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Economic Globalization, Renewable Energy, and CO_2 Emissions in Selected Emerging Countries

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Abstract. The phenomenon of economic globalization (EG) has a significant impact on CO_2 emissions in emerging countries. This research seeks to examine the influence of EG and renewable energy consumption (REC) on CO_2 emissions by utilizing secondary data from the World Bank spanning the years 2000 to 2022. The study hypothesizes that EG contributes to higher CO_2 emissions, whereas the REC leads to a reduction in CO2 emissions. This study uses the Data Regression Results Panel with a Random Effect Model to analyze the data. The results show that EG contributes to economic growth accompanied by increased CO_2 emissions. Rapid increases in economic activity and industrialization, often driven by FDI and international trade, lead to increased use of fossil energy and CO_2 emissions. These findings support the pollution haven hypothesis that suggests that high-polluting production tends to move to countries with looser environmental regulations. However, the study also found that increased REC is associated with a decrease in CO_2 emissions. The theoretical significance of the results of this study shows that while EG can drive economic growth, it also has a negative impact on the environment. In practical terms, this research underscores the necessity for policies that promote the use of renewable energy, enhance energy efficiency, and enforce stringent environmental regulations to mitigate the adverse environmental effects of economic globalization. Measures such as the promotion of renewable energy, the transfer of green technologies, increasing public awareness of environmental sustainability, diversifying the economy into greener sectors, and developing green infrastructure are essential.

Key words: economic globalization; renewable energy; CO_2 emission; emerging countries.

JEL Q54, Q27

1. Introduction

In recent decades, emerging countries have been at the center of impressive economic growth [1]. This growth is mainly driven by the rapid industrialization process, rapid urbanization, and increased international trade activities as part of economic globalization [2]. However, behind this encouraging economic surge, there are consequences that cannot be ignored on the environment, especially the increase in carbon dioxide (CO_2) emissions.

Developing countries, in an effort to achieve rapid economic growth, often rely on conventional energy sources such as coal and petroleum, which produce high CO_2 emissions [3]. Therefore, while enjoying the economic benefits of globalization, emerging markets are also faced with the challenge of reducing negative impacts on the environment, especially when it comes to CO_2 emissions that contribute to global climate change [4].

Economic globalization is a phenomenon in which a country's economic activities are increasingly connected with the economic activities of other countries through international trade, capital flows, and foreign investment [5]. These phenomena include the

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removal of trade barriers, financial liberalization, and global market integration [6].

In general, economic globalization aims to improve market access, expand investment opportunities, and drive overall economic growth [7]. This is reflected in the increase in international trade, freer capital flows, and economic cooperation between countries. Economic globalization has been a key driver of economic growth in many developing countries, bringing significant economic benefits but also posing challenges related to economic inequality, environmental sustainability, and social impacts [8]which fully supports the contention that globalization has a strong integrated relationship with economic growth. Using panel fully-modified OLS (FMOLS.

Globalization is leading to a rise in the manufacturing of goods and services that frequently depend on fossil fuels, a primary contributor to CO_2 emissions [9]. In addition, the growth of the transportation sector resulting from the increase in international trade also contributed significantly, with motor vehicles mostly still using fossil fuels [10] courtesy of the significantly high pollutant emissions from this particular sector. Taking a cue from this, this paper follows sustainable development goals of the United Nations, and investigates the impact of biomass energy consumption, fossil fuel energy consumption, and economic growth (GDP).

The adoption of technologies and inefficient production practices in foreign investment and technology transfer often exacerbate the situation, given that many recipient countries are not yet ready to implement more environmentally friendly technologies. Consequently, there is a rise in unsustainable energy use, resulting in an escalation of CO_2 emissions.

All of these factors pose serious challenges in climate change mitigation efforts, as globalization, while bringing economic benefits, also enlarges the global carbon footprint.

Energy has a crucial role in spurring the economic development process, especially in emerging countries that are experiencing rapid growth [11]. Nevertheless, many of these nations continue to rely heavily on traditional energy sources like coal, oil, and natural gas. This reliance has significantly contributed to CO_2 emissions. The situation is compounded by the fact that populous emerging economies such as China, Indonesia, India, Brazil, South Africa, and Russia are among the world's largest CO_2 emitters (Figure 1).

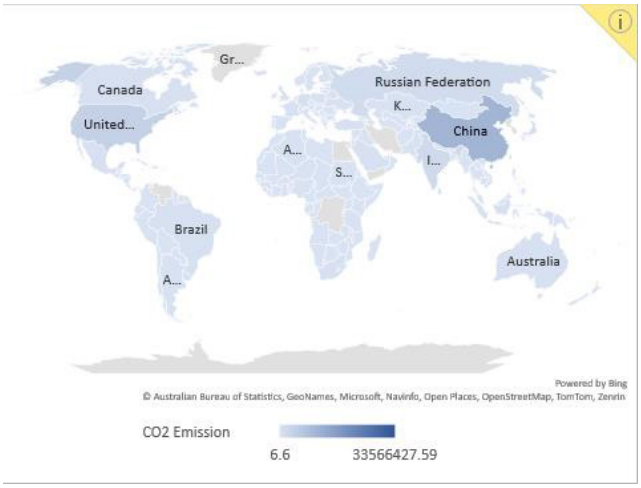

Figure 1. CO_2 Emission (kt) in the world

Source: World Bank, data processed (2024)

Various studies [12, 13] show that the increase in CO_2 emissions in emerging countries is largely due to the unsustainable growth of energy consumption in line with their economic growth. Thus, there is an urgent need for robust collaborative efforts to devise innovative solutions that can expedite the adoption of renewable energy and decrease reliance on fossil fuel sources in these countries.

In response to growing global awareness about the urgency of addressing climate change, developing nations are increasingly pressured to shift towards renewable energy sources. Renewable energies such as solar, wind, and hydroelectric power are seen as viable options to decrease CO_2 emissions while satisfying rising energy demands [14]. Embracing renewable energy in these countries not only offers significant environmental advantages but also enhances long-term energy security and economic stability [15]. Prior research has affirmed that expanding renewable energy use can effectively lower CO_2 emissions [16–18]. By accelerating the adoption of renewable energy, developing nations have the opportunity to reduce their reliance on fossil fuels, which are major contributors to CO_2 emissions.

Emerging markets encounter distinct challenges in maintaining a balance between economic growth and environmental sustainability. Effective and innovative policies are needed to ensure that economic globalization and the transition to renewable energy can go hand in hand to reduce CO_2 emissions without hindering economic growth. Further research is essential to comprehend the intricate relationships between renewable energy, economic globalization, and CO_2 emissions in emerging markets.

This study aims to analyze how the adoption of renewable energy and the process of economic globalization affect CO_2 emissions in developing countries.

The hypothesis of this research is that economic globalization increases CO_2 emissions, while renewable energy consumption lowers CO_2 emissions.

This research is expected to provide useful insights for policymakers in designing sustainable development strategies that integrate economic growth and environmental protection.

The structure of this research is as follows: Chapter 1 provides an introduction and background of the problem, Chapter 2 reviews the related literature, Chapter 3 explains the research methodology used, Chapter 4 presents the results of data analysis, and Chapter 5 presents conclusions and policy recommendations based on the findings of the research.

2. Literature Review

Research on economic globalization, renewable energy adoption, and CO_2 emissions in developing countries has become a major focus in the academic literature. Economic globalization, characterized by increased trade, foreign direct investment (FDI), and technology transfer, not only brings economic benefits such as increased global market access and higher exports, but also has a complex impact on the environment.

The results of research by Mirziyoyeva & Salahodjaev [19] show that renewable energy significantly reduces carbon emissions, while GDP per capita has an inverted U-shaped relationship with CO_2 emissions. This confirms the EKC hypothesis in countries with a high level of globalization.

Research results Pata [20] show a two-way relationship between agriculture and environmental degradation, as well as a one-way relationship from globalization to the ecological footprint and CO_2 emissions, and from renewable energy to ecological indicators. Renewable energy has proven important in reducing environmental pollution in Brazil and China.

Thus, while economic globalization brings the potential for significant economic growth for developing countries, it is also necessary to consider its impact on the environment, especially in the context of global warming and climate change that is increasingly real. Therefore, it is important to strengthen policies that encourage the adoption of renewable energy as part of a strategy to reduce CO_2 emissions globally.

FDI as one of the precursors of globalization has proven to be an important motor in the economic development of developing countries.

Study Osano & Koine [21] reveals that investment in the energy sector has fueled the development of new technologies and increased trade competition, ultimately increasing the efficiency and effectiveness of the industry through the transfer of knowledge to local investors. Trade openness encourages the transfer of new technology, technological progress, and increased productivity, with benefits depending on the level of economic openness [22].

Hille et al. [23] research shows that the influx of FDI simultaneously stimulates regional economic growth and reduces air pollution levels. However, the rapid industrialization process that is often caused by FDI can produce negative impacts on the environment if not balanced with strict environmental policies. Other studies have found that increased industrial activity can lead to increased CO_2 emissions and other pollutants, especially in countries that do not yet have adequate environmental regulations.

The Environmental Kuznets Curve (EKC) hypothesis posits that during the initial stages of economic growth, environmental degradation and pollution levels rise in tandem with rapid industrialization [24]. However, upon reaching a specific level of economic development, further growth can enhance environmental quality due to heightened awareness and the implementation of cleaner technologies.

On the other hand, the Pollution Haven Hypothesis suggests that globalization allows developed countries to move more polluting industries to developing countries that have weaker environmental regulations, which can lead to an increase in environmental problems in those countries [25]. Both concepts offer valuable insights into how economic growth and globalization can impact the environment, either positively or negatively, based on the policies enacted by governments and the level of public awareness regarding environmental issues.

The concept of Technology Transfer, driven by globalization, plays a crucial role in introducing green technologies to developing countries.

The research by Pandey et al. [26] redirects the conversation about international technology transfer (ITT) for sustainable development in developing countries by exploring ITT in the health, agriculture, and climate and energy sectors. Highlighting key elements for successful SDG implementation, this research proposes a more comprehensive «innovation cooperation» framework over «technology transfer». It emphasizes the importance of equitable partnerships and the development of local innovation capabilities, effectively helping developing countries achieve sustainable development.

Zhang et al. [27] emphasize the need for innovation in environmentally friendly technologies and effective technology transfer to developing countries to support the implementation of green economy initiatives. They highlight sustainable production efficiency and natural resource management as crucial for enhancing economic performance and reducing negative environmental impacts. The study underscores the importance of fair international cooperation in technology transfer to foster sustainable green economic development globally.

The study Umar et al. [28] contributes significantly by linking globalization with technology transfer in the context of CO_2 emissions in China. It finds that globalization positively impacts environmental quality, highlighting the importance of international interactions in advancing eco-friendly technologies. However, the study also reveals that globalization can increase CO_2 emissions through rapid economic growth, emphasizing the need for sustainable technology transfer to mitigate long-term environmental impacts. Globalization facilitates the transfer of advanced technology through foreign direct investment (FDI) from developed countries to those with lower technological capabilities. This underscores globalization's crucial role in enhancing economic growth by fostering technological innovation and investment in these countries.

The study by Khan et al. [29] highlights that countries like Bangladesh experience significant positive impacts on CO_2 emissions and environmental degradation due to the use of non-renewable energy and globalization indices.

The adoption of renewable energy in developing countries is influenced by a variety of factors, including economic incentives, technological advancements, and increasing environmental awareness.

Fatima et al. [30] highlight significant challenges in developing renewable energy generation (REG) in countries like Pakistan. Their research aims to identify critical factors influencing REG development through multi-aspect analysis and partial least squares structural modeling. Findings indicate that poor governance, adaptation of renewable energy, and government energy policies are major barriers, while available resources, electricity production approaches, and demand for renewable energy drive REG development. Public acceptance is also identified as a key contributor to promoting REG. The adoption of renewable energy in developing countries, such as India, is influenced by various factors including economic incentives, technological advancements, and increasing environmental awareness.

Luthra et al. [31] identified 28 major barriers to implementing renewable and green energy technologies in India. Using the Analytical Hierarchy Process (AHP), researchers ranked these barriers based on inputs from experts in academia and industry, and conducted sensitivity analysis to ensure stable prioritization of barriers in promoting broader adoption of renewable energy in India.

The declining costs of renewable energy technologies such as solar and wind make them more affordable and appealing to developing countries. These measures not only reduce dependence on fossil fuels but also decrease CO_2 emissions from the energy sector, especially in countries experiencing rapid industrialization [32]. However, the lack of infrastructure challenges and regulatory barriers remain significant obstacles in the implementation of renewable energy in many developing countries [33]. Therefore, achieving the full potential of renewable energy in reducing CO_2 emissions requires a combination of solid policies, investment in adequate infrastructure, and sustained support from the government and the private sector [31].

Overall, the literature shows that economic globalization has significant potential in influencing CO_2 emissions in developing countries through technology transfer and increased economic activity. While technology transfer can introduce effective clean energy solutions, the increase in economic activity induced by globalization can also increase energy consumption and CO_2

emissions, especially in countries with weak environmental regulations. The adoption of renewable energy has proven to be a crucial strategy in reducing dependence on fossil fuels and reducing the global carbon footprint. The declining cost of technologies such as solar and wind has made renewable energy increasingly affordable and attractive to developing countries.

However, the lack of infrastructure challenges and regulatory barriers remain serious obstacles that need to be overcome to facilitate wider adoption of renewable energy around the world. Thus, achieving the goal of reducing CO_2 emissions globally requires a combination of solid policies, investment in adequate infrastructure, and sustained support from governments and the private sector. This is an important step in promoting sustainable economic growth and maintaining the sustainability of the global environment.

3. Data and Methods

3.1. Variable Operational Definition

This study examines economic globalization and renewable energy consumption as independent variables, while CO_2 emissions as dependent variables.

The sample of this study uses Brazil, China, Indonesia, India, the Russian Federation, and South Africa which represent emerging countries. These countries were chosen because of their rapid economic growth, large population, industrialization, wealth of natural resources, foreign investment, economic reforms, and improved infrastructure, making them important in the global economy despite the challenges.

The operational description of the variables is explained in Table 1.

This research utilizes secondary data sourced from the World Bank covering the period from 2000 to 2022. The study employs panel data regression analysis, incorporating common, fixed, and random effects models.

Table 1. **Variable Operational Definition**

Variable	Description	Unit	Source
CO_2 Emission (CO_2)	Carbon dioxide emissions stem from the burning of fossil fuels and the production of cement. This includes CO_2 released during the use of solid, liquid, and gaseous fuels, as well as from gas combustion	CO_2 emissions (kt)	World Bank
Economic Globalization (EG)	A measurement instrument used to evaluate a country's degree of economic integration with the global economy usually includes indicators concerning international trade, foreign direct investment (FDI), labor mobility, technology and innovation, and international business relations	Index	World Bank
Renewable energy consumption (REC)	Renewable energy consumption constitutes a portion of the overall final energy consumption obtained from renewable energy sources	% of total final energy consumption	World Bank

Source: EViews, data processed (2024).

The choice of the most suitable model is determined through tests such as the Chow, Hausman, and LM test. The regression equation model used in this study is outlined as follows:

$$CO_{2it} = \beta_0 + \beta_1 EG_{it} + \beta_2 REC_{it} + \varepsilon_{it}, \quad (1)$$

Where: *CO2* is CO_2 emission, *EG* is Economic Globalization, *REC* is Renewable energy consumption, *i* is cross section, *t* is time series, ε is error term.

3.2. Variable Movement Analysis

Brazil, China, Indonesia, India, Russia, and South Africa are the countries with the highest levels of CO_2 emissions in the world. Based on Figure 2, China shows the highest increase in CO_2 emissions, followed by India which also experienced a significant increase. Russia is in third place with fairly high emissions, although not as high as China and India. Meanwhile, Indonesia, Brazil, and South Africa have relatively lower CO_2 emission levels compared to China and India, but still contribute significantly to total global emissions. The emissions from these countries underscore their significant role in the global economy and highlight the substantial challenges they face in mitigating the impacts of climate change.

China, as the world's largest consumer of energy, also holds the top position as the largest emitter of CO_2. The country has established ambitious targets to reach a peak in CO_2 emissions by 2030 and to reduce carbon intensity by 60–65 percent compared to 2005 levels.

Moreover, China has committed to achieving carbon neutrality by 2060. Over the past four decades, China has undergone a rapid transition from an agricultural economy to an industrialized one — a transformation that typically spans longer periods in developed nations. This rapid economic expansion has been propelled by industrialization and substantial investments, resulting in heightened energy consumption and CO_2 emissions [34]. National energy demand has seen a significant upsurge. Consequently, since 2007, China has held the distinction of being the world's foremost emitter of CO_2, contributing to nearly 30 % of global emissions. Additionally, according to research [35], sustained economic growth and a burgeoning population are anticipated to further drive the long-term increase in CO_2 emissions in China.

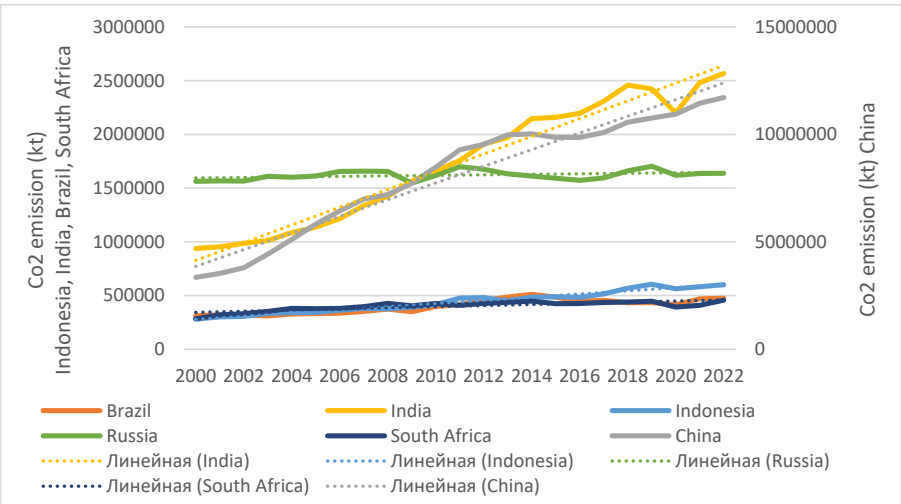

Figure 2. CO_2 Emissions in Selected Emerging Countries

Source: World Bank, (2024)

India ranks among the leading global consumers of coal and possesses a densely populated demographic [36]. By 2019, per capita CO_2 emissions in India had reached approximately 2 tons per individual, positioning it as the third-largest emitter of CO_2 after China and the United States. In 2016, the energy sector alone contributed to around 83 % of India's total greenhouse gas (GHG) emissions, including emissions from land use, land-use change, and forestry. This underscores the significant role of the energy sector in CO_2 emissions and highlights substantial potential for decarbonization [37]. Several studies have investigated India's shift towards low-carbon energy, exploring various pathways for sustainable economic growth under current trends and scenarios. These pathways are informed by national carbon budget allocations and advancements in technology.

Economic globalization, characterized by heightened interaction among businesses, governments, and institutions globally, is widely perceived to stimulate international trade, FDI, industrial efficiency, capital flow, and innovation [38]. India, Brazil, China, and Russia are showing an increase in economic globalization. Meanwhile, Indonesia and South Africa showed a decline (Figure 3).

Globalization impacts the environment through income effects, engineering effects, and composition effects. The income effect demonstrates that globalization stimulates economic production and trade, resulting in heightened environmental degradation due to increased carbon emissions [39]. Additionally, economic globalization contributes to environmental harm by often unsustainable exploitation of natural resources in developing countries [40]. One example is the increasing demand for agricultural products resulting in widespread deforestation.

India and China have seen substantial annual increases in their globalization index over recent decades. This heightened globalization, coupled with expanded investment prospects, is anticipated to attract foreign direct investment from multinational corporations. As a result, these multinational companies will bring the latest technologies that are more energy-efficient to these developing countries [39].

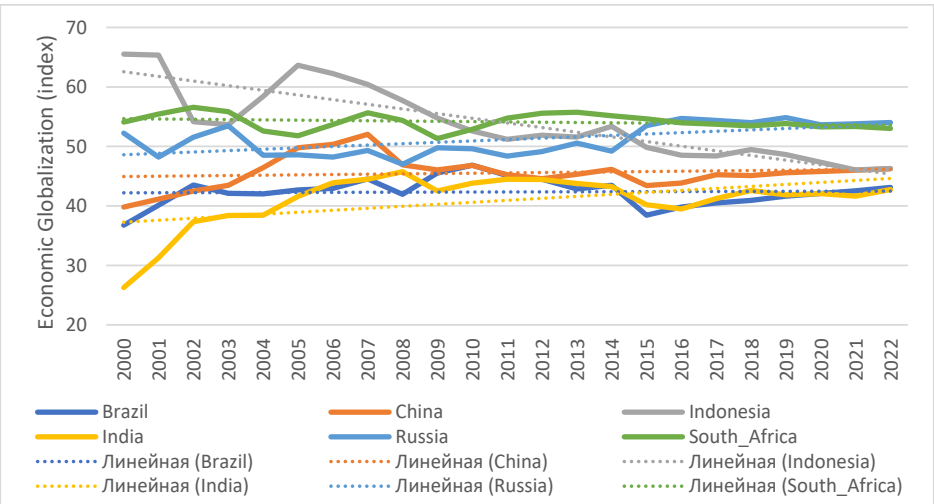

Figure 3. Economic Globalization in Selected Emerging Countries

Source: World Bank, (2024)

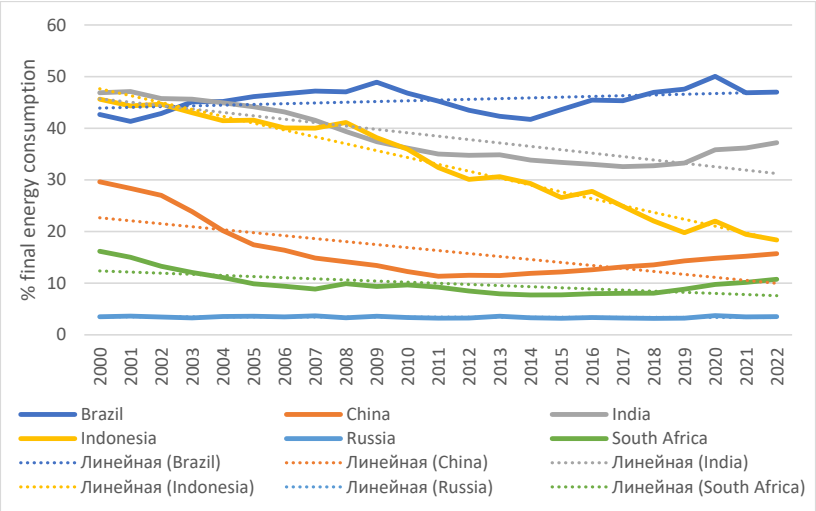

Figure 4. Renewable energy consumption in Selected Emerging Countries

Source: World Bank, (2024)

REC in emerging markets has attracted significant attention due to its potential to mitigate environmental degradation and address energy security concerns. As depicted in Figure 4, only Brazil showed an increase in REC, whereas the other emerging markets (China, Indonesia, India, Russia, and South Africa) exhibited a decrease.

Several factors contribute to this decline, including a prioritization of economic growth over environmental sustainability, as indicated by the prevailing ecosystem development scenario. Moreover, household-level reliance on non-renewable energy resources also plays a role, particularly given the large populations in these countries. To address these challenges, it is imperative to integrate Sustainable Development Goals (SDGs) [41].

4. Results

The Chow test outcome of 0.0000 indicates that the Fixed Effect Model (FEM) is more suitable than the Common Effect Model (CEM) due to the significant difference observed between groups of countries. Conversely, the Hausman test result of 0.1013, with a p-value exceeding 0.05, suggests that the Random Effect Model (REM) is preferable over the FEM, as the disparity between fixed and random estimates is not statistically significant.

However, the LM test yielding a result of 0.0000 demonstrates that the REM is more appropriate than the CEM, given the significant variation observed between countries. In summary, these findings collectively indicate that the REM is the most suitable choice for this analysis, as it accommodates specific country-level variations while maintaining estimation efficiency (Table 2).

The results of the estimation model in this study are described in equation (2):

$$CO_{2it} = 13.0007 - 0.3999EG_{it} + \\ + 0.6732REC_{it} + \varepsilon_{it}. \quad (2)$$

The regression results suggest that REC and EG exert a notable influence on CO_2 emissions in developing countries. An intercept coefficient of 13.001 suggests that when both REC and EG are zero, the predicted average CO_2 emissions stand at 13.00073 units. Renewable energy consumption exhibits a coefficient of –0.039 with a highly significant, indicating that a one-unit increase in REC reduces CO_2 emissions by 0.0399 units.

Table 2. **Regression Results**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.00073	0.997485	13.03352	0.0000***
EG	0.473245	0.239942	1.972328	0.0506*
REC	–0.039997	0.003735	–10.70976	0.0000***
R-squared	0.454979	Mean dependent var		0.651231
F-statistic	56.348***	Durbin-Watson stat		0.857936
Chow	0.0000			
Hausman test	0.1013			
LM test	0.0000			
Cross Section Effect				
_Brazil	–0.066506			
_China	1.685538			
_Indonesian	–0.594231			
_India	0.991603			
_Russia	–0.426120			
_SouthAfrica	–1.590285			

Source: EViews, data processed (2024)

This underscores the significant potential of renewable energy in mitigating CO_2 emissions. In contrast, EG shows a coefficient of 0.4732 and is significant at the 5 percent (p-value 0.0506), indicating that a one-unit increase in EG increases CO2 by 0.4732 units. This highlights the role of EG in contributing to CO_2 emissions in emerging markets.

The coefficients between individuals in the random effects model show how each country deviates from the mean intercept. Countries like China and India have higher-than-average CO_2 emissions, while countries like Brazil, Indonesia, Russia, and especially South Africa have lower-than-average CO_2 emissions after considering other variables in the model. This shows that there are specific variations between countries that need to be considered in the analysis and policy of reducing CO_2 emissions.

5. Discussion

This research indicates that economic globalization has a substantial and statistically significant impact on CO_2 emissions in emerging markets. Economic globalization, characterized by enhanced global economic integration through increased international trade, FDI flows, and technology transfer, has significantly bolstered economic growth in emerging markets.

Empirical studies show that economic globalization often has an impact on increasing CO_2 emissions, in line with studies by [42–44]. The main causes include increased economic activity, rapid industrialization, infrastructure development, and changes in consumption patterns. Increased economic activity, often propelled by FDI and international trade, stimulates industrial sector expansion and greater mobility,

leading to increased reliance on fossil fuels and subsequent CO_2 emissions.

The impact of globalization on energy consumption and environmental outcomes aligns with the «pollution haven hypothesis». This theory posits that industries with high pollution levels in developed countries, constrained by stringent environmental regulations, tend to relocate to developing countries with more relaxed environmental laws [45]. This study provides support for this hypothesis.

In addition, FDI tends to go to industrial sectors that require a lot of energy, and often still use less efficient technologies in energy use. This can increase the intensity of CO_2 emissions per unit of production. Rapid infrastructure development also requires the use of large amounts of energy, both in construction and operation, which contributes to CO_2 emissions.

Conversely, shifts in consumption patterns driven by economic globalization also contribute to rising CO_2 emissions. Enhanced access to global consumer goods like electronics and clothing can escalate energy demands for their production and transportation, thereby increasing CO_2 emissions. Addressing the adverse environmental impacts of economic globalization requires effective policy interventions. These measures include promoting renewable energy adoption, enhancing energy efficiency, enforcing stringent environmental regulations, and fostering the dissemination of green technologies. Moreover, raising public awareness about the significance of environmental sustainability is crucial to fostering more environmentally friendly consumption patterns.

Studies indicate that higher levels of REC correlate with reduced CO_2 emissions, indicating a statistically significant negative relationship between the two variables. These findings align with earlier hypotheses and research conducted by [46, 47] the emission–growth–renewables nexus for a global panel of 120 countries and four income-based subpanels over the period 1995–2015 is examined. Fully considering the potential cross-sectional dependence and slope heterogeneity, a series of econometric techniques allowing for cross-sectional dependence and slope heterogeneity is utilised. Cross-sectional dependence and slope heterogeneity are confirmed for the global panel as well as for all four subpanels. Only for the global panel, high-income subpanel and upper-middle-income subpanel is the environmental Kuznets curve (EKC. As developing countries increase their utilization of renewable energy sources like solar, wind, and biomass, there tends to be a corresponding decrease in CO_2.

This underscores the effectiveness of adopting renewable energy as a solution to mitigate the carbon footprint of developing nations. Embracing renewable energy not only contributes to reducing CO_2 emissions but also yields long-term economic benefits such as job creation, enhanced energy security, and reduced reliance on non-renewable fossil fuels. Therefore, policies aimed at promoting the development and adoption of renewable energy in emerging markets can serve as a robust strategy to achieve global climate change mitigation goals while bolstering economic and energy resilience at the national level.

Countries with high CO_2 emissions such as China, India, Indonesia, Russia, South Africa, and Brazil are facing serious challenges related to environmental impact [47]. They have begun to switch to renewable energy as part of a solution to reduce CO_2 emissions. China and India, the world's two largest economies, have increased their renewable energy capacity, especially solar and wind, to offset their energy needs [48]. Indonesia, with its large renewable energy potential, is also trying to increase the contribution of renewable energy in its energy mix [49]. Russia, as a ma-

jor energy producer, is starting to invest more in renewable energy such as wind and solar. While South Africa and Brazil, despite facing infrastructure and financial challenges, have also shown a commitment to developing renewable energy as part of their strategies for environmental sustainability. Thus, efforts to increase renewable energy are key for emerging markets in reducing their carbon footprint and achieving sustainable economic growth.

In evaluating the results of this study, it is necessary to recognize several limitations that can affect the interpretation of the findings. First, the use of secondary data from available sources may limit the ability to conduct in-depth analyses of more specific or dynamic variables in the context of the relationship between economic globalization and CO_2 emissions. In addition, the complexity of factors such as political dynamics and environmental policies in developing countries can exert significant influences that cannot be fully included in the framework of this analysis. A deeper understanding will require further research to better explore these dynamics.

However, the implications of this study emphasize the importance of strengthening policies and strategies that support the transition to a more sustainable economy. Measures such as the promotion of renewable energy, improved energy efficiency, and the implementation of strict environmental regulations can play a crucial role in reducing the negative impact of economic globalization on the environment.

In addition, public awareness of the importance of sustainability also needs to be increased to change consumption patterns towards a more environmentally friendly lifestyle. These implications underscore that this research is not only relevant for academic understanding, but also has direct application in formulating policies that are responsive to current global environmental challenges.

6. Conclusion

This research indicates that economic globalization exerts a positive and significant impact on CO_2 in emerging countries. Globalization, characterized by increased international trade, FDI, and technology transfers, has driven economic expansion but has also led to heightened CO_2 emissions. The increased economic activity and industrialization associated with globalization necessitate greater energy consumption, often sourced from fossil fuels, thereby increasing CO_2 emissions.

The findings of this study align with the pollution haven hypothesis, which suggests that high-polluting production tends to relocate to countries with less stringent environmental regulations. Moreover, shifts in global consumption patterns and rapid infrastructure development further contribute to rising CO_2 emissions.

However, the study also reveals that an increase in renewable energy consumption correlates with a reduction in CO_2 emissions. This underscores the potential of adopting renewable energy sources such as solar, wind, and biomass as effective measures to mitigate the carbon footprint of emerging markets.

Theoretically, this research adds to the understanding of how economic globalization affects CO_2 emissions in emerging countries, supports the pollution haven hypothesis, and strengthens the argument that the transition to renewable energy can reduce negative environmental impacts. These findings make an important contribution to the literature on economic globalization and environmental sustainability, by showing that the relationship between globalization and CO_2 emissions is complex and can be mitigated through appropriate policies.

In practical terms, this study emphasizes the need for comprehensive policy implementation to address the negative impact of economic globalization on CO_2

emissions in developing countries. Policies that encourage the adoption of renewable energy, such as solar, wind, and biomass energy, are critical to reducing the carbon footprint and achieving climate change mitigation goals. In addition, improving energy efficiency in the industrial and infrastructure sectors should be a priority, with the introduction of stricter energy efficiency standards and training programs for industry players.

Stricter environmental regulations, including carbon taxes and emission limits, must be implemented and enforced to control CO_2 emissions from economic and industrial activities. The transfer of green technology from developed countries through international cooperation and technical assistance programs will accelerate the adoption of green technology in developing countries. Increasing public awareness of the importance of environmental sustainability through educational campaigns and community programs will help change consumption patterns to be more environmentally friendly.

In addition, economic diversification by encouraging more environmentally friendly sectors and the development of green infrastructure that is efficient in energy use will reduce dependence on high-emission industrial sectors. The implementation of these measures will result in significant reductions in CO_2 emissions, support sustainable economic growth, improve energy security, and create long-term social and economic benefits for communities in developing countries.

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Экономическая глобализация, возобновляемые источники энергии и выбросы CO_2 в отдельных странах с формирующейся рыночной экономикой

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Аннотация. Явление экономической глобализации оказывает значительное влияние на выбросы CO_2 в развивающихся странах. Используя вторичные данные Всемирного банка за период с 2000 по 2022 г., это исследование рассматривает влияние экономической глобализации и потребления возобновляемых источников энергии на выбросы CO_2. В исследовании выдвигается гипотеза, что экономическая глобализация способствует более высоким выбросам CO_2, в то время как потребление возобновляемых источников энергии приводит к сокращению выбросов CO_2. В исследовании для анализа данных используется панель результатов регрессии данных с моделью случайных эффектов. Результаты показывают, что экономическая глобализация способствует экономическому росту, сопровождаемому увеличением выбросов CO_2. Быстрый рост экономической активности и индустриализации, часто обусловленный прямыми иностранными инвестициями и международной торговлей, приводят к расширению использования ископаемых видов топлива и выбросов CO_2. Эти результаты подтверждают гипотезу о загрязнении, которая предполагает, что производство с высоким уровнем загрязнения имеет тенденцию перемещаться в страны с более мягкими экологическими нормами. Исследование также показало, что увеличение потребления возобновляемых источников энергии связано со снижением выбросов CO_2. Теоретическая значимость результатов исследования показывает, что, хотя экономическая глобализация может стимулировать экономический рост, он также оказывает негативное влияние на окружающую среду. В практическом плане исследование подчеркивает необходимость политики, способствующей использованию возобновляемых источников энергии, повышению энергоэффективности и обеспечению соблюдения строгих экологических норм для смягчения неблагоприятных экологических последствий экономической глобализации. Такие меры, как продвижение возобновляемых источников энергии, передача зеленых технологий, повышение осведомленности общественности об экологической устойчивости, диверсификация экономики в более зеленые сектора и развитие зеленой инфраструктуры, имеют важное значение.

Ключевые слова: экономическая глобализация; возобновляемая энергетика; выбросы CO_2; развивающиеся страны.

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