2.81118	-8.245
	Lm Pesaran and Shin W-Stat	0.49709	-2.895
	PP-Fisher Chi-square	86.9836	177.361

Based on the result of the optimum lag test in Table 3, it is known that the second lag is selected as the optimal lag. After selecting the optimal lag, namely the second lag, a stability test is carried out. Based on the results of the stability test, this research model was found stable and it passed the stability test. This can be seen from the modulus value, which is still below one or modulus < 1,000.

Table 3. Optimum Lag Determination

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1644,598	NA	5605.474	19.983	20.058	20.013
1	-1192.983	875.85	28.54245	14.702	15.079*	14.855*
2	-1170.107	43.257*	26.26930*	14.619*	15.297	14.894
3	-1157.924	22.445	27.53750	14.665	15.644	15.063
4	-1146.802	19.952	29.26240	14.724	16.004	15.244

Source: Data processed with Eviews

Granger's VECM causality test was conducted to investigate potential causal relationships among trade openness, renewable energy consumption, inflation, and CO2 emissions using Granger's Vector Error Correction Model (VECM) causality test. In the findings from the Granger causality test, presented in Table 3, it was observed that ECT_{t-1} (the error correction term) exhibited statistical significance in the equations concerning renewable energy consumption and trade openness. This result suggests that there is evidence of error correction adjustment in this equation, indicating a tendency towards achieving long-term equilibrium between renewable energy consumption and trade openness with a significance level of 5 percent.

Table 4 presents the results of the Granger causality test on VECM. According to the findings, there is no short-term relationship between trade openness and renewable energy consumption. However, the results do indicate a one-way relationship between renewable energy consumption and both inflation and CO2 emissions. Notably, renewable energy consumption exerts a significant impact on inflation. Economic stability, demonstrated by a stable inflation rate, encourages both producers and consumers to increase their demand for goods and services, including renewable and non-renewable energy sources. Nevertheless, the effectiveness of this phenomenon hinges on whether the country's production and consumption systems are environmentally sustainable. In this context, inflation and interest rates play a vital role in stabilizing the overall price level and energy costs, as well as facilitating economic actors' access to sufficient financial resources for the consumption of renewable or non-renewable energy and related products and services (Akan, 2023).

Carbon dioxide (CO2) emissions are the sole variable significantly affecting the consumption of renewable energy sources in the short term. The emission of carbon dioxide has a positive and significant impact on renewable energy consumption. The findings of this study elucidate the advantageous synergy between low-carbon development and globalization, with globalization playing a significant role in promoting the growth of renewable energy and combating climate change. Notably, certain countries experience a greater negative impact on carbon emissions due to their reliance on renewable energy, particularly those with limited fossil energy resources and advanced renewable technologies, such as Japan, France, and Germany. Among the regions, the European OECD demonstrates a stronger carbon abatement effect, as the positive influences of globalization are well evident in this area (Nan et al., 2022). However, Le (2022) presented a conclusive result, suggesting a negative relationship between change in emission of carbon dioxide and non-renewable energy consumption.

Nonetheless, the study emphasizes the crucial significance of promoting the utilization of renewable energy sources to address the pressing issue of environmental degradation, leading to a remarkable reduction in CO2 emissions. The increasing use of renewable energy is very important in solving the problem of environmental degradation, which is reflected in the extraordinary reduction in CO2 emissions.

Table 4. Granger Causality Test Results

Dependent Variables	Short-run causality				*Long run ECT t-1*
	Δ(RE)	Δ(TO)	Δ(Inflation)	Δ(CO2)	
Δ(RE)		0.901	2.014	13.0331***	-0.007
		0.637	0.365	0.0015	[-0.933]
Δ(TO)	0.045		23.73***	3.50	-0.019
	0.97		0.000	0.173	[-1.127]
Δ(Inflation)	4.834*	10.33***		1.586	-0.004
	0.0892	0.0057		0.452	[-0.501]
Δ(CO2)	3.832	0.471	2.249		0.010
	0.147	0.789	0.324		[11.670]***

The following table reported the result of granger causality test. Note: *** and ** indicate the significance at 1% and 5$ levels, respectively. Figure in the parentheses is the p-value for variables and t-statistic for ECT.

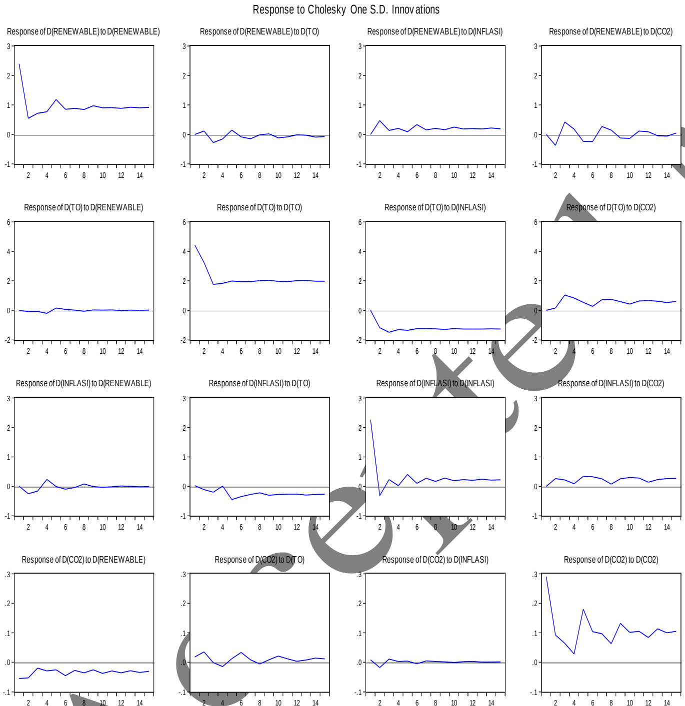

Figure 1. Impulse Response Function

The Granger Causality Test confirms a causal relationship between inflation and trade openness in the short run. This suggests that trade openness has dual effects on the sensitivity of inflation to output fluctuations. On one hand, it fosters strategic complementarity in firm pricing decisions and introduces a level of real price stickiness, leading to reduced responsiveness of inflation to changes in real marginal cost. Conversely, trade openness enhances firms' motivation to adapt their pricing strategies, consequently diminishing nominal price stickiness and intensifying the sensitivity of inflation to fluctuations in marginal costs (Lin et al., 2017). Watson (2016) explains the relationship between trade openness and inflation. The presence of an unexpected monetary expansion triggers a devaluation of the real exchange rate, and due to the higher risk of real depreciation in a more open economy, the benefits derived from such an expansionary shock exhibit a diminishing effect with increased economic openness. Consequently, monetary authorities in more open countries tend to adopt less expansive monetary policies on average, leading to a gradual reduction in average inflation. However, it is worth noting that higher inflation can still manifest in more open economies. In a study by Zakaria (2010) examining the relationship between trade openness and inflation in Pakistan, annual series data from 1947 to 2007 were utilized. The empirical findings of the study reveal a positive correlation between trade openness and inflation in Pakistan.

Based on Figure 1, results of the impulse response show that the response of renewable energy to changes in trade openness, inflation, and CO2 experienced fluctuations in the beginning of the period; during period 8h, the fluctuations began to decrease. This indicates that renewable energy is no longer as volatile as in the previous period, as the graph demonstrates stability. The response of trade openness to renewable energy is stable and tends negatively. This result also corroborates the findings of Karmaker et al (2023) regarding the negative relationship between trade openness and renewable energy consumption. The response of trade openness to CO2 emissions is very volatile until the 10th period, after which it becomes less volatile than in the previous period. This suggests that trade liberalization can be an effective strategy for reducing greenhouse gases. According to Yang et al (2022), trade openness facilitates broad economic growth and the dissemination of sustainable energy products, technologies, and services worldwide. Economic progress relies on energy sources, prompting governments to explore renewable options as replacements for non-renewable resources and to implement relevant policies (Dehhaghi, 2022)

The response of inflation to renewable energy fluctuated slightly until the 8th period, but stability is depicted in the graph for the subsequent period. Furthermore, the results consistently demonstrate a positive relationship between changes in inflation and the consumption of renewable energy throughout the entire analysis period. These findings align with the research conducted by Deka & Dube (2021), which also supports the notion of a positive impact of inflation on renewable energy, as well as the positive impact of renewable energy on the inflation rate. This indicates that as the inflation rate increases, there is a corresponding rise in the level of renewable energy consumption. In the case of Mexico, the increased use of renewable energy contributes to higher inflation rates due to the relatively elevated cost of renewable energy compared to fossil fuels.

The inflation response to trade openness experienced quite extreme fluctuations and turmoil. From period 5 onwards, it decreased until the end of the period. This data is consistent with the results of research by (Wynne & Kersting, 2007), which demonstrates a robust negative correlation between trade openness and the inflation rate in the United States. Similarly, (Mukhtar, 2012) conducted a study using a multivariate cointegration and vector error correction model for Pakistan, analyzing data from 1960 to 2007. The empirical findings from this research revealed the existence of a significant negative cointegration in the long-run relationship between inflation and trade openness.

Inflation, in response to changes in carbon dioxide emissions, fluctuated greatly from the beginning to the end of the period. The threat of increasing world food prices also arises from climate change, which impacts global warming and drought. Carbon dioxide emissions respond negatively to changes in renewable energy consumption from the beginning of the period until the last period. Additionally, renewable energy consumption reduces carbon dioxide emissions. The result aligns with Kwakwa (2023), which explains that intensifying the development and use of renewable energy will help address the trend of increasing carbon dioxide emissions in Africa. Carbon dioxide emissions responded with a slight fluctuation until period 2, but the graph shows stability until the end of the period.

4. CONCLUSIONS

This study revealed a unidirectional relationship between renewable energy and inflation, as well as between renewable energy consumption and carbon dioxide emissions. Notably, the findings suggest that carbon dioxide emissions play a driving role in shaping renewable energy consumption. This underscores the positive impact of globalization on low-carbon development, as it stimulates the growth of renewable energy and contributes to the fight against climate change. Additionally, the research results confirm a bidirectional relationship between trade openness and inflation, with impulse response analysis indicating a strong negative association between a country's trade openness and its inflation rate in both the short and long term. However, the linkages among energy consumption, trade openness, and climate change have varied over time. In the current energy consumption scenario, emerging Asian countries need to exhibit greater flexibility in designing environmental and climate change policies. Policymakers should contribute significantly to economic development and environmental sustainability by mitigating the impact of energy consumption on carbon dioxide emissions. Attaining environmental and social sustainability remains a crucial prerequisite for long-term economic development.

Nonetheless, this research has certain limitations. It focuses solely on the relationship among renewable energy consumption, climate change, and trade openness, thus, considering linkages with economic growth and environmental degradation would enhance the results. Moreover, there might be additional channels through which energy consumption influences environmental performance and economic growth, such as economic complexity and the effectiveness of government policies. Further investigations that incorporate these dimensions are expected to provide valuable insight for economic sustainability. For future research, exploring diverse data sources to gather more comprehensive information on energy consumption and its impact on the environment would be beneficial.

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