AYANTAYO RUKAYAT OLAIDE

THE IMPACT OF GENDER, RENEWABLE ENERGY AND EDUCATION EXPENDITURE ON CO2 EMISSIONS: EVIDENCE FROM BRICS ECONOMIES

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AYANTAYO RUKAYAT OLAIDE

Supervisor

Prof. Dr. Hüseyin Özdeşer

Co-Supervisor

Assoc. Prof. Dr. Mehdi Seraj

Nicosia

January, 2024

Approval

We certify that we have read the thesis submitted by AYANTAYO RUKAYAT OLAIDE, titled **"THE IMPACT OF GENDER, RENEWABLE ENERGY, AND EDUCATION EXPENDITURE ON CO2 EMISSIONS: EVIDENCE FROM BRICS ECONOMIES"** and that, in our combined opinion, it is fully adequate, in scope and quality, as a thesis for the degree of Master of Educational Sciences.

Examining Committee	Name-Surname	Signature
Head of the Committee: (Supervisor)	Prof. Dr. Huseyin Ozdeser	.....
Co-Supervisor:	Assoc. Prof. Dr. Mehdi Seraj	.....
Committee Member:	Assist. Prof. Dr. Abidemi Somoye	.....
Committee Member:	Dr.Laith Tashtoush	.....

Approved by the Head of the Department

29/03/2024

.....

Prof. Dr. Huseyin Ozdeser

Department of Economics

Approved by the Institute of Graduate Studies

...../...../20...

Prof. Dr. Kemal Hüsnü Can Başer

Head of the Institute

Declaration

I hereby declare that all information, documents, analysis, and results in this thesis have been collected and presented according to the academic rules and ethical guidelines of the Institute of Graduate Studies, Near East University. As required by these rules and conduct, I also declare that I have fully cited and referenced information and data that are not original to this study.

Ayantayo Rukayat Olaide

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Day/Month/Year

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Abstract

THE IMPACT OF GENDER, RENEWABLE ENERGY, AND EDUCATION EXPENDITURE ON CO2 EMISSIONS: EVIDENCE FROM BRICS ECONOMIES

M.Sc. THESIS

AYANTAYO RUKAYAT OLAIDE

Supervised by Prof. Dr. Hüseyin Özdeşer

And

Assoc. Prof. Dr. Mehdi Seraj (co-supervisor)

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This study examines how gender roles, renewable energy (REN), and education expenditure affect carbon dioxide (CO2) emissions in big-growing BRICS countries from 1998 to 2020. The study uses Fisher Panel Cointegration to show deep connections and causes significantly affecting sustainable development. The study carefully tests whether there is movement over time and how these countries are linked. It uses ARDL (Autoregressive Distributed Lag) analysis to find the main links that affect the environment in industrial growing areas of the world. This helps us better understand how complex things like industry can change our natural world while looking into different places simultaneously.

We understand the importance of using clean energy to cut down emissions. This is especially true for BRICS countries. In addition, the research shows how policies that are sensitive to gender can change things. It highlights how giving women power helps protect our environment better. This shows how important it is for people getting an education to make intelligent decisions and use resources wisely in these quickly growing economies. This study is critical because it helps improve the little-studied area of BRICS and gives exceptional views on how gender plays a role in environmental policies and CO2 emissions. It looks at how much changing to green energy sources in BRICS countries will help. It also fairly checks if teaching about the environment can better change people's views and actions towards nature.

The study shows meaningful connections and stresses the possible link-up among BRICS countries. It gives valuable tips for policies on renewable energy, ways to include both sexes in climate strategies, and ways to improve education. It also encourages working together with regions nearby. This knowledge is ready to help schools and shape laws. It will direct the economies of BRICS countries towards a long-lasting, solid, and fair future for everyone. The important thing about this study is that it looks at how men and women relate to environmental rules, the effect of money spent on learning about CO2 levels, and what could happen if these powerful countries worked together. This makes the conversation about environmental development (sustainable living) better.

KEYWORDS: Carbon Emission, Gender, Renewable Energy, Education Expenditure and Green House Gas.

Özet

CİNSİYET, YENİLENEBİLİR ENERJİ VE EĞİTİM HARCAMALARININ CO2 EMİSYONU ÜZERİNDEKİ ETKİSİ: BRICS EKONOMİSİNDEN KANITLAR

Yüksek Lisans TEZ

AYANTAYO RUKAYAT OLAIDE

Prof. Dr. Hüseyin Özdeşer danışmanlığında

Ve

Doç. Prof. Dr. Mehdi Seraj (eş danışman)

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Bu çalışma, 1998'den 2020'ye kadar hızla büyüyen BRICS ülkelerinde toplumsal cinsiyet rollerinin, yenilenebilir enerjinin (REN) ve eğitim harcamalarının karbondioksit (CO2) emisyonlarını nasıl etkilediğini incelemektedir. Çalışma, sürdürülebilir kalkınmayı önemli ölçüde etkileyen derin bağlantıları ve nedenleri göstermek için Fisher Panel Eşbütünleşmesini kullanmaktadır. . Çalışma, zaman içinde bir hareket olup olmadığını ve bu ülkelerin nasıl bağlantılı olduğunu dikkatlice test ediyor. Dünyanın endüstriyel büyüme alanlarında çevreyi etkileyen ana bağlantıları bulmak için ARDL (Otoregresif Dağıtılmış Gecikme) analizini kullanır. Bu, aynı anda farklı yerlere bakarken endüstri gibi karmaşık şeylerin doğal dünyamızı nasıl değiştirebileceğini daha iyi anlamamıza yardımcı olur. Emisyonları azaltmak için temiz enerji kullanmanın önemini anlıyoruz. Bu özellikle BRICS ülkeleri için geçerlidir. Ayrıca araştırma, cinsiyete duyarlı politikaların bazı şeyleri nasıl değiştirebileceğini gösteriyor. Kadınlara güç vermenin çevremizi daha iyi korumaya nasıl yardımcı olduğunu vurguluyor. Bu da hızla büyüyen ekonomilerde eğitim alan insanların akıllı kararlar almasının ve kaynakları akıllıca kullanmasının ne kadar önemli olduğunu gösteriyor. Bu çalışma kritiktir çünkü BRICS'in az çalışılan alanının iyileştirilmesine yardımcı olur ve cinsiyetin çevre politikalarında ve CO2 emisyonlarında nasıl bir rol oynadığına dair olağanüstü görüşler sunar. BRICS ülkelerinde yeşil enerji kaynaklarına geçişin ne kadar faydalı olacağına bakıyor. Aynı zamanda çevre hakkında öğretmenin, insanların doğaya yönelik görüşlerini ve

eylemlerini daha iyi değiştirip değiştiremeyeceğini de adil bir şekilde kontrol eder. Çalışma anlamlı bağlantıları gösteriyor ve BRICS ülkeleri arasındaki olası bağlantıları vurguluyor. Yenilenebilir enerji politikaları, her iki cinsiyeti de iklim stratejilerine dahil etme yolları ve eğitimi iyileştirme yolları hakkında değerli ipuçları veriyor. Aynı zamanda yakındaki bölgelerle birlikte çalışmayı da teşvik ediyor. Bu bilgi okullara yardım etmeye ve yasaları şekillendirmeye hazırdır. BRICS ülkelerinin ekonomilerini herkes için uzun ömürlü, sağlam ve adil bir geleceğe yönlendirecektir. Bu çalışmanın önemli yanı, kadın ve erkeklerin çevre kurallarıyla nasıl bir ilişki kurduğuna, CO2 seviyelerini öğrenmek için harcanan paranın etkisine ve bu güçlü ülkeler birlikte çalışırsa neler olabileceğine bakmasıdır. Bu, çevresel kalkınma (sürdürülebilir yaşam) hakkındaki konuşmayı daha iyi hale getirir.

ANAHTAR KELİMELER: Karbon Salımı, Cinsiyet, Yenilenebilir Enerji, Eğitim Harcamaları ve Sera Gazı.

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ABBREVIATION

JRCEC - Joint Research Centre of the European Commission

WB – World Bank

REN – Renewable Energy

GEN – Gender Equality

EDU — Education Expenditure

GHG – Green House Gas

CO2 – Carbon Emission

GW – Global Warming

CHAPTER 1

INTRODUCTION

The comfort and quality of people's lives have been significantly improved in recent times as a result of technological advancements and progress in modern society. The emission of greenhouse gases (GHGs), which cause climate change and global warming, worsens environmental concerns caused by these breakthroughs (Wang et al., 2021).

Climate change has a global influence, making it a significant issue for developed and rising nations. The issues of global warming and degradation to the environment have emerged as two of the most urgent global problems in the past few years. This phenomenon can be ascribed to the escalating discharge of GHG. CO2 emissions are the most detrimental among greenhouse gases, impacting human beings and the environment. Stocker et al. (2014) found that CO2 emissions account for 76.7 percent of global GHG emissions. CO2 emissions from exploiting conventional energy sources, including petroleum, natural gas, and coal substantially influence nature and human health. The results from 2019 by the International Energy Agency indicate that around 68% of CO2 emissions originate from sources that cause pollution.

Consequently, researchers and policymakers have devoted considerable attention to reducing the release of CO2 into the environment. Policymakers, in particular, aim to comprehend the primary factors that contribute to such increases, such as emissions that result in pollution. Utilizing REN sources is a highly efficient approach that preserves the country's economic progress while reducing CO2 emissions. Alternative energy sources like biomass, hydroelectricity, geothermal heat, solar, and wind power are gradually replacing polluting ones in many countries. Additionally, their goal is to encourage energy saving and improve energy efficiency.

With positive effects on both society and the environment, the climate technology business is booming. A new age of climate technology is being embraced by investors who understand the significance of lowering emissions (Cheng, 2022). A potential remedy is proposed in the latest report of the Intergovernmental Panel on Environmental Change, emphasizing the need for strong collaboration between nations and companies to accelerate the widespread and cost-effective implementation

of clean technologies worldwide (IPCC, 2022). Kartal (2022) asserts that the widespread implementation of REN sources is crucial in mitigating global CO2 emissions. The advancement of technology is essential for both environmental and economic advancement. Eliminating emissions from fossil fuels, improving air quality, increasing energy security, and promoting sustainable economic development are the primary goals of alternative energy. The development of effective plans to reduce carbon emissions is highly dependent on technological advancements (Khan, 2023). Social and economic progress, as well as the discovery of new energy sources, are important for making the planet habitable. According to Aqib and Zaman (2023), a low-carbon transportation system cannot be developed without prioritizing energy saving.

However, a country demands an ideal clean and healthy environment for an economically and politically sound society. This is because, according to Bekun et al. (2019), only a setting that combines conducive conditions for human activities with the preservation of all natural resources living and non-living alike can society achieve its goals. Environmental contamination can arise from several toxins, whether of natural origin or caused by human activities. Carbon dioxide emissions cause a lot of harm to the environment.

Hence, releasing CO2 emissions generates toxic gases that harm the ozone layer found in the stratosphere, which typically serves as a shield against hazardous ultraviolet radiation. CO2 emissions trap heat in the Earth's biosphere, leading to GW that disrupts climatic cycles and negatively impacts human health, as well as other forms of life and the environment.

Moreover, the CO2 emissions in the atmosphere weave a wall that does not allow sun heat to flow back into space, leading to a temperature rise on Earth (Ikram et al., 2019; Sadiq et al., So there will be an unprecedented rise in world temperature. CO2 emissions and the repercussions like GW considerably impact or affect ecosystems, weather patterns, and natural resources on Earth, such as soil, mineral food, and water life. Consequently, achieving long-term economic expansion becomes exceedingly difficult for any nation. Sustainable economic growth is characterized by a productive and efficient work environment, fertile land, and ample and high-quality minerals that increase the bioproduction of a water-quality, friendly workforce. Reducing emissions

of carbon dioxide can help lessen the effects of environmental degradation, according to Ao et al. (2019) The amounts of carbon (iv) oxide in the atmosphere are increased by natural and human-caused processes. The development of infrastructure, economic practices, social welfare efforts, and household chores all fall under this category. A broad variety of human-caused activities contribute to this wide variety of sources, including, but not limited to, transportation, operating electrical appliances, lighting, heating, and cooling buildings, and various forms of manufacturing, construction, service, information and communication technology (Yu et al., 2023, Hartani et al. 2021). All of these things need energy, which is the main thing that makes CO2 emissions, albeit to varying degrees (Shibli et al., 2021; Song et al., 2021). Carbon taxes, green financing, eco-innovation, and the use of REN for both consumption and production are all part of the green initiative. The term "green finance" describes the monetary efforts made by governmental and commercial entities to prevent environmental degradation. Included in this is eco-innovation, the practice of enhancing products and processes in a way that is less harmful to the environment.

Additionally, green finance promotes the consumption and production of renewable energy and advocates for implementing carbon taxes to reduce CO2 and encourage sustainable practices. Therefore, it is possible to regulate the release of CO2 into the atmosphere and manage the resulting consequences (Stagakis et al., 2019). The economies of BRICS, specifically, encompass 42% of the global population and account for 23% of the world's GDP. Given their status as the top 10 global energy consumers, the BRICS economies have responsibility for 40% of worldwide energy consumption and 43% of worldwide CO2 (Ngepah, 2022; Shen et al., 2023). It should be emphasized that swift economic growth leads to higher detrimental emissions in BRICS countries.

Consequently, the economies face challenges in attaining sustainable development targets despite their commitment to curbing global temperature increases through enhanced measures and programs to tackle environmental concerns. Given the matter, it is crucial to investigate how these economies can effectively inhibit GHG emissions to attain the objective. Furthermore, which tactics and policies are productive and have the potential to offer enhanced support in such a circumstance? As previously mentioned, the BRICS economies, known for their rapid economic expansion, face challenges from institutions due to their significant carbon emissions. Therefore, it is

necessary to implement stringent policies to align with the desired goal (Jermsittiparsert, 2021; Ojogiwa, 2021). BRICS nations are seen as freshly developing economies with considerable importance due to their geo-economic influence, high productivity development, and active participation in worldwide economic integration. China is reported to be one of the most significant contributors to global CO2, accounting for 30% of the total in 2020. In 2021, Russia, India, Brazil, and SA accounted for 6, 4.71, 1.29, and 1.09% of world emissions, respectively (World Bank, 2021). These nations' capacity is often questioned due to their significant contribution to CO2. In theory, these nations are responsible for leading other economies in discouraging detrimental emissions by implementing sustainable policies. The BRICS nations must face formidable hurdles to fulfill their vow, and the study aims to produce results that can address these issues. The study examines many strategies, including carbon taxes, eco-innovation, green finance, and increased use of REN, that have the potential to reduce emissions. These strategies have been discussed in previous research conducted by Caglar et al. (2022) and Sadiq et al. (2023b).

2012 the BRICS economies were responsible for over 41% of GHG emissions worldwide. In addition, these economies were also included in the list of the top seven states with the highest carbon emissions in 2014 (Ainou et al., 2022; Bai et al., 20). High industrial production, fuel use, and exports mainly cause this. Nevertheless, BRICS economies exhibit a more significant proportion of CO2 than low-income, lower-middle-income, and high-income nations while somewhat distant from the mid and upper-median revenue levels. Understanding the origins of emissions of carbon in these states is essential due to the predominant contribution of non-renewable resources to CO2. In addition, it seems that BRICS countries mostly rely on solid and liquid fuels as the primary contributors to carbon emissions (Chien, 2022a; Chien et al.

Despite these states' negative reputations for CO_2 emissions, they have made significant investments in green technology, alternative fuels, energy efficiency measures, and technological innovation (Chien et al., 201; Chien). Two important areas and formal institutions were given priority in the eco-related policies of the BRICS governments: the industrial sector and higher education. Sustainable technology and eco-innovation are two keys that businesses and universities may utilize to help push green tech forward. When it comes to sustainable technology

development, China has the highest rate of 81% among the BRICS governments. In light of the growing number of international alliances, the BRICS nations have established a number of joint projects to advance environmentally friendly technologies. For example, the BRICS meetings and the emerging development banks are examples of such alliances (Dinh et al., 2022; Duong et al., 7).

The Chinese economy has grown substantially over the last several decades, and it has surpassed all others to be the world's best second-largest since 2010 (Rasool et al., 2021). Furthermore, China's significant reliance on high levels of input energy consumption and its resulting pollution, as highlighted by Precious Monaheng et al. (2018), has contributed to an escalation in GHG emissions, positioning China as a prominent worldwide emitter of these harmful pollutants among several threats. For instance, the persistent haze weather issues in China's eastern and northeastern regions are severe (Ramanathan, 2018), implying that the ecosystem is rapidly degrading to the point where it will collapse.

China's primary contributors to emissions are coal-fired power generating and mining activities. This country holds the highest global position in coal production and consumption. As part of its efforts to reduce its reliance on coal, the firm plans to make modifications to its energy infrastructure. It was reported by Liu et al. (page?) that China was responsible for almost one-third of the world's CO2 emissions in the year 2014, when the country's emissions surpassed 12 gigatonnes.

In contrast, the cement, iron, and steel sectors are among China's consumers that contribute less to greenhouse gas emissions than producers. Greenhouse gas emissions in China have been mostly caused by the energy sector since the start of the previous decade. In spite of this, its CO2 emissions per capita are lower than those of both industrialized nations and developing ones. During the year 2007, the annual average of carbon dioxide emissions per person in China was approximately 5.1 tons. It is a considerable improvement when one considers that the United States of America, Europe, and Russia all had emissions that were more than twice as high as this. It is important to point out that China's emissions have consistently been lower than those of the countries that are associate of the OECD.

China has incorporated the reduction of greenhouse gas emissions into its national plan as a response to environmental diplomacy on a global scale and rules pertaining

to the preservation of ecological systems within the country. In its capacity as a signatory to the Paris Climate Agreement, China has made a commitment to completely eliminate carbon emissions by the year 2060.

Furthermore, China's significant reliance on high levels of input energy consumption and its resulting pollution, as highlighted by Precious Monaheng et al. (2018), has contributed to an escalation in GHG emissions, positioning China as a prominent worldwide emitter of these harmful pollutants among several threats. For instance, the persistent haze weather issues in China's eastern and northeastern regions are severe (Li and Ramanathan, 2018), indicating that environmental degradation in the ecosystem is nearing a critical threshold.

China's primary contributors to emissions are coal-fired power generating and mining activities. This country holds the highest global position in coal production and consumptionIn order to reduce its reliance on coal, the company is working to modify its energy infrastructure in order to reduce its consumption of coal. It was estimated by Liu et al. that China was responsible for almost one-third of the world's CO2 emissions in the year 2014, when the country's emissions surpassed 12 gigatonnes.

In contrast, the cement, iron, and steel sectors are among China's consumers that contribute less to greenhouse gas emissions than producers. Greenhouse gas emissions in China have been mostly caused by the energy sector since the turn of the previous decade. Still, compared to both developed and developing nations, its CO2 emissions per capita are lower. About 5.1 tons of carbon dioxide were emitted per capita in China in 2007. This is compared to the United States, Russia, and Europe, whose emissions were over twice as high. It is worth noting that the OECD countries had consistently higher emissions than China's.

As part of its national policy, the goal of reducing emissions of greenhouse gases has been reduced by Chinese government. This is in accordance with the country's goals of ecological conservation and its efforts to engage in international environmental diplomacy. Specifically, the Chinese government has stated that By 2060, it will have fulfilled its obligation to become carbon neutral, as mandated by the Climate Change Agreement of Paris, which it has committed to implementing.

According to Glen Peters, a researcher at the International Center for Climate Research in Oslo, more emphasis should be placed on implementing policies to phase out the

use of fossil fuels (FF). This is a compelling incentive to revisit the energy policies of rich countries through the lens of climate change. In the middle of the twentieth century, there was a significant increase in public awareness and concern about environmental quality. Multiple global frameworks, like the SDGs and the Millennium Development Goals, have responded to this concern. Additionally, there was a notable development of impact assessment laws and the establishment of state ecological organizations (Frank et al., 2000; Sharif et al., 2020a).

The institutions in question have been credited with significant achievements in promoting environmental consciousness, as evidenced by the studies conducted by Constant and Davin (2018) and Sarti and John (2019). Akerlof (2017) posits that three conditional conditions can augment the significance of environmental awareness in addressing ecological degradation concerns. Initially, it is necessary to establish a policy that facilitates the cultivation of behavioral modifications among individuals. Moreover, decision-making organizations must join majority rule inclusion forms to create compelling arrangements. Eventually, it is fundamental to prioritize accentuating instructive and value-based changes at the community level.

Besides, the later rise of corporate social duty (CSR) has increased firms' acknowledgment of their commitment to contribute to maintainable improvement (Santos-Jaén et al., 2021). This, in turn, has driven the expanded execution of maintainable hones, driven by the critical weight applied by different partners inside the company. Agreeing with Fauver et al. (2018), the endeavors attempted by organizations to upgrade natural conditions have improved their notorieties and general execution.

However, it is essential to note that a disparity exists among corporations in their contribution towards sustainable development, specifically in reducing CO2 emissions. Existing scholarly research has endeavored to elucidate the determinants that lead to corporations' heightened levels of environmental consciousness. For instance, prior research has provided evidence suggesting that family-owned businesses are more dedicated to environmental conservation. As pointed out by Berrone et al. (2010), they are exceptionally dedicated because they wish to safeguard the social and emotional capital that they have created. This is the reason why they are so dedicated. According to Walls et al. (2012), previous research has demonstrated

that the composition of a company's board of directors or ownership can have an impact on the degree to which the company participates in environmental conservation programs.

The significance of the board of directors' structure in affecting the decision-making handle and forming the critical heading of a company has been recognized by researchers (Fuente et al., 2017; Demb and Neubauer, 1992). As of late, there has been a developing insight into the commitment of ladies serving on corporate sheets, as proven by the work of Hossain et al. (2017). There is evidence from prior research that shows a connection between having more women on boards of directors and the enhanced environmental performance of organizations (Valls Martínez et al., 2019). One such hypothesis is that individuals of the female gender may exhibit a heightened receptiveness towards ecological issues (Xiao and McCright, 2015), and they also tend to have a more considerable degree of prudence, hence increasing their awareness of the potential hazards stemming from climate change (Burkhardt et al., 2020). Drawing upon Chodorow's (1978) gender socialization theory, it can be posited that societal expectations place a greater emphasis on women's inclination to exhibit heightened responsiveness towards the detrimental consequences that corporate activities may impose upon the environment. It is crucial to emphasize the significance of the gender composition of the board of directors (Hossain et al., 2017).

The economic development model observed in the BRICS countries is marked by elevated levels of pollution and energy consumption due to inherent limitations. This is evident through substantial investments in conventional energy sources and excessive exploitation of mineral resources. The approach in question has resulted in a direct outcome characterized by an escalation in carbon emissions and heightened environmental pollution, thereby impeding economic growth. Based on the data presented in the "BP Statistical Yearbook of World Energy (2020)," it can be observed that within the group of BRICS nations, China presently exhibits the most outstanding levels of carbon emissions globally. In 2020, China's total CO2 constituted 28.8% of the global emissions, positioning it as the most significant contributor.

On the other hand, India contributed to 7.3% of worldwide outflows, positioning it as the third most prominent emitter worldwide. The carbon outflows of Russia, Brazil, and SA account for 4.5%, 1.3%, and 1.4% of worldwide emanations, respectively.

Within the year 2020, the total carbon outflows of the BRICS countries were 43.3% of the generally worldwide carbon emanations. CO2 emissions are a metric for environmental degradation that researchers have identified and evaluated and a significant factor influencing climate change (Doğan et al., 2017; Murshed et al., 2022). Different social and financial variables impact the era of carbon emissions in developing economies such as China, influencing the country's interest in economic advancement. The nearness of financial development altogether affects the phenomenon of natural weakening. According to the idea known as the EKC, it is posited that as a country's economic growth progresses to more advanced phases, there is a potential for reducing carbon emissions. This objective can be attained through resource allocation towards RE products, establishing cleaner energy infrastructure, and advocating for manufacturing processes characterized by minimal or zero net emissions (Hossain et al., 2023). In contrast, countries that are just starting out on the path predicted by the Environmental Kuznets Curve (EKC) theory rely heavily on fossil fuels, hence resulting in a detrimental impact on the environment when considering the connection between rising prices and ecological damage (Umar et al., 2022; Yousaf et al., 2022).

Promoting sustainable development is significantly influenced by creating and exploiting renewable energy sources, which derive from natural resources and possess exceptional carbon emissions capabilities. REN sources, such as those highlighted by Ahmad et al. (2020), offer viable options instead of Non REN sources, such as FF. These alternatives mitigate the negative impacts on economic growth and alleviate environmental degradation. There is a growing global emphasis on the development of REN technologies as a means to reduce reliance on fossil fuels produced from natural resources and achieve long-term resource sustainability. The international support for renewable energy consumption is extensive, primarily attributed to its notable capacity to create energy while minimizing the production of GHG (Murshed et al., 2022b). The energy technologies beneath address incorporate solar control, wind control, and hydroelectricity. China has displayed an outstanding devotion to the interest of natural maintainability, as proven by its considerable speculation of $758 billion through the period traversing from 2009 to 2019. The investments in question are designed to promote environmentally friendly economic development and support the pursuit of a sustainable future (Gao et al., 2021).

Moreover, allocating funds toward education is crucial in fostering economic growth. Nations that give educational resources enhance their human capital by augmenting their workforce's efficiency, competence, and capabilities. According to Raihan (2023), the outputs in question can lead to enhanced creativity, advancements in technical capabilities, and overall economic productivity. It is anticipated that countries will move towards a biologically economical and low-carbon financial show in arrangement with the objectives set forward by the 27th Conference of the Parties (COP 27). Contributing to instruction plays a significant part in encouraging this change. Investing in educational programs that prioritize the development of skills and knowledge related to long-term viability energy efficiency, climate change research, and green technology allows governments to cultivate a proficient workforce capable of spearheading a transition towards a more conscientious and sustainable economy (Khan et al., 2023b, Khan et al., 2023a).

China has implemented many initiatives to reduce carbon emissions, including campaigns promoting carbon-free technologies. Additionally, the government has incentivized industries and businesses to develop green buildings and vehicles with reduced carbon emissions (Su et al., 2021; Umar et al., 2020, 2021). These programs can promote environmental sustainability and facilitate long-term advancements in greener energy. Figure 1 illustrates the patterns observed in government spending, mineral rents, and REN for the period spanning from 1988 to 2021. The source is cited by the World Bank (2022).

The contribution of this article is to provide a comprehensive investigation of gender, renewable energy, and education expenditure on carbon emissions, utilizing experimental proof from the case considered nations. By analyzing the different measurements of gender flow, renewable energy adoption, and their impact on carbon emanation, together with the effect of education expenditure, this article sheds light on the complex and interrelated variables that shape natural results and identifies potential approach mediations that can address them.

The overall structure of this work is depicted within the graph that can be found underneath. We'll review the relevant writing and examine possible cures within the taking after. The following part will be titled "Methodology and Data," it will provide

in-depth descriptions of our approach and the data we utilized. The discussion and the conclusion comprise the two sections that come toward the end of the paper.

1.1 Statement Of Problem

This research examines an important and complex matter from environmental sustainability, social interactions, and monetary measures. One of the current issues at the global level is the occurrence of anthropogenic CO2 emissions that cause GW. The growing economies in these BRICS countries are necessary due to their industrial development and the exertion of influence upon nature.
Therefore, it is essential to comprehend which and how many factors influence emissions of CO2 in these states. The recognition of REN significance in reducing emissions is well accepted; nonetheless, there is a lack of comprehensive exploration regarding the influence of gender equality and education expenditure on environmental outcomes, specifically within the BRICS environments. The economies under consideration, distinguished by their expeditious growth and multifaceted social frameworks, offer an exceptional context for examining these interconnections.

The rationale for incorporating gender dynamics into this study is the increasing acknowledgment that gender roles and representation, particularly in decision-making processes, substantially impact environmental policies and practices. However, very few detailed academic studies look at carbon dioxide reduction in developing countries through the lenses of gender in their energy sector.

Similarly, the resource allocation used in education is another significant factor influencing people's awareness, attitudes, and actions taken to save the natural world. Nevertheless, there has not been enough research on Education Expenditure and partial impacts on CO2 discharge, especially the role of BRICS as an agent of green education.
This research aims to fill gaps regarding the linkages between gender dynamics, the uptake of renewables, education spending, and CO2 emission trends in BRIC countries. The results of this research are expected to shed light on the views of policymakers, school teachers, and environmental agencies. Comprehending these dynamics is essential in formulating enhanced strategies to address climate change and

advance sustainable development in several globally influential and swiftly progressing economies.

1.2 Significance Of The Research

The interconnected impacts of BRICS nations' socioeconomic variables and CO_2 emissions are the subject of this exploratory study. An extensive analysis of a relatively unexplored field under the BRIC framework, gender in environmental policy, and CO2 emissions. This research offers an unusual aspect of implications for gender distribution within the energy field concerning the effect of environmental conditions. On the other hand, such an analysis is crucial in understanding the broader impact of gender equality on environmental governance and policy. Furthermore, considering renewable energy within BRICS countries accurately assesses the impact of changing to an alternative power outlet contributing to gas emissions. This study is intended to provide a neutral assessment of the relevance of REN in tackling GHG in different developing countries around the world. Finally, assessing the influence of environmental education expenditure on perceptions and actions regarding the environment would objectively evaluate the power of environmental education in shaping people's environmental outlooks and practices. The latter portion of this study could offer valuable data on whether educational efforts lead to an increased understanding of the environment and reduced carbon emissions. This study aims to provide an unbiased assessment of how gender roles, REN sources, and EDU influence CO_2 emissions in the BRICS countries. We expect this will generate unbiased views on issues surrounding fast-growing economies and the environment that could be very important to policy-makers, educators, and other stakeholders.

1.3 Research Question

- What is the relationship between gender representation in decision-making roles within the energy industry, Renewable Energy, Education Expenditure and CO2 emissions in BRICS countries?
- To what extent is a correlation between differences in CO2 emissions among BRICS nations and disparities in gender equality, renewable energy adoption, and education investment?

- What are the potential policy consequences arising from the interplay between gender roles, renewable energy, and education expenditure in the context of CO2 emissions management within BRICS economies?

1.4 Limitations

It is crucial to acknowledge various limitations of the study to gain a comprehensive grasp of its findings within their appropriate context and scope. One of the main constraints lies in the dependence on secondary sources. Although secondary data provides extensive coverage and is a cost-effective option, it may not align precisely with the specific requirements of the research due to potential discrepancies in data availability, level of detail, and consistency across different sources. The dependence on this factor may have implications for the accuracy of the analysis. It may restrict the capacity to customize data collection according to the precise parameters of the study.

Another noteworthy constraint is the time and geographical scope of the investigation. Focusing on the preceding decade yields significant insights, particularly on BRICS nations. Yet, it may not encompass enduring patterns or possess generalizability to alternative geographical areas or economic circumstances. Moreover, the study's reliance on quantitative methods, although valuable for detecting trends and correlations, may not comprehensively capture qualitative subtleties such as the complexities of gender dynamics or the nuanced effects of education on environmental awareness.

The research also encounters possible obstacles related to confounding variables. CO2 emissions are subject to several influences, encompassing economic expansion, technological advancements, political determinations, and cultural dispositions. The process of isolating the effects of the study's specific variables within the context of various other influences can be intricate, and there is a potential for additional relevant factors that may influence the outcomes.

Additionally, it is essential to acknowledge that the quality and trustworthiness of the secondary data sources present a constraint. The analysis assumes that data received from various databases and articles are correct and truthful. Nevertheless, one should be aware that such problems as bias and false information collected by the initial procedure can affect the research results. Therefore, it is crucial to identify these

restraints to interpret the study findings accurately. Nevertheless, the authors caution against over-generalizing or hasty application of its findings while suggesting new directions for subsequent research to solve these and other related issues and move the knowledge base forward.

1.5 Contribution to the study

The researcher has contributed widely to Environmental economics and Policy with a critical concentration on Emerging Economies. This has contributed tremendously towards the expansion of knowledge in this field. Specifically, this study provides evidence on how these three interrelated factors in CO2 of BRICS nations complement each other.

A significant input is on including gender equality in evaluating sustainable environment studies. The researcher expands the standard orientation of environmental studies to explore gender factors like the influence of female participation in environmental policies and the energy industry on decision-makers. This addition reveals a fairly unaddressed dimension and signifies the importance of being gender sensitive during ecological policymaking.

The second point is the extensive analysis of the implementation of REN consumption in the BRICS countries linked with CO2 emission. The complexity of potential impacts on the environment that may occur during this energy transition is considered in this study. The concept is even more critical today when the shift towards REN plays a big part in efforts directed at global environmental issues. Furthermore, the researcher's focus on educational expenditure as a variable makes a specific element in the study. This study provides valuable details showing how the indirect nature but important routes could be that educational investments could influence CO2 emissions due to increasing awareness levels and attitudes to environmental sustenance. It shows the researcher’s commitment towards thorough and systematic analysis in the study by using a combination of descriptive units, root tests, etc, among others, and high-end techniques like the ARDL model and cointegration test. However, this specific methodological strategy ensures the accuracy and reliability of the outcomes and enlarges the weight of findings for empirical research within the scope of this discipline. The researcher’s study widens our understanding of the complex relationships among economics, society, and the environment within the BRICs. The benefits derived from this study are essential for providing tailor-made strategies to

reduce greenhouse emissions by political leaders, educationists, and environment managers as these countries' developments scurry.

1.6 Thesis Structure

This entire study has been arranged in a way that helps to make a clean-cut presentation of data, analysis, and results. The study begins with a brief introductory part explaining why the critical problem is essential. The purposes of the research are also defined here, as well as the role of the researcher. This chapter summarizes the study's content and importance, arguing why gender equality, renewable energy, education expenses, and CO2 emissions should be included in future studies focusing on BRIC economies.

This chapter contains an in-depth discussion of previous studies about environmental sustainability, gender roles and policy, the use of REN resources, and the linkage between education and environmental awareness. Therefore, this review not only consolidates the current literature but also points out areas where more research is required that this study aims to address. Research theory is critical because it provides a sound groundwork by linking existing assumptions and previous findings for the analysis. After the literature review, this section deals with the methodology, whereby the research approach, data collection methods, and sources are explained. This study makes use of secondary data gathered from reputable sources, like the World Bank, and spans the years 1990 to 2020. Here, an outline regarding the analytical statistics used, such as descriptive statistics, units root test, ARDL models, Cusum and Cusum square test, and integration tests, are outlined. In addition, this section ensures that the study is transparent and possible to recreate.

The next part of the thesis is focused on the Results and Analysis section, where the gathered information is analyzed. This section examines the statistical data on the interlinkages among gender balance, renewable electricity, and education spending and their influences on CO2 emissions within the BRICS nations. The discussion covers a detailed consideration of the results of various statistical tests important for understanding interdependencies between the studied variables.

The discussion sections come after analysis, and the interpretations are in light of the existing literature and theoretical foundations. This part of the thesis discusses the

significance and implications, revealing why they matter in understanding sustainable development in third-world nations and associated policies.

Conclusions include summaries of significant findings, additions to existing knowledge, possible policy recommendations, and proposed studies that can build on this research. Both the strengths and weaknesses of the current study are analyzed in the preceding statement, which also suggests directions for future research. Lastly, it provides a final touch by reiterating its importance and possible implications following the research effort.

The thesis has a bibliography or reference section that lists all the sources referenced and may have appendices that contain more material and statistical data supporting the research done in this study. Developing this framework ensures the thesis is arranged correctly and comprehensibly and provides a precise and comprehensive exploration of the study theme.

CHAPTER II

LITERATURE REVIEW

Everything from soil and water to minerals and energy sources as well as trees and food and nonfood crops all have a role in creating an environment that is favorable to a nation's prosperity. The great resources and clean, healthy environment contribute to the nation's development. But polluted environments have limited resources that are bad for creatures' health (Lan et al., 2022). Deterioration of the environment hinders the advancement of the nation. CO2 poses a serious threat to the ecosystem because it disrupts climatic balance and influences patterns like weather. The standard of natural goods is also affected (Pata, 2021). It is critical to decrease CO2 emissions in order to have a clean and healthy environment for the country.

Studying the impacts of REN, GEN, and EDU spending on CO2 emissions is crucial as it enhances company resource efficiency and reduces waste by minimizing CO2 usage.

The initial section of this chapter centers on the preceding investigations pertaining to REN and CO2 emissions. Due to the scarcity of economic literature on this topic, many different fields are investigated. The primary emphasis of these investigations revolves around three specific domains: The correlation between the utilization of REN and the release of CO2 emissions. The second portion comprises a compilation of prior literature reviews on the factors that influence CO2 emissions, concentrating on gender as an important control variable in particular. Section 3 delves into the information gap about the impact of education financing on CO_2 emissions, which is the primary goal of this research. Nevertheless, the increasing global awareness of environmental sustainability and climate change has highlighted the significance of GEN, EDU, and REN use in lowering CO2 emissions. This is particularly relevant for emerging nations of the BRICS countries. This area comprehensively examines the current body of literature exploring the interrelationships between these components and their impact on CO2 emissions inside the system of BRICS countries.

Numerous scholarly investigations have highlighted swift economic growth in BRICS nations, encompassing China and consequently giving rise to notable environmental predicaments (Rasool et al., 2021). The dominant growth paradigm has led to a

noteworthy surge in energy consumption, pollution levels, and increased emissions. Consequently, China has emerged as the leading worldwide contributor to GHG and atmospheric pollutants (Monaheng et al., 2018). The debasement of the environment presents critical dangers to biological systems, as proven by the continuous presence of murky climate patterns in entirely different geological regions (Li and Ramanathan, 2018).

The increment within Brazil's agricultural division and deforestation were distinguished as critical contributors to GHG emissions (Silva et al., 2020). In expansion, using fossil fuels in transportation and industry has made Brazil one of the region's most contributors to CO2 emissions.

Whereas, finding a middle ground between economic growth and environmental protection has proven difficult for India (Prasad et al., 2019). The country's overwhelming dependence on coal as the most important source of energy generation has come about in tremendous CO2 emissions, compounding worldwide warming and causing natural debasement.

Due to its endless natural resources, Russia has appeared to have a noteworthy reliance on FF as the primary source of energy production, which results in critical emissions of CO2 and other GHG (Shmakova et al., 2018). In expansion, the country's industrial efforts have played a part in worsening environmental contamination and discharging destructive gases.

Despite its moderately little commitment to global emissions, South Africa is under increasing pressure to decrease carbon emissions (Marais et al., 2017). The country's reliance on coal as the most source of electricity generation has played a vital part in expanding carbon dioxide emissions.

Research by Jebli et al. (2016) inspected the relationship between CO2 emissions, global exchange, economic development, and energy utilization from particular sources. Moreover, the results of this study not only bolster the affirmation of the EKC hypothesis but also highlight the significance of improving global trade and embracing energy choices and renewables as critical approaches to handling climate change. This proposition is based on the rationale that industrialized nations are more likely to adopt cleaner technology in international commerce, leading to a gradual decrease in carbon

emissions over time. Over a long period of time, the study discovered evidence of a causal relationship between the variables that were being studied.

In their study, Shafiei and Salim (2014) looked at what factors affect carbon emissions. The STIRPAT model, which takes into consideration random effects by means of regression on GDP, population, and technology, was used to examine OECD country data from 1980 to 2011.

According to the statistics, carbon emissions are strongly correlated with the use of non-renewable energy sources. However, the inverse is true when looking at total carbon energy and renewable energy usage.

The study provides more evidence linking urbanization to environmental degradation, lending credence to the EKC concept. The goal of the policy directive is to combat climate change by encouraging the development of cities and the use of renewable energy. The impact of energy usage, GDP growth, FDI, and CO_2 emissions in the five ASEAN member states were examined in a 2016 study by Zhu et al. Foreign direct investment (FDI) may help reduce carbon emissions, according to a study that used panel quantile regression as its technique. In addition, nations with high emissions levels see a decline in environmental quality as their economies improve.

The study revealed that the effects of several independent variables on emissions varied significantly across different quantiles. While Lee (2013) finds little evidence of a connection, FDI inflows are unrelated to carbon emissions in G20 nations. From 1971 to 2009, a correlation was found whereby lower CO2 emissions were linked to economic expansion. G20 countries' classification as developed may not be conducive to promoting clean energy technology through additional FDI. Research conducted by Pao and Tsai (2011) suggests a positive correlation between FDI and carbon emissions in BRIC nations. This finding implies that emerging economies should exercise caution when considering the terms and conditions of FDI or establish environmental protection measures to regulate such transactions. Previous research on this topic has yielded varying findings within single-country studies (Shahbaz, 2018) and across many countries (Shahbaz et al., 2019).

The literature has extensively examined the environmental difficulties of BRICS countries. Hence, a significant research gap exists on the influence of gender on environmental attitudes and practices within these nations. Research by Qamar, uz

Zaman, and other researchers sheds light on how gender may affect CO2 emissions in the aforementioned countries.

This research sheds light on the discrepancies connected to gender and highlights potential avenues for developing environmental policies that include gender considerations.

Moreover, academics are interested in exploring the relationship between education expenditure and sustainable development indicators, particularly concerning emissions reduction. Examining the relationship between investment in education and its impact on environmental awareness and sustainable practices is essential for policymakers in BRICS countries seeking to address these issues. Determine CO2 emissions.

Furthermore, there is increasing emphasis on deploying renewable energy sources to lower global CO2 emissions effectively. Nevertheless, additional research is needed to examine its precise function within the framework of emissions reduction endeavors undertaken by BRICS nations. Researching the relationship between REN uptake and emission reduction in the BRICS setting is essential for crafting effective and contextually relevant policies on renewable energy.

The research that was carried out by Qamar uz Zaman et al., it has been observed that China has undergone a substantial expansion in its economic sector, resulting in its emergence as the second-largest global economy in the recent year (Rasool et al., 2021). However, China's current position is at least partially attributable to the dominating paradigm of development, which is defined by high inputs, energy consumption, pollution, and emissions (Monaheng et al., 2018) as the primary global emitter of GHG and atmospheric pollutants, giving rise to numerous significant environmental challenges. For example, the eastern and northeastern regions of China are currently facing persistent hazy weather conditions at a very severe magnitude (Li and Ramanathan, 2018). This points to the fact that the ecological threshold that China's pollution is getting close to has been crossed (Peng et al., 2016).

In China, the primary source of emissions is energy generation through coal combustion and mining activities. As the leading global coal consumer and producer, this nation actively tries to reduce its coal consumption by implementing efficient energy reforms. The findings from Liu et al.'s research indicate that China accounted

for almost a third of global CO2 emissions in 2014, with its emission levels reaching an overwhelming figure of 12 gigatons. While production activities within these sectors produce higher emissions, consumption activities display a more manageable GHG footprint. The past ten years have witnessed China's energy sector rise as the primary generator of GHG emissions. Let us highlight that China has lower per capita CO2 emissions than developed and developing nations. As the OECD (2009) states, China's per capita CO2 emissions in 2007 were lower than those of the United States (19.4 tons), Russia (11.8 tons), and European countries (8.6 tons). The primary sectors in China's economy that lead to CO2 emissions are visualized in Figure 1.

Amid international environmental diplomacy and domestic environmental protection requirements, China's government has acknowledged its environmental obligations by implementing a national policy to decrease GHG emissions in the environment. China aims to achieve CO2 emission neutrality by 2060 while actively supporting the Paris Climate Agreement. China has decided to implement policies promoting technological and institutional innovation. These policies aim to enhance the industrial mix, establish a reduction of carbon energy system, improve it transportation, and foster the development of green buildings.

Tambo et al. (2016) states that China has committed to achieving its maximum CO_2 emissions by 2030. According to one plan, China aims to cut its CO2 emissions per unit of gross domestic product (GDP) by 60-65% from 2005 levels. Not only that, but the project also aims to increase forest stock by about 4.5 billion cubic meters and increase the proportion of non-fuel sources in primary energy use by 20%. Gao (2016) states that the Chinese government has made preparations to encourage global cooperation in a range of areas, such as renewable energy, environmentally conscious farming, disaster preparedness, smart cities, low-carbon, and ecological preservation.

The literature analysis underscores the necessity for additional investigation into the impact of GEN, EDU, and REN on CO2 emissions in the BRICS nations. Through a comprehensive analysis of current deficiencies and a thorough comprehension of the interrelatedness of these variables, the main goal and objective of this research endeavor is to provide a valuable contribution toward advancing environmentally sustainable and inclusive policy frameworks.

2.1 Gender and CO2 Emissions

Scholarly work has established a link between women's political empowerment and a reduction in the amount of carbon dioxide emissions emissions. Ergas and York (2012) employ an indicator to determine the political status of women, and then they use regression analysis to determine whether or not there is a connection between the level of political participation and the amount of CO2 emissions. The percentage of women who are members of parliament, the number of women who hold ministerial positions, and the length of time that women have been allowed to vote are all factors that were taken into consideration while developing this statistic. Due to the fact that the study demonstrates a negative association between women's political position and emission levels per capita (Ergas & York, 2012), policymakers need to make the political empowerment of women a priority in order to reduce CO2 emissions.

In their 2015 study, McKinney and Fulkerson employ a structural equation model to analyze the identical relationship. Climate overshoot and the percentage of female lawmakers also show a negative correlation, according to their findings. Eighteen of the world's wealthiest nations saw their emissions fall or remain relatively stable from 1990 to 2004, according to 2007/2008 UNDP Human Development Report (HDR). According to Buckingham (2010), fourteen of these eighteen nations had a higher proportion of female lawmakers than the global average. The aforementioned studies do not establish a causal connection between the political status of women and CO2 emissions, but they do raise questions and motivate additional research into this possible relationship.

Women have a tendency to lead lives that are more energy-efficient, according to research that compared the decision-making processes of men and women. These studies focus on a number of key consumption categories, including housing, food, and transportation, among others. Both Carlsson-Kanyama et al. (1999) and Cohen (2014) have conducted research on gender disparities in transportation. While the amount of CO2 is connected with the choice of vehicle and the duration of route, gender discrepancies in transportation have been investigated. In a study that was carried out by Carlsson-Kanyama et al. (1999) and Cohen (2014), it was discovered that the transportation decisions made by men can result in up to 53 percent more carbon dioxide emissions than those made by women. The significance of the gap in

their energy consumption is brought to light by this discovery. Another sort of consumption is the unequal distribution of food intake between men and women. Researchers Carlsson-Kanyama et al. (2003) found that males had a tendency to consume a greater quantity of calories than females do. In addition, they came to the realization that there are differences in the kinds of foods that individuals chose to consume. Men's food consumption demands more energy than women's does because the heart consumes a greater amount of energy than women do. In addition, men consume a far greater quantity of meat.

This inequality is demonstrated by the fact that men in Sweden consume an average of 63 kilograms of meat per year, whereas women consume just 47 kilograms of meat according to Carlsson-Kanyama et al. (2003). Finally, Carlsson-Kanyama et al (2010) in their article "Energy Consumption by Gender" investigate the ways in which people of different genders consume energy. A study that examines four countries—Germany, Norway, Greece, and Sweden—found that men and women in Sweden and Greece use significantly different amounts of energy overall. Raty and Carlsson-Kanyama (2010) found that the differences in energy consumption were considerable. When all of these studies are considered together, they demonstrate that men, in comparison to women, are more prone to participate in lifestyle choices that are both energy-intensive and carbon-polluting.

There is a correlation between the degree to which women are involved and empowered in the working and the level of environmental responsibility and efficiency that is present in business operations. Buckingham et al. (2005) conduct research to evaluate the possibility that gender-sensitive waste management methods could improve ecological performance. The purpose of this study is to investigate the gender mainstreaming methods that are utilized by municipalities in Ireland and the United Kingdom in relation to garbage management. According to Buckingham et al. (2005), the findings suggest that the recycling rates in the region are higher when there are a greater number of female managers. This evidence lends support to the concept of gender mainstreaming.

Furthermore, research has indicated that women do have an impact on firms' sustainability reporting. Research from 2008 by Barako and Brown looks at the

Kenyan banking sector and how gender diversity on corporate boards affects CSR reports.

The study's results show that companies with more female employees are more inclined to publish and highlight their sustainability and social responsibility efforts on a regular basis.

"The Role of the Board of Directors in Disseminating Relevant Information on Greenhouse Gases" by Prado-Lorenzo et al (2010) explores more into the impact of gender diversity on corporate boards. In spite of the fact that they find that corporate boards are progressively placing a higher priority on the generation of economic value, they also find that improvement in sustainability reporting occurs when there are a greater number of women serving on corporate boards. Consequently, previous research on the economic empowerment of women has demonstrated that the reporting of sustainability and the efficiency with which firms operate in regard to the environment are both improved when a greater number of women hold managerial or board roles inside corporations.

Despite the evolved nature of our world, the proportion of women employed globally is lower compared to that of men. China currently has the most significant population in the world, with a total of 1.4 billion people. Females comprise forty-seven percent of this population, and the female labor force accounts for approximately forty-three point seventy percent of the entire working force as of 2020. Over 2.7 billion females worldwide are currently excluded from labor, resulting in a lack of contribution to economic production. Chinese rural women in Asia have the most significant labor force participation rate. However, this number has declined from 73.2% in the 1990s to only 60.5% in 2018 (Veronika, p4). The Chinese economic reforms have adversely impacted the lives of women, resulting in a decrease in job prospects and a significant income disparity for Chinese women. According to Connelly et al. (2018), a significant number of working women are subjected to discrimination based on their marital status as well as their physical appearance. According to research conducted by Tianming et al. (2018), the province of Henan and the northeastern provinces of Heilongjiang, Jilin, and Liaoning have a higher prevalence of prejudice among women.

Regarding societies on a global scale, a significant norm is around the responsibility of caring for the family, with women being considered the primary caregivers. This situation is particularly evident in China, where one-sixth of the population is engaged in childrearing activities without receiving any form of compensation. Furthermore, it significantly affects women's employment opportunities and poses challenges for mothers aspiring to attain leadership positions within their organizations. China possesses a reservoir of well-educated and competent women who have the potential to make valuable contributions to its society, provided they are utilized appropriately. According to Rashid et al. (2014), in certain regions of Beijing and Shanghai, young women constitute seventy percent of the workforce for multinational firms. On the other hand, this pattern might appear differently in a number of different locations in China. The graph shows how the employment rates of men and women changed over this time: The Chinese government has made it a policy that all women are required to work in order to increase their marketability within the framework of the planned economic model that the country has adopted.

While this is happening, the average age of China's workforce is increasing, which is a positive trend. It was imperative that Chinese women get married and start families in order to forestall the impending demographic shift that was about to take place. The number of female presidents and chief executive officers in China's commercial sector is fast growing and demonstrating amazing development. According to the findings of the research carried out by Lam et al. (2013), there was a direct correlation between the number of female CEOs and the decrease in the amount of meddling by the government in businesses.

According to research, this environmental hazard has a disproportionate impact on women. (Buckingham 2010; Eisler et al.). This is because the environmental threat causes considerable damage to the ecosystem. There is evidence to suggest that women in the United States have a significant concern for environmental issues (McCright, 2010). They demonstrate a strong emotional connection to these issues and present an opportunity for addressing the destruction of the environment in the United States. Recent findings indicate that the global GDP might potentially experience a substantial boost of up to 28 trillion dollars annually by 2025 due to women's increased participation in the workforce. This increased engagement of women also contributes to enhanced profitability for organizations (Trivedi et al., Furthermore. Increased

female participation in energy sectors will result in increased profits. It is possible to promote a development strategy that produces the least amount of carbon emissions with the assistance of women who are empowered. An rise in renewable power investment and energy efficiency are both linked to a decrease in carbon emissions, which in turn is a consequence of more women holding executive positions.

It was discovered by Karlsson (2007) that when women are actively involved and trained in the energy sector, there is a considerable advancement in the development of sustainable energy solutions. Among the countries whose governments have discovered that women's participation in energy policy has a major and positive effect, Uganda, Botswana, and Zambia are among such countries. According to the findings of another study (OECD, 2008), women are more likely to purchase environmentally friendly products and prefer settings that save energy. According to Johnsson-Latham (2007), women choose to use public transportation, particularly for shorter excursions, even when they have access to their own vehicles. This is done in order to save energy and prevent damage to the environment.

Women in countries with low incomes frequently take the initiative when it pertains to controlling the amount of energy used at home. The female agents working in the marketing and distribution sector can convince their female counterparts to make use of green energy services if they are given access to information on cutting-edge technology that improves the efficiency of the system. As an additional point of interest, research has demonstrated that societies flourish when women in positions of authority possess advanced degrees. According to Kwauk and Braga (2017a), individuals who take a green economic attitude and show support for environmentally friendly products are more likely to be inspired to think of innovative solutions to protect the earth.

A considerable amount of energy is consumed by the power sector's heating and electricity generating activities, amounting to approximately 25% of total GHG emissions (Climate Change Synthesis Report, 2014). The accessibility of power supply is a crucial determinant for the advancement and welfare that enhance the quality of human life across several domains (Zhou et al., 2021; Bouzarovski & Petrova, 2015; Sadath & Acharya, 20). An uninterruptible power supply in hospitals enhances productivity by ensuring timely delivery of healthcare services to society

(Sovacool 2013). Renewable energy sources currently have a high cost and are limited in availability globally. As a result, economies around the world are shifting towards affordable and clean renewable energy options that can be effectively utilized (Wang et al., 2020b). A number of researchers, including Waygood and Avineri (2016), Lv and Deng (2012), and Ergas and York (2012), have already investigated this topic. The methods that Ireland and England use to manage waste in urban areas were the focus of a study that was funded by the European Union. It found that women in positions of authority and management had a more significant percentage of recycling compared to those who did not hold such positions.

The extent to which women may participate in shaping climate-related decision-making policies will depend on their education and leadership skills. It is more probable that a nation will support global environmental accords and implement legislation that are environmentally friendly if it makes a concerted effort to rise the number of women who serve in parliament. Nineteen countries were included in the scope of Norgaard and York's investigation of the possibility of international initiatives to advance gender equality and environmental protection during their research. Research has shown that countries with more female MPs are firmly committed to environmental issues. These countries are more likely to endorse and ratify additional environmental accords than countries with fewer women legislators in their national parliaments.

The relationship between deforestation, the number of nongovernmental organizations (NGOs) per capita, and women's participation was investigated in 61 states between the years 1990 and 2005. The findings indicated that nations with a greater proportion of households comprised of women and environmental nonprofit organizations had lower rates of deforestation than countries with lower levels of female involvement (Shandra et al., 2008). An international ranking of the 70 most developed nations were also the subjects of an extensive study that began in 1990 and was formally released in 2007 by the UNDP. According to the numbers, fourteen nations led the pack in cutting carbon dioxide emissions and had the most female members of parliament.

Additionally, women should make an effort to acquire efficient energy sources during the family phase so that they can purchase effective equipment that can meet vital daily human needs (Wang et al., 2020a). The goal of this poll was to find out whether

there is a connection between customers' lighting habits and their eco-consciousness in the US. Research by Lee et al. (2013) shows that eco-conscious females are more likely to spend a pretty penny on lights for their homes that use less energy. As part of the continuous endeavor to reduce carbon emissions in the environment, the educated and knowledgeable, Liquefied petroleum gas (LPG) is widely used for heating and cooking, particularly by women.

2.2 Renewable Energy and CO2 emissions.

It can be observed that the international community's endeavors to address the difficulties of climate change and GW are well-coordinated (Kahouli, 2017). The transition to the exploitation of REN is crucial for enhancing environmental quality. Several prior experts have extensively examined REN consumption's impact on economic growth and environmental circumstances.

The natural resources that yield non-renewable fossil fuels are regarded as the most rapid energy sources. The utilization of fossil fuels is increased when this particular energy source is employed, resulting in the emission of CO2. REN sources, in contrast, do not release any substances that produce CO2. Research on the effects of consumption of REN and non-REN sources, R&D sponsorships, population density/urbanization, innovation, and CO_2 emissions has been carried out by Zhao et al. (2019), Jebli et al. (2020), and Moslehpour and Jouziroudi Nafeesfard Ali et al. (2022). From 1990 to 2019, the data from China was culled from an annual sequence. The Dynamic ARDL simulation methodology was employed by the writers. According to the research, renewable energy sources barely reduced CO2 emissions.

There have been a number of studies looking at the relationship between CO_2 emissions globally and the percentage of energy coming from renewable and non-renewable sources. Using nuclear power reduced carbon monoxide (CO) levels, according to research by Apergis et al. (2010). Electricity generators are forced to depend on fossil fuels in order to fulfill the enormous demand for delivered energy, as there is no suitable storage solution. The authors have assessed the association between CO_2 emissions and aggregated energy consumption using data from OECD countries covering the years 1980–2011 and the AMG method. REN sources are better for the environment than non-REN ones, according to their empirical data.

In their 2014 study, Farhani and Shahbaz proposed using panel cointegration methods to investigate MENA countries' REN and pollution levels. One major source of carbon dioxide emissions in the United States, according to Bilgili et al. (2016), is the combustion of fossil fuels. The use of renewable resources, on the other hand, enhances environmental quality from 1981 to 2050. The environmental effects of various forms of power generation, including those from renewable and non-renewable sources, were examined in a recent study by Belaıd and Zrelli (2019) in a panel of nine Mediterranean nations. From 1980 to 2014, they analyzed data using particular econometric application methods.

But their findings showed that using non-renewable energy sources was significantly associated with higher emission rates. On the other hand, research showed that renewable energy sources hurt the environment. Several empirical studies have investigated the impact of renewable energy use on environmental quality, since this form of energy is crucial for reducing carbon dioxide emissions and satisfying the need for sustainable power. Research by Salim and Rafiq (2012) examined the variables influencing renewable energy consumption in six major developing nations, including India, China, and Brazil. Years 1980–206 were the focus of the research. It was found that economic growth and CO_2 emissions are the primary drivers of renewable energy demand in developing economies like India and China.

Along with that, they found that renewable energy sources and carbon dioxide emissions in India, China, and Brazil were inversely related. Renewable and non-renewable energy sources, CO_2 emissions, and other metrics were the focus of the study by Long et al. (2015). Using renewable energy sources resulted in a dramatic decrease in CO_2 emissions, according to the study.

Using renewable energy sources can effectively reduce future environmental pollution in the US, according to Jaforullah and King (2015). Along with other confounding factors, Rafiq et al. (2016) investigated the interplay between renewable energy sources, emissions, and energy efficiency in developing cities. The study found that renewable energy sources reduce emissions and energy intensity.

Paramati et al. (2017) also found that, when looking at a panel of G20 economies as a whole, using REN significantly improves environmental quality. Using data collected from 1991 to 2014, Bhattacharya et al. (2017) found that renewable energy

consumption can significantly slow down degradation of the environment in both rich and developing countries around the world. Khan et al. (2020) analyzed data from 194 countries to find out how renewable energy usage correlated with CO2 emissions. They used panel analysis to determine that renewable energy usage was negatively correlated with CO2 emissions. In order to investigate the impact of power generation and consumption on CO_2 emissions, Ehigiamusoe (2020a) used estimating methods such FMOLS, DOLS and AMG for 25 African nations. Electricity produced by hydropower has no influence on CO2 emissions, in contrast to that of power plants that use oil, coal, or natural gas as fuel.

REN sources are playing a pivotal role in enhancing the total energy mix and are being acknowledged as pathways to sustainable growth, marking the dawn of a cleaner energy era (Aguirre & Ibikunle, 2014; Gan et al., 2007). Both industrialized and developing nations have made increasing the use of REN sources a priority in their policy agendas. As a means to curb consumption and boost efficiency, carbon-intensive fossil fuel energy sources are coming under stricter control in the majority of nations. Most countries aim to strike a balance between three policy goals in view of the worldwide consciousness of climate change and its dangers:

1) Energy stability through increasing the use of REN sources.

2)Reducing CO2 emissions through decreasing the use of fossil fuels and increasing the use of clean energy.

3) Working towards sustainable economic growth.

At the most recent Conference of Parties (COP21) meeting, which was convened by the United Nations Framework Convention Committee and confirmed by the International Renewable Energy Agency, it was stated that the worldwide renewable energy market has gained speed over the past few decades. But there is a lack of uniformity in the use of renewable energy sources. To illustrate the challenges associated with integrating heat and electricity generation during the shift to renewable energy, see the work of Nastasi and Basso (2016). Renewable energy adoption is conditional on national institutional framework, investment, infrastructure, and scientific rationale. Countries' CO2 emissions are so very different from one another. The most recent numbers from BNEF (2015) show that developing nations are seeing faster rates of development. Reconciling goals and interests on a global and regional

scale is crucial for the successful deployment of renewable energy sources. Countries' rates of renewable technology adoption and CO2 emissions may be influenced by institutional factors as well.

The latest scholarly research on renewable energy has started to examine the determinants that impact its acceptance and the mitigation of CO2 emissions. Nevertheless, the existing body of literature aimed to elucidate the adoption of renewable energy by examining a range of factors, with particular emphasis on the choice of policies (Jacobsson & Lauber, A neglected subject in literature pertains to the examination of CO2 emissions and the divergence in the adoption of renewable energy, which is contingent upon institutional discrepancies within nations. What is the influence of variations in institutional frameworks between nations on the process of adopting renewable energy and the levels of CO2 emissions? Does an improved installation layout decrease CO2 emissions? The objective of this research is to resolve these inquiries. We demonstrate that cross-country institutions may account for a substantial portion of the variations in CO2 emissions. Undoubtedly, policy plays a crucial role in driving the adoption of renewable energy. REN21 (2015) has noticed that government action policies are primarily responsible for initiating improvements in this field. In 2015, a minimum of 164 countries implemented REN objectives, while an estimated 145 countries had policies to boost the use of renewable energies.

Various strategies, such as implementing feed-in tariffs, Tradeable Green Certificates (TGCs), Renewable Green Certificates (RECs), tenders, and tax incentives or credits, have been employed in different regions. The policy instruments regulating the speed and level of renewable energy utilization rate differ among countries. Nevertheless, implementing technology in developing countries is hindered by the need for additional policy modifications and uncertainties, which obstruct its adoption. However, implementing renewables may face hurdles due to infrastructural issues and institutional frameworks. Such obstacles can either halt the implementation or substantially raise expenses. Therefore, it is crucial to surmount these obstacles to succeed in adopting and utilizing renewable energy. The ongoing discourse has focused on the requisite policy aspect to surmount these inherent obstacles. The study we aimed to contribute to the ongoing discussion on the institutional role by introducing new insights. Examining the impact of institutions is the target on both

economic growth and the mitigation of CO2 emissions through the promotion of REN sources in overall energy consumption.

However, our primary focus is on the impact of institutions on abatement efforts within a specific group of countries.

According to Acemoglu et al. (2005), institutions have a crucial role in determining economic results and promoting sustainable development through the continuous expansion of the economy, particularly in the context of renewable energy. Free market institutions, through the enforcement of contracts and adequate legal systems, effectively safeguard property rights. This fosters individual freedom of choice and voluntary actions while allowing governments to implement selected policies. We contend that the effectiveness of renewable policy interventions hinges on sound governance, whereas the absence of robust institutions weakens the government's enforcement capabilities regarding policies. Consequently, institutions have a crucial role in determining the rate at which REN is embraced. Variations in the structure of these institutions among countries can account for the disparities in adoption rates.

However, one effective method for lowering CO2 and other harmful emissions is to replace FF energy with renewable sources. The impact of REN sources on CO2 emissions was the primary focus of the study by Bilan et al. (2019). Their argument was that we can wean ourselves off of fossil fuels if we replace them with REN sources in our homes and businesses. It reduces the combustion of carbon-based fuels, which are known to release CO2. As a result, we can anticipate less carbon dioxide emissions as a consequence of a rise in the usage of renewable energy sources.

Using RENs was associated with lower CO2 emissions, according to Saidi and Omri (2020). According to the findings, nations that use more renewable energy sources produce lessCO2.

Reduced CO2concentrations are the primary result of using renewable resources for both consumption and production, which effectively fights environmental pollution. More and more REN is being generated, which means less pollution and more sequestration of carbon dioxide. In addition, the development of technological and material resources that can function entirely on a clean, low-voltage source would be accelerated by a substantial uptick in REN generation, leaving no room for additional

energy inputs. As a result, energy-related activities produce less CO2 emissions. New sources reduce emissions of CO2.

(Moslehpour et al., 2023c). show how the generation of REN might impact the decrease of CO2 emissions. From 1995 to 2015, data on REN usage and CO_2 emissions from more than 100 countries were collected and divided into four subpanels according on socioeconomic levels. To investigate the connection between CS and slope variability, econometric methods were used. According to the research, REN sources use things that already exist in nature, including heat, light, water, carbon dioxide, and waste products from people's daily lives. Both the present amount of CO_2 emissions and the probability that waste products polluted with emissions may produce CO_2 are reduced by the growing production of REN. The correlation between REN production and carbon dioxide emissions is inverse. Regarding CO2 emission levels in particular, Razmjoo et al. (2021) investigated the link between sustainable energy and the environment. Information for this study came from Iranian hybrid renewable systems that produce power. In order to assess the association with these attributes, HOMER was utilized. Bioenergy, wind power, hydroelectricity, and solar electricity are on the rise, and the authors explain how this contributes to sustainability. Businesses operate largely in an environmentally friendly manner, producing minimal CO2emissions, when this is the case. According to Zhao et al. (2022), the emission of CO2 is directly proportional to the development of REN sources.

REN sources are vital to the expansion of the American economy, say Sari et al. (2008). Using data collected from 27 European member states between 1997 and 2007, Menegaki (2011) analyzes the link between renewable energy and economic success. In other words, they failed to discover evidence that REN use is correlated with economic growth. The lack of a statistically significant correlation between the two values lends credence to the null hypothesis. The unequal and insufficient use of renewable energy sources by these countries is a contributing factor. In their study, Pao and Fu (2013) examined the correlation between gross domestic product (GDP), consumption of REN, and energy consumption overall. According to the VECM study, GDP and REN are inversely related; in other words, EC and REN are preceded by long-term economic growth.

Their results show that GDP is also critical for providing the funds for sustainable development. They also show that Brazil's economy can function independently of foreign energy sources. REN use and its effect on China's economic growth are the subjects of Lin and Moubarak's (2014) research. In terms of the direction of causality, the Granger test results show that REN and long-term economic growth in China are positively related. But there is no proof of a long-term or short-term causal relationship between REN use and CO2 emissions. Using Portugal's economy as an example, Leitao (2014) investigates how REN usage relates to carbon monoxide emissions.

Within the GMM model, the three variables exhibit a strong correlation. According to the Granger causality test, the connection between renewable energy and economic development is unidirectional. In addition, using the VECM Granger causality technique, Shahbaz et al. (2015) investigate how renewable energy and economic development in Pakistan are related. A two-way street between the two parts is revealed by their investigation. Urban characteristics, renewable energy consumption (REC), energy, gross fixed capital formation (GFC), globalized trade openness, and economic growth in Iran were some of the many variables studied by Khoshnevis and Shakouri (2017). All variables show co-integration and have lasting links, according to the results. In addition, REN is correlated with globalization, FDI, and real GDP in both directions, according to the Granger causality test.

But some research looks at how renewable energy sources affect the environment in particular. But there have been different conclusions drawn from the studies on REC and CO2 emissions. For instance, in a set of developing nations, Sadorsky (2009) provides two empirical models that look at the correlation between REN and income. The results show that the utilization of renewable energy per capita is positively and significantly affected by increases in per capita GDP. Over time, and in these countries in particular, a 1% increase in GDP per capita results in a 3.5% increase in the utilization of renewable energy resources that are available to every person. According to Tiwari (2011), renewable energy sources have a positive effect on GDP growth rates, while net resource extraction (NRE) slows down economic growth in Europe and Eurasia and increases CO2 emissions.

Also, Payne (2012) looks at how renewable energy, real GDP, and carbon dioxide emissions are related. A review of the laws and regulations pertaining to renewable

energy since 1978 reveals that RECs have benefited greatly from these initiatives. Regardless, the results show that renewable energy sources and CO2 emissions are positively correlated. Autoregressive SVAR analysis was employed by Silva et al. (2011) to determine the correlation between REC, real GDP, and the CO_2 emission rate. Using renewable energy sources is significantly associated with lower CO_2 emissions per capita, according to this study.

Furthermore, using US-based data, Wolde-Rufael (2010) examine the correlations between actual GDP, CO_2 emissions, nuclear power usage, and renewable power consumption.

Granger causality test results show that nuclear power and CO_2 emissions are positively correlated, but only in one direction. As it relates to the REN, this is indeed the case. Another point is that the user's text is meaningless. In his 2013 study, Aydin looks at the correlation between the G7 countries' population densities, real GDP, CO_2 emissions, and REN usage. The study found that GDP, REC, and population density were some of the factors that affected CO_2 emissions.

Saidi and Mbarek (2016a, 2b) also showed that from 1990 to 2013, emerging economies' emissions were affected by income. To determine this, they used empirical analysis. There is a direct relationship between GDP and CO2 emissions, according to the results. The EKC hypothesis proposes an inverted U-shaped non-linear relationship between wealth and environmental degradation; however, not all models support this idea. Using statistics from a study that included sixteen Asian countries, Lu (2017) analyses the relationship between emissions, REC, and GDP. In the end, their research shows that RECs, GDP, and emissions are all positively correlated with one another. The correlation between oil prices, REC use, CO_2 emissions, and GDP in OECD nations is investigated in the paper of Zaghdoudi (2017). A consistent quadratic relationship between emissions and economic growth is shown by the empirical results, lending credence to the hypothesis put forth by the Environmental Kuznets Curve (EKC). By looking at Granger's causality, we can see that emission and REC are related in the short and long run.

Soukiazis et al. (2017) shed light on the industrialized nations' shift towards sustainable development by demonstrating the importance of the REC impact. An

increase in human capital is required because of the critical role that REC plays in reducing CO2 emissions.

Balsalobre-Lorente (2018) and Shao et al. (2019) state that the environmental circumstances in the European Union have been greatly impacted by the combination of REN certificates (RECs) and advancements in energy technology. Khan (2020) looked into how renewable energy use, carbon dioxide emissions, and innovations in environmental innovation are related. REN Certificates and environmental innovation positively impact quality improvement, according to Augmented Mean Group (AMG) and Common Correlated Effects Mean Group (CCEMG) experiments. A total of 85 nations were included in the sample by Bhattacharya et al. (2017). We used the Ordinary Least Squares (OLS) and Generalized Method of Moments (GMM) techniques. In light of these results, it appears that renewable energy sources reduce both CO2 emissions and GDP. There are a number of regions where the use of REC has been found to have ecological consequences. These include the MENA area, China, the Middle East, and South Asia (the N-11 Countries). The authors of the 2018 study by Balsalobre-Lorente et al. include Bao and Xu, together with Charfeddine and colleagues.

The correlation between REN and CO2 has been the subject of multiple investigations in different countries due to the importance of REN in attaining environmental sustainability. In the course of the investigation, many strategies have been employed, including T-tests, quantile-on-quantile estimators, machine learning approaches, and the autoregressive distributed lag (ARDL) test. There are several subfields within the current body of literature investigating the link between REN and CO2 emissions. In the first round of talks, scientists laid out the data that proves a link between increasing REN sources and decreasing carbon emissions.

Between 1980 and 2010, researchers Apergis and Payne looked at the relationship between CO2 and REN production in Central American nations. We used regime-specific Granger causality tests and non-linear cointegration approaches to evaluate the data. Using no REN sources results in a 1% increase in CO_2 emissions. A study by Bilgili et al. (2019) reevaluated this assumption by looking at the effects of REN on 17 OECD member states between 1976 and 2015.

Researchers use dynamic OLS and completely modified OLS estimators to analyze the data. The utilization of renewable energy sources is linked to a non-linear relationship between carbon dioxide emissions, gross domestic product, and the degradation of the environment, as indicated by the studies' findings. The effects of both REN and non-REN sources on CO2 emissions in the European Union were investigated by Dogan and Seker (2013). The study used a panel dynamic ordinary least squares (OLS) regression framework to examine the link between CO2 emissions and the consumption of REN and NREN. While using non-renewable energy sources is associated with an increase in CO2 emissions, using renewable energy sources has the opposite effect, according to the results. In addition, the results of the causality test confirm that renewable energy (RE) and CO_2 emissions are causally related in both directions. The relationships between economic growth (EG), REN, and CO2 from the tourism industry were studied in all 18 EU member states by Leitão and Lorente (2023).

It was the generalized method of moments (GMM), fully corrected, and panel dynamic ordinary least squares (OLS) estimators that were used in this research. Based on the research findings, lowering CO2 emissions is possible through the use of renewable energy (RE), the promotion of tourism, and the facilitation of international trade. Thus, it may be possible to lessen the impact of climate change in the EU by pushing for the rapid adoption and widespread use of renewable energy sources.

In their 2016 study, Jebli and Youssef investigates how REN sources on carbon dioxide emissions reduction in five North African developing nations spanning the years 1980–2016. Numerous studies' long-term predictions have demonstrated a direct correlation between REN and CO2 emissions, suggesting that RE lowers CO2 emissions. Agricultural activity and CO pollution are inversely related, according to these studies. Economic growth (EG) was the dependent variable in the study by Bhattacharya et al. (2015), which also looked at institutions—RE and CO—as independent factors. From 1994 to 2018, they looked at consumption panel data from low-income nations.

Use of the completely modified Ordinary Least Squares (OLS) and the Gaussian Mixture Model (GMM) yields conclusive evidence that RE implementation promotes economic growth (EG) and reduces CO2 emissions. The effectiveness of a nation's

initiatives to reduce CO2 emissions is highly dependent on the strength of its institutions.

The purpose of Zoundi's (2016) research was to examine 25 African nations' CO_2 emissions from 1980 to 2013 and the relationship between renewable energy and those emissions.

Using dynamic OLS and completely modified OLS estimators, the panel cointegration methodology was used in the study. The results show that even after a long time, RE still has a negative effect on CO_2 emissions. As an effective alternative to traditional energy sources derived from fossil fuels, the author stresses that REN is a powerful and environmentally friendly strategy for development.

To investigate the connection between REN usage, NRE consumption, and CO_2 emissions in power-generating nations in the Big 1 and Sub-Saharan Africa areas, Inglesi-Lotz and Dogan (2017) used panel cointegration tests and group-mean dynamic ordinary least squares (OLS) estimators. The study's time frame was from 1980 to 2011. According to studies, pollution levels rise as reliance on non-REN sources increases.

There are distinguishing features of REN sources. In addition, the analysis reveals that NRE and CO_2 emissions are directly related. Between 1990 and 2015, the impact of REN, natural resources (NR), and economic development (EG) on CO2 emissions in BRICS states was examined in a study by Baloch et al. With the exception of South Africa, where the authors find a conflicting relationship, the authors use the APMG estimator to examine the link between RE and CO_2 emissions in the BRICS nations.

Using a simultaneity-aware spatial modeling technique, Radmehr et al. (2019) analyze the relationship between RE, EG, and CO2 emissions in EU member states from 1995 to 2014. According to the results, the link between RE and CO_2 emissions is one-way causal. The research also shows that EG and RE are not independent of one another.

2.3 Education Expenditure and CO2 Emissions

The Chinese government has reduced carbon dioxide emissions in keeping with the principles stated in the Paris Climate Agreement. (Christoff, 2016). These reductions can be attributed, in part, to the factors that were examined in this analysis, such as the amount of money spent on education and the utilization of renewable energy. The

Chinese government's increased investment in the education sector will allow individuals, regardless of gender, who have been raised with an ecologically conscious mindset to pursue their studies. This will contribute to the development of a society that is environmentally friendly. Furthermore, the aforementioned female employers, who have excellent reputations, demonstrate a propensity for implementing environmentally conscious decision-making criteria in their managerial roles. They also promote the adoption of green technologies and the utilization of renewable resources, both at the household level and on a national scale.

Most prominent scientists and politicians have utilized sustainable clean energy sources, known as Green technology, to achieve economic expansion and industrialization while minimizing gas emissions. These elements are also interconnected with the environment to facilitate economic growth that mitigates low CO2 emissions. However, there is a shortage of research that establishes a connection and delves into this environmental problem with consideration for human capital. The aim of this investigation was to establish a correlation between human capital and the natural environment. The problem was addressed by prioritizing three crucial elements: allocating additional funds to education, promoting gender diversity in the workforce, and augmenting the utilization of renewable energy sources. Education is a crucial individual attribute (Zaman et al., 2019) that has the potential to influence both health outcomes and economic progress. Enhancing educational attainment is a crucial component of Sustainable Development Goals (SDGs) in economies, certain regions that are not operating as efficiently as they could (Rasool et al., 2015; Smith et al., Coady and Dizioli). In the event that it is accomplished, this Sustainable Development Goal (SDG) will have a significant influence on the environment and will result in increased levels of adult education. The references cited are Hanmer & Klugman, 2016, and GA, 2015. The gender distribution of adults with tertiary education in China in 2018 was perfectly balanced, with an equal the proportion of men to women. Over the course of the last several decades, there has been a significant increase in the number of educational establishments that provide more advanced degrees due to a country's financial commitment to enhancing its educational sector (Bank, 2017). Allocating additional resources to education yields a commensurate augmentation in knowledge.

Additionally, it stimulates economic expansion and influences energy usage, ultimately impacting the environment. Education exhibits a substantial association with both labor productivity levels and carbon emissions. Enhanced education leads to heightened productivity, hence bolstering a nation's economy.

In addition to promoting economic growth, education also drives technological advancements (Joaquim & Zaman, 2018), ultimately enabling efficient energy sources used in manufacturing. These exceptionally effective fuel options help reduce carbon emissions in the environment. Furthermore, a robust correlation exists between schooling and demographic rate. By augmenting the female education ratio, we may successfully address population reduction, providing a significant solution to mitigating climatic changes. By the year 2050, providing secondary education to every woman worldwide might significantly reduce about eighty-five Gigatons of CO2 emissions. The decrease in population growth can be attributed to the successful implementation of effective family planning methods, due to the fact that they have prevented the global population from increasing by approximately 1.5 billion individuals (Kwauk & Braga, 207b).

This study comprises three more components. The following section encompasses variables, data sources, and study design. The third section of this chapter presents the methodology for calculating the findings. The study examines the outcomes and subsequently offers research discoveries, culminating in several crucial policy suggestions regarding the mitigation of carbon emissions in the environment.

A Brief Summary of the Available Literature

Table 1. A Summary of the Research Conducted

Author	Place of study	Research objective	Time of study	Methodology	Brief Result	Brief Policy Recommendation
Adnan Hossain et al	South Asian countries	The paradox of recognition: *hijra*, third gender and sexual rights	2017			
Asif Raihan et al	Uruguay	The contribution of economic development, renewable energy, technical advancements, and	2023	FMOLS		In order to reduce carbon emissions, the legislators of Uruguay should prioritize the expansion

		forestry to Uruguay's objective of becoming carbon-neutral				of forests in their plans for a sustainable future.
Behera, Smruti & Dash, Devi	South and South east Asian	The effect of urbanization, energy consumption, and foreign direct investment on the carbon dioxide emission in the SSEA	2017	FMOLS	Supports the EKC	The government must embrace more energy conservation policies to reduce emissions and environmental pollution.
Hsiao-Tien Pao, Chung-Ming Tsai	Brazil	Modeling and forecasting the CO_2 emissions, energy consumpti	May 2011	GMM	support the EKC hypothesis	Brazil ought to implement a dual approach by augmenting

		on, and economic growth.				investment in energy infrastructure and intensifying energy conservation policies in order to mitigate avoidable energy wastage.
Qamaruz Zaman, Zilong Wang, et al	China	Examining the relationship between expenditure on education, the number of female employers, the use of renewable energy sources, and	August 2021	ARDL and FMOLS		The government ought to implement "award and punishment" programs if it is serious about lowering the amount of pollution in the

		CO2 emissions				environment.
Sahar Shafiei, Ruhul A. Salim	OECD countries	Non-renewable and renewable energy consumption and CO_2 emissions	March 2014	STIRPAT model	support the EKC	Policymakers should prioritize urban planning and the development of clean energy in order to significantly decrease the consumption of non-renewable energy and address the issue of climate change.
Sinha, Avik, et al	India	Estimation of Environm	2018	ARDL	support the EKC	government should implemen

		ental Kuznets Curve for CO2 emission			hypothesis	t renewable energy sources across the country.
Zhen Wang, Difei Hu, et al	China	Revisiting China's natural resources-growth-emissions nexus: Education expenditures and renewable energy innovation	2023	GLS	Support the EKC	Governments should prioritize providing households with access to cleaner energies and technology in order to mitigate the greenhouse gas emissions associated with CO2, aligning with the objectives set by COP27.

Lanouar Charfeddine, Montassar Kahia	MENA region	Effects of increasing use of REN sources and improved access to capital on CO2 emissions and GDP growth.	2019	PVAR		Green energy and low-carbon projects should be prioritized in banking operations to help the financial system promote environmental quality.
Mariana Aguirre, Gbenga Ibikunle	BRICS	Determinants of renewable energy growth: A global sample analysis	June 2014	GLS		Through the provision of direction and information, the government's involvement ought to be restricted to the facilitatio

						n of enterprises and consumers into the implementation of prescribed actions.
Ainou, F.Z., et al.		Green energy security assessment in Morocco: green finance as one of steps to sustainable energy transition.	Febr uary 2022			
UzairAli , Qingbin Guo et el	China	The influence of renewable and non-renewable energy usage on carbon intensity.	2022 Aug	ARDL		To mitigate the severe environmental impact of CO2 emissions , policies should

						prioritize ongoing investment in renewable energy sources, reforestation efforts, and measures to achieve carbon neutrality.
Reza Alizadeh , Leili Soltanisehat		Development of a hybrid MCDM method to improve renewable energy policy planning and decisionmaking.	2020	BOCR-ANP		The government should address the lack of a dynamic strategic management team comprising experts from different organizations.
Asad Amin, Jie Yu et al	South Asian	How does energy	2020	ARDL		The public and

		poverty affect impact development?				private sectors should strive to use contemporary, energy-efficient, and environmentally friendly technology to promote economic advancement and address ecological deterioration.
Nicholas Apergis, James Payne	Developing countries	Pertaining to the sequence of occurrences that starts with emissions and culminate	2010	panel error correction model		

		s with nuclear power, renewable energy, and prosperity				

CHAPTER III

The Differences Between The European Union Countries and The BRICS Economies About the Impact of Expenditures on CO2 Emissions.

CO2 emissions are the most common kind of greenhouse gas emissions. These comprise approximately 87 % of GHGs (Khan et al., 2014). The increase was high considering that in 1990 there were 3.0991 metric tonnes per capita, while in 2016, it had increased to 4.6807 metric tonnes per capita. At this time, there was a rise of 1.5% of CO2 worldwide (Koengkan & Fuinas, 2020). Just like other parts of the World, in the European Union (EU), In 1971, the CO_2 emissions per capita were 8.0244 metric tons, and by 2016, that number had dropped to 6.4684 metric tons.

This is true because the emission of CO2 in the EU did not change significantly between 1990 and 2004. A drop of about 10.8% in primary energy consumption ultimately led to this sharp decline in these emissions.

For the EU, energy consumption per capita in 1990 amounted to 4.70 Mtoe, while by 2004, it had increased to 4.90 Mtoe. Nevertheless, it reduced between 2005 and 2016, amounting to Mtoe in 2016. The decline may also be linked to the economic crash during 2007–2012. The depression hit the EU economies, ultimately influencing individual consumer behavior. Due to that, other non-vital consumption was minimized, further affecting energy-intensive industries. It may also be linked with increased energy efficiency due to globalization, which leads to reduced energy use. Additionally, the population shift in the urban environment within the EU may also contribute to the fall.

As much as 93% of Europe's energy consumption in 1970 was FF or associated energies, and just 6.90% were from renewables. Nevertheless, it has changed, and fossil fuels accounted for 75% of primary energy use, a decline. Alternatively, REN usage increased by 25% in 2016.

However, other drivers influence this augmentation of CO2 emissions, for example, economic development, internationalization, urbanization, obesity, and so forth. This

finding has been established long in the literature that significant inequalities of power and wealth can drive environmental degradation. However, the literature has paid scant regard to the potential relationship between the increase in environmental degradation and the gender equality issue, except for gender disparity.

Gender equality in the EU was viewed chiefly as an equal opportunity/justice issue (Klasen and Minasyan, 2017). In recent years, discussions around the wage gap between men and women, employment gap between men and women, under-representation of women in senior positions in companies, political gap between men and women, and others, were addressed by some governments or authorities. Nevertheless, it raises a concern for policymakers and governments because it tends to hamper short- and long term economic growth. It reduces, on average, the stock of human capital per capita, which hurts financial performance. For instance, it deliberately narrows down pools of human resources to sample for education, excluding highly trained women (while it settles with less qualified men).

Discussing female workers in the EU's labor market, the employment gap for women as compared to their male counterparts was put at 11.7% in 2019, leaving some 14 percentage points between both genders, as the European Commission reported in 20 Specifically, regarding the part of the gender pay gap that also constitutes among others the gender equality index and the previously mentioned gender inequality index, this rate reads 14.1 percent in 2019 and varies very little during the past ten years. This translates into women earning only 86 cents for each dollar a man makes on average every hour.

As we get at the individual countries in the EU, there is clear differentiation among the countries. In 2019, gender pay gaps ranged from below five percent in Luxemburg and Italy to above nineteen percent in Austria, Germany, and Estonia.

Nonetheless, the gender pay gap has marginally declined in some of them while stabilizing in others. Women in the EU earned only 63,3% of what they were worth in 2018 compared to men. Firstly, the average number of hours women spend in paid work is less than men. In 2019, the EU only had 8% of men working part-time, whereas about 30.7% were female across the EU (European Commission, 2021).

Furthermore, the distribution of compensation among female workers in the EU is unfavorable towards those who work part-time or full-time in Italy and those who

work full-time in Belgium in 2019. For example, the gender wage difference for part-time work is less than 5% in certain nations, such as Hungary, Germany, Denmark, Lithuania, Netherlands, Sweden, and Belgium.

However, in 2019, the gender wage gap for full-time employment exceeded 10% in Netherlands, Hungary, Slovakia, Croatia, Germany, Denmark, Lithuania, Finland, and Portugal. When analyzing the economic activity of businesses in the EU economies of 2019, it is essential to take into account the gender pay gap, which exceeds 10% in the majority of these countries. In the Swedish workforce, the gender pay difference is below 5 percent in industrial activities, which is lower than the pay gap in other nations that exceed 10 percent. In countries like Belgium, Croatia, Poland, Portugal, Slovenia, and Sweden, the gender pay gap in the supply of energy (electricity, gas, steam, and air conditioning) is less than 5%. In comparison, it's often higher than 10% in a lot of other countries. Managing waste, water supply, sewerage, and cleanup operations constitute less than 5% of the total sector in the following countries: Finland, Sweden, Estonia, France, Poland, Portugal, Slovenia, and Slovakia.

Additionally, the gender pay gap in construction activities is below 5% in most EU countries, except for Estonia, where it exceeds 10%. The gender pay gap in information and communication activities surpasses 10% in nearly all countries. Every European country exhibits a wage discrepancy of over 10 percent between men and women in the finance and insurance sectors. The average gender pay gap in the real estate sector varies among EU member states, with all countries except Croatia and Slovenia experiencing fluctuations above 10%. In these two countries, the female pay gap remains around 5%. The final category pertains to professional, scientific, and technical activities when the gender wage disparity exceeds 10 percent across all EU countries.

However, as discussed above, economic control reveals that the private sector exhibited a higher gender pay gap than the public sector in the EU in 2019.

Thus, it has a negative impact on women’s pay and household’s choices toward green consumption. This issue hinders people’s desire to acquire energy-efficient appliances and willingness to join an adequate program (Li et al., 2019). This means their incapability to buy efficient electricity devices and save power is associated with the low female wage relative to male wages, impairing the women’s bargaining position

within the household. Lower bargaining power makes it unmanageable for women to determine green energy investments, cutting off saving opportunities for family and production investments in the family. These savings and their investment might also make it impossible to help the environments caused by subsistence labor. The other setback was due to limited credit, which came from low wages and gender prejudice caused by manliness in some countries in purchasing greener energies or energy-efficient appliances by the women and their families. The limitations raise the incidence of energy poverty whereby households depend on dirty, clean, or polluted fuel sources for their routine requirements.

3.1 Renewable Energy

The climate changes induced by the recent increase in CO2 concentration have led to various negative effects on sustainability of environmental condition (Boluk & Mert 2014; Shayanmehr et al. 2020a). This has affected the environment's endurance capabilities. According to JRCEC, the combustion of fossil fuels is responsible for over ninety percent level carbon dioxide emissions in the world. The following sources are cited: Olivier et al. (2012) and Shayanmehr & Marda, Many countries have signed the Kyoto Protocols as well as Paris Climate Agreement to avert greenhouse gas emissions due. According to the Paris Climate Agreement, Europe, which is a leading producer of greenhouse gases worldwide, has pledged to ensuring that the increase in average global temperatures does not exceed two degrees Celsius more than it is already. This can be accomplished by reducing emissions of greenhouse gases by forty percent by the year 2030.

Despite the growing worries associated with increased CO2 concentration and GW, gas is an essential driver of increases in Gross Domestic Product in any European Union member state (Pirolgea & Cicea, 2012). Most countries still resist slashing pollution levels for possible financial gain. This means that economic growth requires more energy production, which results in more significant amounts of carbon dioxide being emitted into the atmosphere. Some people think it may be an option to balance sustainable development with economic growth. Therefore, numerous countries, particularly in the EU, have focused on REN development. The energy and climate strategy of the EU for the year 2030 aspires to increase energy efficiency by 32.5 percent and to generate at least 32 percent of electricity from renewable sources.

REN development is a reliable means of reducing emissions for a low-carbon strategy to meet sustainable development Goals (Lee, 2019). This work is centered on empirically analyzing the relationship of the GDP with natural pollution and energy use by considering the increased share of renewable within the EU framework with a new methodology.

The chapter on the correlation between the variables of interest encompasses three research domains. The primary study examines the relation between economic growth and CO2 emissions. This study branch examines the EKC theory. According to this idea, a curvilinear relationship exists between pollution and economic growth, characterized by an inverted U-shape. The majority of empirical investigations provide evidence in favor of the EKC theory. The EKC phenomenon is observed in EU countries, as demonstrated by studies such as Linmark's (2002) analysis of Sweden's data from 1870 to 1997 and Acaravci & Ozturk's (2010) examination of Denmark and Italy's data from 1960 onwards. Mazur et al. (2015) relied on a dataset consisting of information from multiple EU member states to substantiate the validity of the EKC thesis's validity. Nevertheless, according to the EKC theory, it does not apply to the entire EU.

Afterwards, the second component of the system investigates the connection between output and renewable energy sources. Two studies that looked at the past twenty years concluded that economic development and renewable energy worked hand in hand, regarding in the short-term and in the long-term (Al-mulali et al., 2014; Apergis and Payne, 2010). Both of these studies were conducted in this century. Panel data analysis was utilized by Soave et al. (2018) in order to examine data from 28 different member states of the EU. The findings of their analysis indicate that these economies would reap economic benefits from making the transition to renewable energy sources.

According to the findings of research conducted by Rafindadi and Ozturk (2017), a higher utilization of renewable energy sources is associated with an improvement in the national GDP. Nevertheless, Cho et al. (2015) demonstrate that REN has a positive correlation with GDP in 31 OECD countries, while it has a negative correlation with other factors.

When it comes to revenue, carbon emissions, and alternative energy sources, the last chapter discusses the relationship between all of these factors. Several empirical

studies have shown that two possible effects of economic expansion are the utilization of REN sources and the increase in pollution.

Sustainable energy sources are essential in a number of countries, and two examples of such sources are the decrease of emissions of CO2 and the promotion of economic development. This study is primarily concerned with determining the existing connection that exists between these factors. Research conducted by Lee (2013), Apergis et al. (2010), and Adewuyi et al, (2017) all offer data that lends credence to the notion that the aforementioned components are interconnected with one another. Menegaki, on the other hand, utilized a random-effect model to conduct an analysis of the data collected from 27 European countries about three dependent variables. Within a specific time frame, our findings demonstrate that there is a link that goes in both directions between carbon emissions and the flow of R. The figures do not provide support for either the short or the long term effects that policies on renewable energy have on GDP respectively. Dong et al. (2018) investigate the connection between GDP, CO2 emissions, and other related variables, and renewable power by utilizing data from 128 nations that have been divided into four categories and two subsets for the North American, European, and various other regions. Carbon dioxide emissions from renewable energy sources are predicted to be directional in both Eurasia and Europe.

In addition, rising GDP is positively associated with rising carbon dioxide emissions. Dong et al. (2020) demonstrate that the three elements are causally related in a two-way relationship in high-income nations. This association is shown to exist in high-income nations.

The country depends on renewable energy resources because of its excessive energy consumption, which is critical to economic development. Consequently, the economies of all the BRICS countries are classified as emerging, those in the top half of the income distribution spectrum. As a result of rapidly growing worldwide economies, energy demand keeps growing. Conventional fossil fuels remain a significant energy source in many emerging markets; despite this, they will remain a primary energy source. However, it has only made it easier for countries to discontinue; they promote economic growth, provide affordable electricity, and grow dependency on fossil fuels. The import of fossil fuels constitutes a significant share of

all these countries' economic activity. The net national requirement of energy, or the primary energy consumption referred to as immediate energy demand, apart from South Africa, these other countries fall amongst the top 10 prior energy users. Since there are no significant providers of LPG and oil in the world, all others will be considered as suppliers. Implications abound for several of these nations because of their reliance on imported oil.

Since energy consumption is vital for the overall national economic growth, diminishing the importance of other REN sources is unavoidable. Rapid growth and energy consumption have rendered the BRICS countries upper-middle-income economies. Increased economic growth translates into more energy needed to drive up the costs of products in the market. Many developing countries still rely on conventional fossils such as oil and coal for energy supply growth. It has caused two major problems, the first one being how to continue economic growth and the second problem is making affordable energy available for all.

3.2 Education Expenditure

The European Union devotes part of its education expenditure to this long-term strategic competition. Many policy framework documents and projects clarify the EU's resolve to bring sustainability into education. The focus on education for sustainable development reflects that an educated and environmentally aware people is a prerequisite to reaching longer-term climate goals.

This emphasis on STEM education is particularly timely in light of environmental problems. STEM education produces people with the knowledge and skills to participate in a dialogue on complex environmental issues. It can provide new directions for sustainable technologies and solutions. Furthermore, the spread of sustainability-related content across curricula exacerbates the influence of education expenditures on molding a society concerned about environmental protection.

In contrast, with the BRICS economies--Brazil, Russia, India, China, plus South Africa--the picture is far more varied regarding education's relationship to CO2 emissions. The challenges and opportunities faced by each BRICS member nation are unique, which reflects the broad spectrum of economic development within the group.

For example, education for sustainability has become a focus area in Brazil. There have been movements to include environmental themes in the national curriculum. However, these efforts are limited by obstacles such as shortages of resources and differences in levels of educational opportunity.

As another member of BRICS, Russia deals with its unique problems in education and environmental awareness. The country's varied cultural backgrounds and enormous size account for differences in educational priorities. The need to integrate environmental education For all its good intentions, the effect of educational expenditures on reducing CO2 emissions depends on place by place and community by community.

Due to its large, complex population, India faces many difficulties in effectively using education dollars for environmental sustainability. The Green Skill Development Program is an example of making youth more environmentally aware and skilled. But, the vast education system makes providing equal access to high-quality environmental education difficult.

Like China, an essential member of the BRICS countries in particular, emphasis on technological progress and economic development is also found throughout its education system. The government has worked to bring environmental education into the school curriculum. However, these regional differences must be considered to turn education expenditure into a policy instrument that can curb CO2 emissions.

South Africa faces the legacy of historical educational inequalities in the BRICS context. Promoting environmental education is inseparable from plans to narrow the socio-economic divide. Education expenditure to reduce CO2 emissions links inseparably with the broader problem of welding an environmentally friendly and accessible educational system.

It requires analyzing the socio-economic environments, policy frameworks, and cultural settings shaping educational priorities for EU countries and BRICS economies. The EU presents a much more integrated approach featuring ecological and STEM education; the nations of BRICS are different landscapes with varying degrees of environmental teaching.

CHAPTER IV

The General Differences Between the European Union Countries and BRICS Economies in Taking the Measurements For Lowering the Role of Expenditures on CO2 Emissions.

When pursuing sustainable development globally, we must recognize that nations have established various means of resisting and reducing the effects caused by gender dynamics on CO2 emissions. Some countries spend more than others on education expenditure, while some opt for faster adoption rates rather than longer duration involved with renewable energy installation. How different strategies are adopted around varying levels of home country factor LDC This comparative exploration concerns the European Union (EU) and BRICS economies. A comparison of their different methods suggests clues about environmental policies, socio-economic trends, and the relation between gender, REN sources, and education expenditure on carbon emissions reduction. Through this investigation, we hope to reveal these too-subtle strategies, illuminating the various directions in which these regions are moving toward a greener future.

Within this comparative framework, we explore the subtle measures both EU and BRICS nations seek. Each area faces specific obstacles, from gender-neutral policies to green energy projects and education expenditure. Exploring these approaches yields a wealth of information about the international drive for sustainable policies and shows how different landscapes have shaped environmental awareness. This study strives to reveal the complex tapestry of actions and approaches taken, providing a thorough picture of how these regions work through gender-renewable energy-education expenditure on CO2 emissions.

Equality between the genders is part of everyday thinking, even in environmental policy within the EU. The EU also recognizes the effect of gender identity on ecological attitudes and behavior. In response, gender-related programs are now part of ecological strategies. Apart from closing the gap between women and men, it also hopes to take advantage of everyone's distinctive outlook by encouraging each individual to contribute towards sustainable policies.

These results show that the EU wants to integrate gender perspectives into climate change adaptation and mitigation policies. You could say that the European Institute to Promote Gender Equality (EIGE), which builds expertise and develops gender mainstreaming in all EU policies, especially environmental policies, has become a significant force driving equality.

Moreover, the EU's sustainable development strategy shows through projects to create green jobs and promote gender equality in a green economy. The flagship European Green Deal is an exclusive investment in making the EU's economy sustainable by changing climate and environmental crises into opportunities. The EU also ensures that no one gets left behind in the transition process, mainly by keeping a gender perspective.

4.1 Gender Dynamics in BRICS Economies:

The economies of the rest of our focus, the BRICS nations, are in sharp contrast. Where do they stand regarding including gender considerations in environmental policies? However, each of the four members faces singular challenges and opportunities that reflect a much broader range of economic development within all of them.

Brazil:

Promoting gender equity in environmental decision-making: There are signs that the situation is improving. Brazil, for example, has moved afoot to reduce this imbalance in favor of women. Of course, they also know the need for equal rights between men and women. However, CO2 reductions depend on circumstances, including resource limitations or differences in access to education. M.A.Vicente-Molina, A.Fernández-Sainz, and J.Izagirre-Olaizola study shows that environmental education in Brazilian schools is still weaker than it should be, especially given the importance of gender diversity to positive changes in environmental behavior.

Russia:

Gender relations and environmental consciousness Just as their geographical area is vast, so are cultural backgrounds varied in Russia. However, although there is now knowledge that ecological education needs to be integrated with CO2 emissions reduction efforts, it may not always be so in some areas and within specific

communities. Russia's diverse and dense socio-cultural environment will affect the success of such measures in environmental concerns and gender issues.

India:

India's enormous population comprises a diverse group, so there are many challenges to be transformed into opportunities by gender-specific, environmentally sustainable development. CO2 emissions reduction There are programs, like the Green Skill Development Program, which seek to improve environmental awareness and skills. Yet, the colossal size of gender disparities and the varying socio-cultural environments in India make it difficult to implement a uniform policy.

South Africa:

For South Africa in its current state, inside the rhythm of being a part of BRICS, there is great concern about women's inequality and education owing to historical unfairnesses. Strides to improve gender equality in environmental policy are bound together with pursuing general socio-economic objectives. Gender-neutral CO2 emissions reduction How gender neutrality can shape the development of an inclusive and environmentally aware society is a larger question.

4.2 Comparative Analysis and Challenges:

We see from comparing the gender equality policies and their effects on CO2 emissions of the EU with those in control economies like China, India, or Brazil that there are some similarities and differences. In contrast to the EU, with its emphasis on incorporating gender into all aspects of environmental policy, the various regions faced by each of the BRICS countries have different landscapes and levels of concern for what happens in nature.

Obstacles to pursuing gender-oriented activities include traditional concepts about the order of society, the imbalanced distribution of resources for men and women at present, special planning considerations (e.g., each country has its particular socio-cultural background), etc. Gender-inclusive policies must overcome these challenges to reduce CO2 emissions and promote a comprehensive approach effectively.

4.3 The Global Renewable Energy Transition Initiative

The imperative to switch to renewables is a global trend stemming from the need for climate change and carbon dioxide CO2 reduction. The transition entails a low-carbon transformation from polluting fossil fuels to reliable, sustainable energy sources.

4.3 European Union's Cohesive Strategy:

4.4 Ambitious Targets and Collaborative Initiatives

The European Union (EU) is a leading example of successful sustainable energy transitions featuring collective integration. As a result, in an effort to reduce pollution and dependence on fossil fuels, the European Union has set lofty goals for the use of renewable energy.

It says the EU has pledged to reach at least 32 % renewable consumption by 2030 in its Renewable Energy Directive. It is a general directive to incorporate renewable sources in all sectors (electricity, heating and cooling, transportation, etc.) of society's energy mix.

That's why collaboration is one of the foundations of EU strategy, seen in such things as Clean Energy for All Europeans. As the package stresses regional cooperation, it also gives particular weight to cross-border investments in renewables because of this intercontinental linkage of energy markets.

The EU's sustainable energy program emphasizes technological innovation. For example, funding projects such as Horizon 2020 enables R & D to use renewable energies while promoting energy savings and sustainable urban development.

4.5 BRICS Economies: Diverse Trajectories:

Sustainable energy transitions The BRICS states are taking different paths.

China's Leadership in Renewable Investments:

Even more impressive is that China has become a global leader in investing in and deploying renewable energy. The government's determination to meet the targets for renewables, especially in wind and solar power, is part of a long-term plan to cut carbon emissions. Its investments in renewable energy infrastructure and

technological development make China a leader among its global counterparts in the transition to sustainable energy.

4.6 India's Challenges and Ambitions:

With the retreat of coal and the proliferation of renewables, India is in a difficult position concerning CO2 emissions. While the country has adopted ambitious targets for expansion in renewable energy capacity, it also faces issues like grid integration, land acquisition, and financial obstacles. The International Solar Alliance is just one example of India's focus on solar energy.

Brazil's Emphasis on Bioenergy:

One notable feature of Brazil's renewable energy policy has been a focus on bioenergy, especially for ethanol made from sugarcane. With projects like Proálcool furthering their efforts, Brazil has become a world leader in producing and using biofuels. However, using bioenergy in transport is another way to lower CO2 emissions from fossil fuels.

4.7 Russia's Diverse Energy Mix:

Russian energy resources are not only diverse; they also include a high fossil fuels dependence. Yet, while the country is aware of the value of REN, its strategy is to utilize different kinds of power judiciously. Beyond CO2 emissions reduction, Stressing nuclear energy, hydroelectric power, and emerging technologies also supports establishing a diversified Russian energy portfolio.

4.8 South Africa's Pursuit of a Balanced Mix:

The attitude of the people in South Africa toward energy resources emphasizes balance. The nation plays on renewables (wind and solar power) but acknowledges the contribution of old energy standards such as coal. The Integrated Resource Plan sets out South Africa’s path for how renewable energy might enter the grid, providing a more stable power source.

Compared with the EU, measures being taken to reduce the effect of REN on CO2 emissions also reveal commonalities and differences between the BRICS economies.

With a unified direction and concerted energies, covered by viable goals with sound policies, the EU provides a model for sustainable energy transitions. By contrast, the

same five BRICS nations take very different paths. China is ahead in investments into renewable energy; difficulties have punished India, Brazil champions bioenergy, Russia diversifies, and South Africa is bundled.

4.9 Effect Of Education In Alleviating Carbon Emissions

The Role of Education Expenditure in CO2 Reduction A budget for resources Generating revolution with money It's not how much you spend. Still, the priorities that are desperate measures are allotting human energies and treasure. When it comes to complex challenges like reducing GHGor and helping disadvantaged classes catch up educationally to mainstream kids facing their predicament to billboards, big bucks.

Education expenditure is essential in raising environmental awareness and promoting environmentally friendly behavior so we can do our part to reduce CO2 emissions. From these, this comparative analysis examines what the EU and the BRICS economies are doing to reduce the impact of education spending on CO2 emissions.

4.10 EU's Coordinated Initiatives:

In the EU, expenditures for education are strategically aimed at raising environmental consciousness. The EU's plans focus on collaborative programs and research that help teach the concept of sustainability in everyday life. The EU is embracing the challenge of climate change, and significant investments are being made in education for environmental awareness.

4.11 BRICS nations' varied paths:

In contrast, the four countries of the BRICS have various approaches regarding their expenditure on education and its relationship to CO2 emissions.

China's Technological Investments:

As a leading member of the BRICS group, China is concerned with using education spending to drive technological development. Research and development investments also help disseminate sustainable practices. Education can only spur innovation and the spread of green technologies, which also fits China's pledge to cut carbon emissions.

India's Emphasis on Awareness:

In India, educational expenses are spent to raise consciousness about the environment. It stresses the need to educate people about CO2 emissions and sustainable lifestyles. However, India understands the robust nature of education to promote conscientious stewardship of our environment.

Brazil's Sustainable Education:

So, Brazil has adopted a strategy of including sustainability in the education budget. Investments are focused on curriculum design that combines environmental concepts. Brazil hopes to internalize its vision of sustainability in education to become part and parcel of people throughout their lives.

Russia's Innovation in Education:

The new Russian way of spending on education is put forward; technological methods are used to solve environmental problems. Investments in green technologies and informational programs facilitate this awareness and promote sustainable practices. This strategy shows Russia is serious about using education to promote environmental protection and innovation.

South Africa's inclusive approach:

Thus, South Africa's education budget is based on inclusivity considerations. The nation funds projects to provide citizens with environmental education so that everyone can have the ability and right of choice. Thus, education becomes a tool for developing ecological awareness among every segment of society.

The key to reducing CO2 emissions worldwide now turns out to be education expenditure. The EU's coordinated activities reflect its importance to educational exchange programs and large sums of money spent on developing a sustainable mentality. On the other hand, you can see various strategies being used by the BRICS nations, such as educational spending, to spur technological development and raise consciousness about sustainability, using education to integrate with society.

CHAPTER FIVE

THEORETICAL FRAMEWORK

A set of interrelated conceptions forms the basis of the theoretical framework, allowing one to present a comprehensive view of the causes of greenhouse gas production in BRIC countries. This idea is based on the complex relationship between economic growth and pollution according to EKC hypothesis. The environmental Kuznet's curve, EKC has demonstrated that as the economy grows and income increases above a certain level initially environmental standards tend to depreciate greatly contributing to greater emissions of CO2. Nevertheless, the trend changes beyond a specific financial limit, bringing more stringent environmental regulations and measures to light. Education expenditure plays a significant role, especially in this part of the hypothesis. Better education may support higher incomes and increase attention to sustainable practices and technologies.

Gender dynamics are crucial in environmental management: Many empirical studies show that gender significantly impacts environmental decision-making. While at it, women seem to have a higher tendency to advocate for environmental preservation than men. A vital aspect influencing environmental policy and practice is the difference in environmental attitudes and behavior based on sex. Women's participation in policymaking and its potential impact on defining social options may critically influence a nation's carbon emissions.

This theory also includes a shift to renewable energy sources. Moving from fossil fuels to sustainable energy forms will be crucial for reducing carbon emissions. Transition Theory explains the complexity of transitions by which a country changes its primary energy source. These include technology breakthroughs, political determination, and societal attitudes to transition towards renewable technologies and energy sources.

To conclude, the role of environmental education cannot be overstated. Education does more than impart knowledge; it shapes social behavior and attitude towards the environment. Accordingly, heightened public awareness about change in climate and the need to cut down on emissions ofCO2 is expected following increased education spending. Educated people are empowered because they possess the critical

information and enlightenment to guide sound choices and advocate for green energy and related sustainable approaches.

5.1 Hypotheses

H1a: Countries with more gender equity in decision-making posts in the energy sector are likely to experience lower levels of CO2 emissions.

H1b: Increased enrollment of women in the creation process for environmental policy leads to the enactment of stringent environmental preservation laws and decreasing CO2 emission levels.

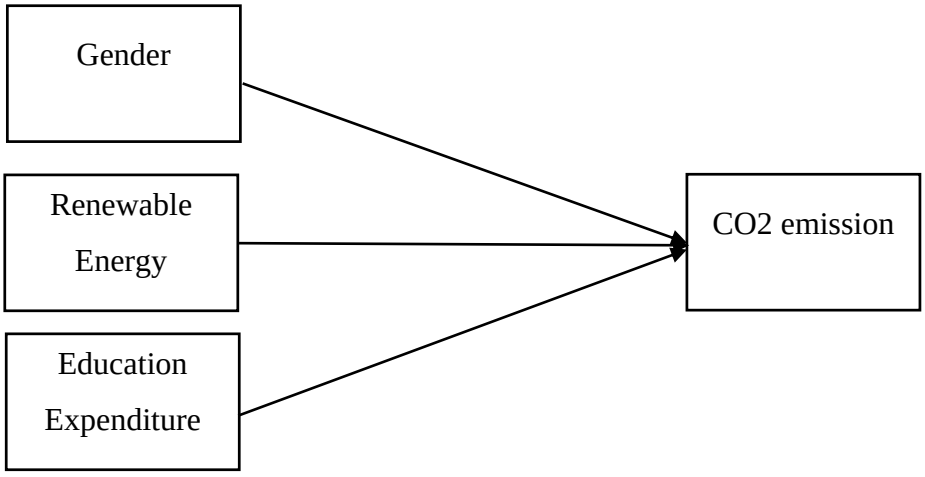
H2: Enhanced allocation of resources and utilization of sustainable energy sources in BRICS economies result in a substantial decline in emissions of CO2.

H3: A positive relation exists between higher education expenditure in BRICS nations and increasing environmental consciousness, leading to fewer CO2 emissions.

5.2 Conceptual Model

Dependent variable: CO2 Emission

Independent variables: Gender, Renewable energy, and Education expenditure



CHAPTER SIX

RESEARCH METHODOLOGY

The study's research method is structured to systematically examine the correlations between gender equality, adoption of REN, expenditure on education, and emissions of CO2 in the BRICS states. A comprehensive technique used to conduct secondary data analysis was utilized. The justification for using this methodology stems from its effectiveness in gathering and examining extensive amounts of pre-existing data from multiple perspectives, including gender equality, renewable energy, and education expenditure on CO2 emissions among the BRICS nations. Secondary data is especially beneficial in this context because it provides access to comprehensive datasets encompassing various variables across several periods. This facilitates a more extensive comprehension of the present circumstances and patterns.

The research was conducted with an exploratory intent to reveal intricate connections between the chosen factors and CO2 emissions. Consequently, the most appropriate methodology employed was the analysis of secondary data. This approach facilitates a comprehensive examination of available data, encompassing many sources such as global databases, official government records, and scholarly publications. Through the systematic review of this dataset, the study could encompass a wide range of viewpoints and observations, enhancing the comprehension of the research issue.

The technique employed in this study was characterized by its quantitative nature, which facilitated a systematic and standardized approach to examining data. Maintaining uniformity ensures consistency across diverse data sources, augmenting the research findings' reliability and validity. Using statistical techniques and software for data analysis in this study confirmed a systematic and rigorous data investigation, promoting objectivity in the analytical process.

Secondary data analysis provided practical advantages regarding accessibility and comprehensiveness, particularly in light of the emphasis on BRICS countries. Obtaining individual-level data from many nations can pose challenges and require significant resources. Hence, using pre-existing datasets proved an efficient and successful approach encompassing the extensive geographic and thematic scope necessary for this research.

6.1 Data Collection and Sources

The WB database served as the principal source of data. The database in question offers a comprehensive and highly regarded collection of data relevant to the specific areas of interest being investigated in the study. The data gathering encompassed a substantial timeframe, spanning from 1990 to 2020. The thirty-year duration was deliberately selected to provide a comprehensive and extensive view, containing the changes in carbon dioxide (CO2) emissions alongside the progression of gender roles, renewable energy endeavors, and investments in education within the BRICS economies over the specified period.

The extensive dataset provided by the World Bank played a crucial role in offering critical insights into several relevant subjects being investigated. The database offered complete annual emissions data for each of the BRICS countries concerning CO2 emissions, facilitating a comprehensive examination of emission trends and patterns spanning three decades. The database presented statistics on the uses and expansion of REN resources in various nations, providing insights into the possible influence of energy source transitions on the emissions of carbon dioxide.

The World Bank database contains data that can be utilized to make inferences about the participation and representation of women in sectors relevant to environmental policy and energy. As mentioned above, the data played a pivotal part in analyzing the possible impact of gender roles on environmental outcomes within the BRICS states.

Furthermore, examining the correlation between funding for education spending information drawn from the database and the degree to which individuals are aware and enact environmentally friendly practices. This study component aimed to explore any possible links between investment in education and emissions of CO2. It was presumed that a higher level of education results in better environmental knowledge and, therefore, lower emissions.

The utilization of data obtained from the WB database ensured the maintenance of consistency and comparability among the BRICS countries. This was facilitated by the standardized methods employed by the international financial institution for data gathering and reporting. The considerable duration of the data collection period enabled the examination of patterns and fluctuations over an extended timeframe, enhancing the depth of comprehension regarding the underlying dynamics.

The data-gathering methodology employed in this study was focused on a single, authoritative source encompassing thirty years. This technique established a robust basis for the investigation, guaranteeing that the analysis was firmly rooted in dependable and uniform data. The selection of this methodology had a crucial role in enabling a comprehensive and rigorous investigation of the intricate connections among gender, REN, and education expenditure on emissions of CO2 within the framework of the BRICS economies.

6.2 Measurement of Variables

For this research, the validity and integrity of the study's conclusions depend on precisely measuring and defining each variable. The research investigation centers on a single dependent and three independent variables, each characterized by its distinct metrics.

6.3 Dependent Variable: CO2 Emissions

"CO2 emissions" refers to the aggregate amount of CO2 emitted from human activities. This study places particular emphasis on studying this phenomenon. This is a category that includes the burning of fossil fuels and deforestation. Understanding and addressing CO2 emissions are crucial for comprehending and minimizing the effects of global and climate damage. In addition, measuring CO2 emissions concerning BRICS countries that industrialize rapidly is critical in ensuring sustainable future outcomes while providing an environmental assessment.

Measurement: CO2 emissions are measured using the metric tonne per capita. This metric normalizes emissions with the population size of a country, facilitating an equitable comparison among the varied economies of the BRICS nations. The data, which covers the period from 1990 to 2020, has been obtained from the World Bank database, providing a comprehensive perspective on the trends and patterns of emissions over three decades.

6.4 Independent Variables:

Gender Equality: The term "gender equality" in this study pertains to the level of participation and representation of women in significant positions of authority, particularly within sectors that directly influence environmental policy and energy management. This aspect explores the potential impact of gender representation in

leadership and policy-making roles on ecological results. The underlying assumption is that including various genders can contribute to formulating more comprehensive and efficient environmental plans, specifically within the energy sector. This is of utmost importance for the sustainable progress of any nation.

Measurement: The evaluation of gender dynamics entails the examination of the representation of women in positions of leadership within the environmental and energy sectors, as well as within governmental entities tasked with formulating ecological policy. This may encompass information about the proportion of female representation in parliamentary bodies, the presence of women in leadership positions within energy or environment ministries or departments, and employment figures in renewable energy sectors broken down by gender.

Renewable Energy

Renewable energy adoption shows how much solar, wind, and water are mixed with other utilized types of energy in each nation. It is essential since it reduces the emission of carbon dioxide that may provoke climate change impacts. One significant evidence of this progress can be illustrated by comparing the adoption of green energy against how much fossil fuel was needed by an economy in the past.

Measurement: This variable is quantified by determining the proportion of overall energy consumption derived from renewable sources, expressed as a percentage. The data of this metric, obtained from the World Bank, illustrates the degree to which the BRICS nations have included renewable energy in their energy portfolios, thereby offering a comprehensive assessment of each country's dedication to and advancement in sustainable energy strategies.

Education Expenditure

This refers to what a particular country would spend on its education sector when a case arises relating to spending such an amount for education. It is always perceived as a vision for a country concerning what concerns its people, like educating them about the environment and conservation. Indeed, the distribution of CO2 emissions towards education may give rise to society's awareness and consequent action for these issues. Hence, they can be seen in the influence on national and personal practices that accumulate to produce the greenhouse effect emission.

Measurement: The study employs the statistic of 'Adjusted savings: education expenditure (current US$)' from the World Bank database to quantify education expenditure. This metric offers a perspective on the total financial commitment made by each BRICS country towards education, enabling an examination of the possible influence of education on environmental consciousness and behaviors.

6.5 Model Specification

Between the years 1990 and 2020, the article makes use of a wide variety of econometric models to investigate the correlations between the independent variables that have been chosen, both in terms of their type and their strength. A number of cutting-edge econometric methodologies have been incorporated into the design of the model in order to facilitate a comprehensive analysis of the ways in which financial investments in education, the utilization of renewable energy sources, and gender equality influence carbon dioxide emissions.

In this particular investigation, the ARDL Model serves as the primary focus. This particular application of Time Series Data is in part owing to the remarkable performance of the model when it comes to dealing with data that is integrated at multiple levels. In order to evaluate the short-term and long-term link between gender equality, renewable energy, education spending, and CO2 emissions (the dependent variable), an ARDL model was developed. An accessory metric, it is used to enhance the ARDL model in order to help improve it. The only method to verify that the variables you are examining have a connection over a longer period of time is to conduct this test. A comparison between the alternative of co-integration and the null hypothesis of non-co-integration is required in order to determine if the linked association is merely a temporary equilibrium or whether it is a permanent equilibrium over a lengthy period of time.

Once a long-lasting link has been established by the utilization of the ARDL bound test, the research will proceed to merge the ECM. When seen from this perspective, the Error Correction Model (ECM) offers a glimpse into the process by which variables recover equilibrium after being stimulated by transients. The foundation of the analysis is the rate of CO2 adaptation to changes in the independent variables during the course of the time period taken into consideration. It is quite helpful to have

the information that it provides regarding the dynamics of the adjustment process among the BRICS countries.

This investigation additionally makes use of the CUSUM and CUSUMSQ tests in order to ensure that the model coefficients are consistent with one another. These tests are crucial in verifying the model's reliability throughout the investigation. They also visually inspect the changes in each of the variables. That is necessary for the stability and plausibility of the models to be true over the periods considered. Overall, this model incorporating the ARDL Model, ARDL bound test, ECM, and CUSUM and CUSUMSQ tests provides a good framework for exploring complicated and multi-faceted relations in this study. These innovative approaches give us a more transparent comprehension of the effect of gender issues, green economy, and educational funding on carbon emissions in highly developing BRICS countries.

The following is a list of the specified operational variables and model parameters that were suitable for the ARDL that was utilized in this paper:

$$\Delta lnCO2t = \alpha 0j + \Sigma \beta pi=1ij \Delta lnGENt-1 + \Sigma \beta q1i=12JlnRENt-1 + \Sigma \beta q2i=13j \Delta lnEDUt-1 + \mu i + \varepsilon it \quad (1)$$

Where; CO2 = Carbon Emission

GEN = Gender Equality

REN = Renewable Energy

EDU = Education Expenditure

i = Number of variables in Model.

j = number of time lags.

p = Lag Values of the Dependent Variable.

q = Regressor Variable Lag orders.

μi = Error terms.

ith = Vector of Error terms.

6.6 Unit Root Test

It is essential to determine the data's stability before assessing the reliability of the information collected using ARDL modeling methods. For the ARDL model to work adequately, the unit root should manifest as significant at 1%, 5%, and 10%. It is also noted at the level and the first differences of the data series. This condition helps to ascertain the order of integration of the variables, which is very important when determining whether the ARDL model is appropriate for analyzing the given dataset. The unit root test used advanced statistical techniques. The analysis started with the execution of the ARDL bound test, and then it moved on to the ARDL model. Additionally, the ability to comprehensively examine the stationarity of the variables is a possibility when utilizing this method. Tests such as the ADF, DLS, and PP were utilized in order to guarantee that our findings were reliable and that our study was thorough. The different types of tests give diverse insights into how unit root affects the data characteristics, implying comprehensive comprehension.

In addition, time series data are often tested using the Augmented Dickey-Fuller (ADF) test to determine whether or not a unit root exists. It measures non-stationarity by looking for any possible autocorrelation in a data set. In cases of serial correlation, Dickey-Fuller GLS can be an alternative test because it helps improve efficiency in the presence of heteroskedastic errors. These studies are enhanced by using the Philips-Perron test, which allows for a more flexible specification of autocorrelated errors in the data. This has been the most vital verification tool for unit root. In unit root analysis, these tests help ensure that the variables used are appropriately integrated to satisfy preconditions before applying the ARDL model. A careful approach in the first stage of the analysis gives a solid basis for precisely examining the transformation of the interactions of gender parity, renewable energy, expenditure on education, and CO2 emissions in the emerging system economy BRICS.

Two of the most important econometric techniques for time series research are the ARDL bound test and the ARDL model. These tools are particularly useful for analyzing both short-term and long-term correlations between variables.

The Autoregressive Distributed Lag (ARDL) bound test and the ARDL model are two important econometric techniques that are utilized in time series research. These

methods are helpful in determining the long and short term correlations that exist between the variables.

In order to acquire a more comprehensive understanding of the interrelated aspects that are investigated in the article titled "The Role of Gender, Renewable Energy, and Education Expenditure on CO2 Emissions in BRICS Economies," these instruments are necessary.

ARDL bound test

When applied to a dataset consisting of time series, the ARDL Bound Approach is typically used to ascertain whether or not there is a consistent arrangement of variables. This strategy is absolutely necessary when working with models in which the variables are either I(0) or I(1) depending on the situation. A similar method is utilized by the ARDL framework as well. To achieve this objective, Pesaran et al. proposed that the bounds testing approach be used to test for cointegration after estimation of ARDL model implies confidence interval regression. In this test, the alternative theory claims that variables are cointegrated while arguing against null hypothesis which states that there is no link of one variable to another in the long term (cointegration) among the variables. Through use of the F-statistics together with ARDL Bound Test, we can know whether it is possible to reject the null hypothesis or not. However, it should be noted that this test is only applicable in situations where the regressors are either co-integrated, I(0), or I (1).

6.7 Autoregressive Distributed Lag (ARDL) Model

The research studies make use of a popular econometric designated identified as the Autoregressive Distributed Lag (ARDL) Model, which is used for analyzing proportions between variables over both short and long periods. A prominent aspect of this model is that it can be used under all types of stationary variables: level, first difference or mixed. The long-run relationship coefficients are calculated via the ARDL methodology. After that, it uses this long-term forecast to build the ECM which is then used in order to incorporate short term dynamics.

A regression analysis is performed on the dependent variable in the ARDL model, using both the dependent variable's own lagged values and the lagged values of the independent variables. Through this method, we are able to observe how the

trajectory of carbon dioxide emissions is affected by changes in gender equality, renewable energy, and education investment.

Utilizing the typical asymptotic standard theory allows for the estimation of the model's long-run properties as well as the identification of conclusions regarding those properties. Zhang et al. (2017, Bilgili et al. (2016), and Wang et al. (2016) all offer comprehensive evaluations of the literature that is pertinent to the topics being discussed. The analysis is made significantly more challenging by the presence of variables that exhibit difference stationarity, often known as integration of order I (1). The investigation of the long-term linkages that exist between I (1) variables is the primary focus of the existing body of research on co-integration. Beginning with the premise that variables having an index of I (1) are not suitable for the conventional ARDL approach, it moves on to more specific examples. On the basis of this fundamental concept, the majority of the recent investigation on co-integration has been conducted. Consequently, this resulted in the creation of a multitude of specific methods for estimating and evaluating hypotheses within the setting of I (1) variables.

$$\mathbf{yt = \alpha 0 + \alpha 1t + i{=}j\Sigma p\emptyset iyt\text{-}I + \beta *1xt + \Sigma \beta pi{=}0it + \Delta Xt\text{-}1 + \mu t} \quad \mathbf{(1)}$$

$$\mathbf{\Delta Xt = P1\Delta Xt\text{-}1} + \mathbf{P2\Delta Xt\text{-}2} + \ldots + \mathbf{Ps\Delta Xt\text{-}s} + \mathbf{\varepsilon it} \quad \mathbf{(2)}$$

Take into consideration that the independent variables in the k-dimensional I(1) space are denoted by the symbol xt. The random disturbances μt and Ш𝑡 are characterized by the absence of any correlation between them, the presence of zero means, and the presence of constant variance-covariance profiles. P1 is the name that is given to the k x k coefficient matrices in order to ensure that the vector autoregressive process in ΔXt-1 remains stable. As an additional point of interest, it is assumed that all of the solutions to the equation $\Sigma \beta pi{=}0i = 0$ are situated outside of the unit circle. A further hypothesis that we put forward is that yt and xt are linked in a manner that is both singular and enduring.

6.8 Residual Diagnostics and Stability Test

The Residual Diagnostics consists of plots depicting residuals as the difference between observed data and the model predictions. The process assesses any specific patterns, such as linearity, symmetry, and cyclic arrangement, among others, to indicate potential problems with the model. In terms of residual diagnostics, these

entail looking into serial correlation that indicates residuals are not independent and checking for homoscedasticity where residuals have consistent scaled variation across all values. These complications are essential for the reliability of regression results. Furthermore, residuals' normality is assessed by applying tests like the Jarque-Bera test. This test assesses the normality distribution of residuals. This is one of the basic assumptions for different statistical reasoning methods. Observing non-normal residuals may signal model misspecification and outlier presence.

The Stability Test confirms the steady-state nature of coefficients for the study period. This test is essential in time series analysis because it assesses the true nature of relations the model reflects at different time points. For that reason, the CUSUM and CUSUMSQ tests are commonly used. These tests provide visual ways of detecting instability among regression coefficients. The stability manifests itself in a form when the CUSUM or CUSUMSQ graph stays within bounds, and these values do not change during the test period.

The analysis is made more reliable and consequently increases the reliability of its conclusions by involving residual diagnostics and stability tests within it. When undertaking such an intensive examination aimed at understanding the interdependencies between various economic, social, and environmental variables, it is essential to focus on the credibility of the empirical model. Such tests demonstrate that the model is credible and trustworthy and thus enhance faith and trust in the findings concerning the impact of factors like gender equality, renewable energy, and education spending on CO2 emissions within BRICS states.

CHAPTER VII

EMPIRICAL FINDINGS

The study uses an extensive and methodological statistical illustration involving data compiled for thirty years, from 1990 to 2020. The results are obtained from different statistical tests and models, focusing on descriptive statistics, unit root tests, ARDL model, Cusum and Cusum square, and co-integration tests.

Descriptive statistics is used to make the first step of understanding the data and later in the study. The final phase synthesizes the central tendency, dispersion, and overall distribution of variables of concern, such as carbon dioxide emission, gender equity, renewable energy supply, and education expenditure. It should be noted that the first step of analysis is critical because it helps you spot any changes or trends that may have occurred over thirty years.

Unit root tests were employed to ascertain the robustness of time series data. These are important as they enable us to determine the stationary nature of data for time series analysis and its subsequent effect on the reliability of the model used during economic modeling in the future period. It is essential to check first if each data series is stationary and requires differencing before further use of complex models to analyze. Statistically, the significant aspect of this study is centered on the ARDL model. The current model can examine relationships among components over short and long term settings. This study provides evidence of the ARDL model's adaptability to mixes of order integrations, including some stationary series.

Finally, using the CUSUM and CUSUM SQUARE test, the stability of the ARDL model was established. Graphically, these tests show how the coefficients have been temporally stable, offering helpful information on whether the correlates were consistent and reliable throughout the research's timeframe. Cointegration tests were utilized to examine the long-term equilibrium relationships among the variables. Cointegration suggests that, despite temporary differences, there is a consistent and lasting relationship between GEN, REN, EDU, and CO_2 emissions in the BRICS nations.

Hence, the study will address what emerged from applied statistical techniques. The whole strategy, which provides comprehensive information on carbon dioxide from

fast-developing countries, such as gender equity, renewable energies, and education costs, is used in this study. This implies that these outcomes have far-reaching implications for policymaking and prepare grounds for further investigations.

Table 2. Justification of the variables

Parameters	Symbol	Units	Source
Dependent:			
Carbon Emission	(lnCO2)	CO2 emissions (metric tons per capita)	World Bank (2020)
Independent			
Gender	(InGEN)	The proportion of seats held by women in national parliaments (%)	World Bank (2020)
Renewable Energy	(InREN)	Renewable energy consumption (% of total final energy consumption)	World Bank (2020)
Education Expenditure	(lnEDU)	Adjusted savings: education expenditure (current US$)	World Bank (2020)

Table 1 demonstrates the utilization of a logarithmic representation for all variables. The log form is utilized to circumvent the intricacy of approximated outcomes. The regression form can be expressed as equation (1) by applying the natural logarithm to the variables.

$$\ln CO2_t = \beta 0 + \beta 1 \ln GEN_t + \beta 2 \ln REN_t + \beta 3 \ln EDU_t + \varepsilon_t$$

Table 3. List of BRICS Countries

Brazil	Russia	India	China	South Africa

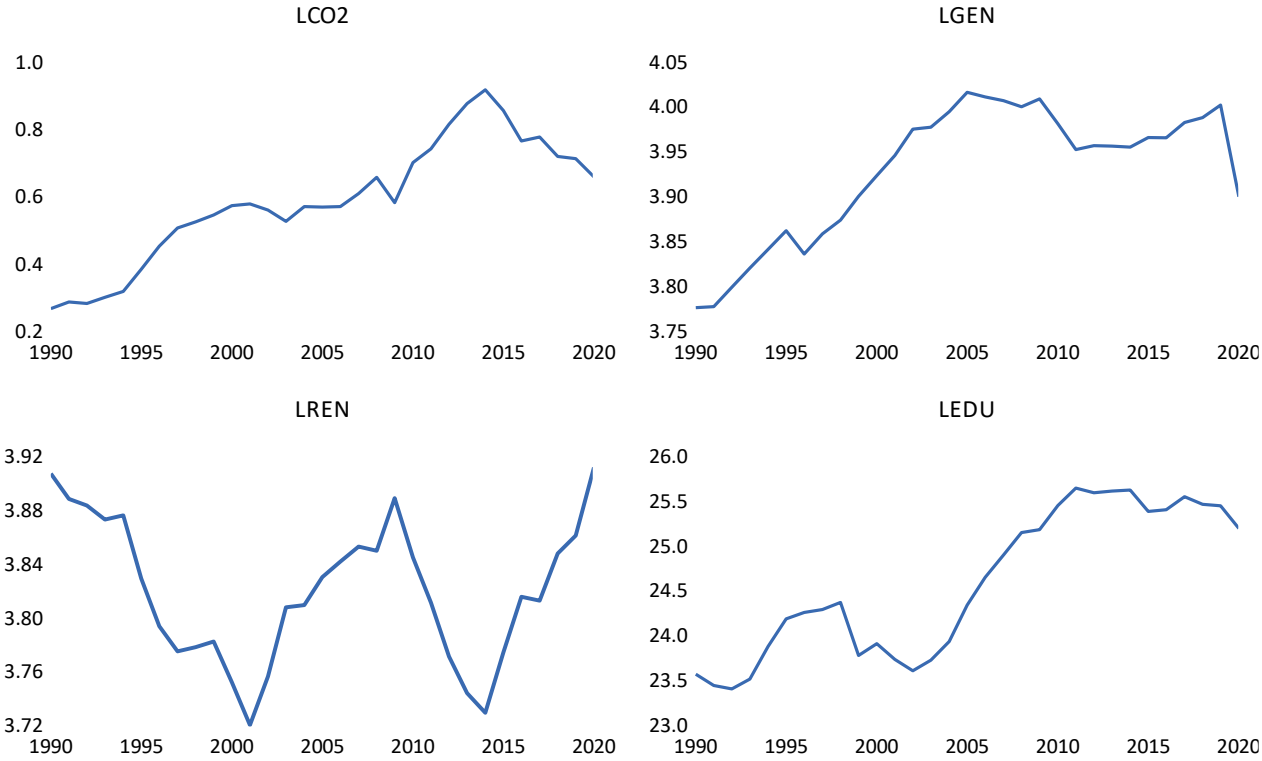
BRAZIL

Table 4. Descriptive Statistics

	LCO2	LGEN	LREN	LEDU
Mean	0.592532	3.931293	3.821275	24.60715
Median	0.578578	3.958200	3.816833	24.39017
Maximum	0.922111	4.018075	3.913023	25.66487
Minimum	0.272415	3.778423	3.721589	23.42612
Std. Dev.	0.180804	0.074389	0.053054	0.809657
Skewness	-0.168105	-0.733640	-0.079967	-0.019987
Kurtosis	2.305055	2.236666	2.041427	1.396008

In Table 3, you can see the descriptive statistics for the framework that were used; the mean value is the average for each variable. Mean deviations for CO2, GEN, REN, and EDU are as follows: 0.592532, 3.931293, 3.821275, and 24.60715, respectively. By utilizing the median, one is able to determine the middle value of each variable. The numbers that are the highest and lowest, on the other hand, provide information about the capabilities of each variable. Taking a look at the standard deviation allows one to quantify the degree to which each variable deviates from the representative sample mean. With a value of zero, the average skewness does not have any value. Therefore, CO2, GEN, REN, and EDU each have a negative distribution with kurtosis values of 2.305055, 2.236666, 2.041427, and 1.396008, respectively. A negative distribution is associated with these values. In order to determine if a series' distribution is peaky or flat, kurtosis is used. The kurtosis values of 2.305055, 2.236666, 2.041427, and 1.396008 indicate a distribution that is less than the value of 3, which suggests that it is not normal or mesokurtic but with 2.305055, 2.236666, 2.041427, and 1.396008. we can say the CO2, GEN, REN, and EDU. However, they mirror a normal distribution, are platykurtic, and platykurtic implies that this series will have a lower value below its sample mean and is going to have a lot of values that are lower than 0.592532, 3.931293, 3.821275, 24.60715.

Figure 1



According to Fig. 1, CO2 is on an upward sloppy; by 2015, it shows a downward sloppy. For GEN, there is an upward sloppy, but by 2020, there's a downward sloppy. For REN, there's a download sloppy, but by 2000, there's upward sloppy; by 2010, there's downward sloppy, and by 2015 there's upward sloppy. Therefore, Renewable Energy is fluctuating. For Education, it's fluctuating.

Table 5. Unit root test - Brazil

variables	ADF	RALS-ADF	ρ^2
CO2	-1.61	-2.37	0.94
EDU	-0.99	-0.63	0.96
GEN	-2.05	-2.44	0.62
REN	-1.94	-2.18	0.92
∆CO2	-4.08***	-3.66**	0.96
∆EDU	-3.66***	-3.50**	0.90
∆GEN	-2.65*	-6.38***	0.87
∆REN	-3.29**	-3.53**	0.95

Note that: The asterisks ***, **, and * represent statistically significant values at the 1, 5, and 10% levels, accordingly. The Augmented Dickey-Fuller (ADF) test yields critical values of -3.58, -2.93, and -2.60 at significance levels of 1%, 5%, and 10% accordingly. Based on the information provided in table 4, the RALS-ADF has critical values of -3.75, -3.30, and -3.05 at the significance levels of 1, 5, and 10 percent accordingly.

Table 6. RALS cointegration test results- Brazil

Methods	K	Test statistics	ρ^2
EG	0	-4.14*	–
RALS-EG	0	-4.72**	0.82

Note: ***, **, and * are the symbols that are used to denote importance at the 1%, 5%, and 10% levels, respectively. K is the abbreviation for the ideal lag length, which is determined through the use of recursive statistics. While the critical values for the EG test are -5.02 at the 1% level, -4.32 at the 5% level, and -3.98 at the 10% level, the EG test has crucial values. During the RALS-EG test, the critical values at 1%, 5%,

and 10% are -4.80, -4.19, and -3.88, respectively. These values are taken into consideration.

All variables seem to be integrated at level I(1) and within the initial differences, as shown in Tables 4 and 5, which display the results of the unit root test. All BRICS country variables were determined to be integrated at the first difference based on the ARDL test.

This included Brazil's CO2 emissions. This indicates that the variables were integrated in the order of I(1), which resulted in distinct outcomes for each variable. This is what this means; The results of the unit root test indicate that the null hypothesis, which asserts that the series does not have a stationary level, ought to be rejected. This is indicated by the fact that the test was done under the presumption of a continuous trend.

According to the findings of an additional analysis of the unit root test that was carried out at the level and 5% significance level, the variables exhibit stationarity at the first difference. The variables for the BRICS states are stationary at 1st differences I(1), according to the results of the unit root test.

This is comparable to what occurs when a trend is evident for the same reason. At both the 5% and 10% levels of statistical significance, there are a few variables that are statistically significant, which indicates that they are stationarity.

As a result, the study comes to conclude that the series is not stationary enabling null hypothesis rejection successfully. However, it offers support for the alternative hypothesis which states that when differenced once series is stationary at 5% and also at 10 % level as shown on table above. Because the conclusion provides a substantial foundation for later ARDL modeling and cointegration research, this guarantee ensures that evaluations used to assess long-term correlations among variables inside BRICS economies are accurate.

Table 7. ARDL Bounds Test

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	5.734550	10%	2.37	3.2
K	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
Actual Sample Size	29		Finite Sample: n=35	
		10%	2.618	3.532
		5%	3.164	4.194
		1%	4.428	5.816
			Finite Sample: n=30	
		10%	2.676	3.586
		5%	3.272	4.306
		1%	4.614	5.966

The F-statistic, which had a value of 5.734550, was found to be significantly greater than both the I(O) and I(1) values, as shown in Table 6. The F-statistic is statistically more significant than both the I(O) and I(1) bounds, which implies that there is a long-term link between the two variables. The null hypothesis asserts that there is no relationship. We conclude that the alternative hypothesis regarding the long-term relationship is correct, and we deny the null hypothesis as a result.

Table 8. ARDL long-run and short-run

Variables	Coefficient	Std. Error	t-Statistic	Prob.
LGEN	0.576987	0.302371	1.908208	0.0708
LREN	1.815530	0.313622	-5.788903	0.0000
LEDU	0.120753	0.027751	4.351370	0.0003
C	2.331597	1.856371	1.255998	0.2236

Table 9. Short Run ARDL Results

Variables	Coefficient	Std. Error	t-Statistic	Prob.
D(LGEN)	-0.249067	0.142296	-1.750345	0.0954
D(LGEN(-1))	-0.461040	0.244055	-1.889086	0.0735
D(LREN)	-1.314965	0.132864	-9.897045	0.0000
D(LREN(-1))	0.327248	0.138415	2.364253	0.0283
CointEq(-1)*	-0.337522	0.057541	-5.865774	0.0000

NOTE: "***,**" denotes significance at 1 percent and 5 percent accordingly, DW = Durban Watson, AIC = Akaike info criterion, HQC = Hanna-Quinn criterion, SC=Schwarz criterion,

ARDL analysis was performed on both long-run and short-run correlation among the factors, and the findings are given in Tables 7 and 8. The coefficient values for the factors within the long-run condition show the quality and course of their effect on the subordinate variable, with an increment in "LGEN" by 1 unit driving to an approximately 0.576987 increment within the subordinate variable, an increment in "LEDU" by 1 unit being associated with an increment of around 0.120753 within the subordinate variable, and an increment of 1 unit in "LREN" being linked to an increment of almost 1.815530 within the subordinate variable. Within the short-run equation, the coefficients give an understanding of the quick alterations taken after a change within the free factors, with "COINTEQ01" having a coefficient of -0.337522, proposing a negative effect on the subordinate variable within the brief term, the variable "D(LGEN)" having a coefficient of 0.249067, showing that a 1-unit change

in its esteem leads to a diminishing of around 0.249067 within the subordinate variable, "D(LREN(-3))" showing coefficients of 1.314965.

Figure 2. Normality Test

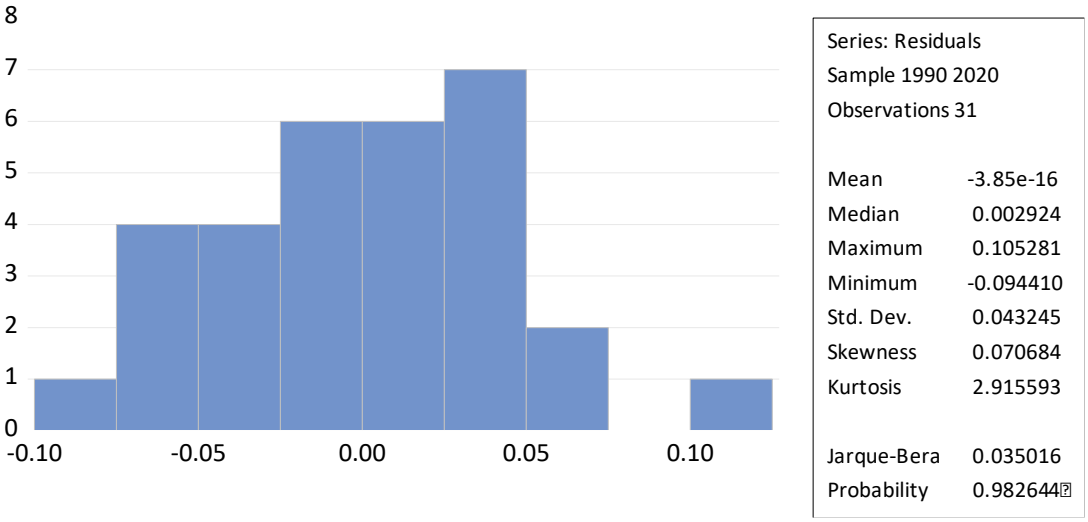


Figure 6 displays both the alternative and null hypotheses. The alternative hypothesis suggests that disturbances do not often follow a normal distribution, whereas the null hypothesis states that they do. Due to the fact that the probability value is more than 0.05 (0.284388), we are able to draw the conclusion that the disturbances do, in fact, follow a normal distribution.

Model stability Diagnosis

This investigation employs the CUSUM and CUSUMSQ approaches for the purpose of stability diagnosis. Tanizaki (1995) states that the investigation variable are stable if the blue lines in the CUSUM and CUSUMSQ plots fall inside the limitations provided by the 2 red lines at a significance level of 5%. This indicates that the blue lines are stable. On the other hand, blue lines that deviate from the boundaries are used to illustrate study parameters that are shown to be unstable. According to the findings of the CUSUM and CUSUMQ tests, the particular model that was utilized in this work was successful in passing the stability tests. At a significance level of 5 percent, the blue line in both tests remains within the red lines throughout the statistical analysis.

Figure 3. CUSUM TEST

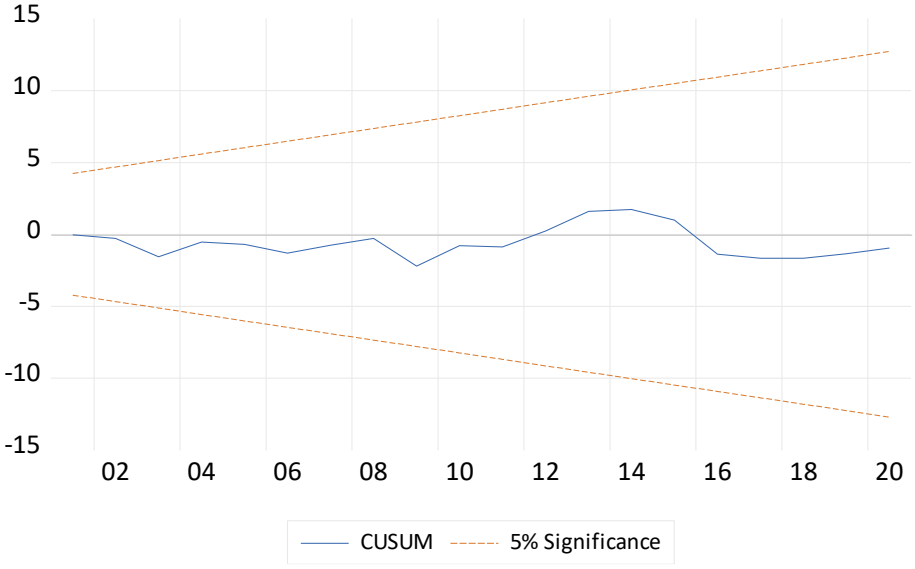
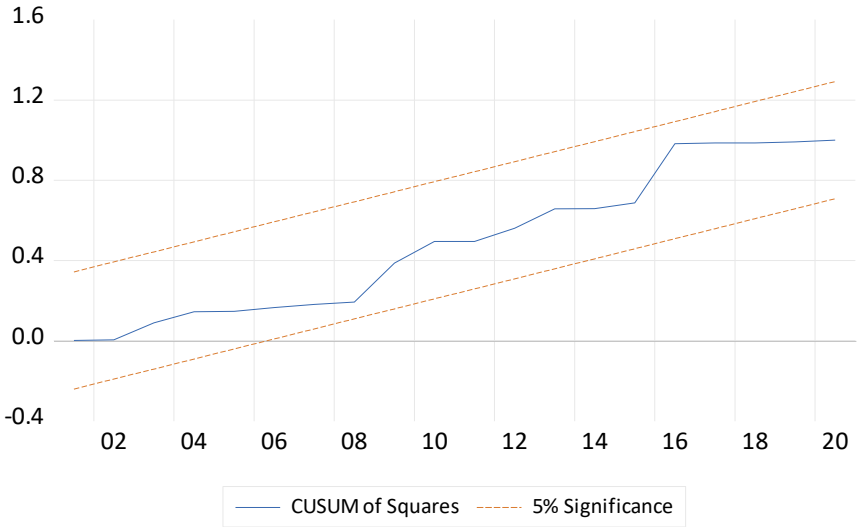


Figure 4. CUSUM OF SQUARE TEST



RUSSIA

Table 10. Descriptive Statistics

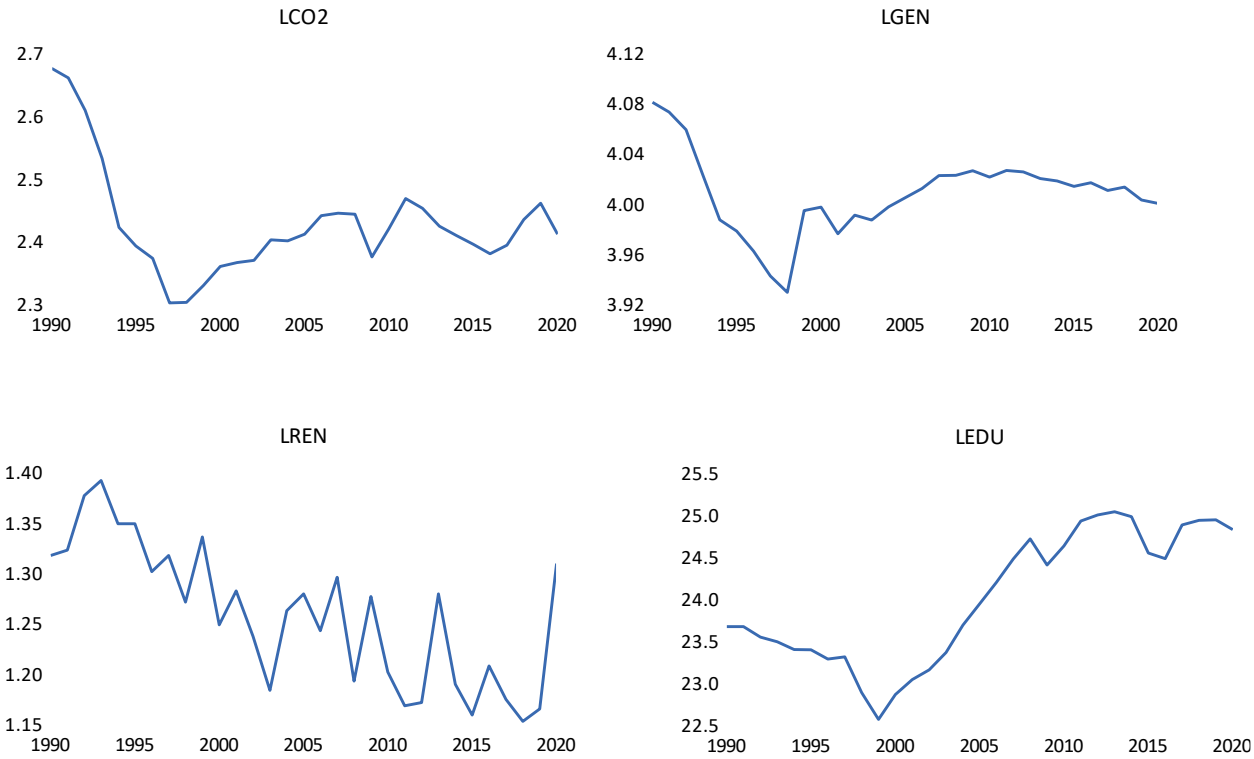
	LCO2	LGEN	LREN	LEDU
Mean	2.435106	4.011152	1.262754	24.06372
Median	2.418754	4.015626	1.275363	23.99899
Maximum	2.682492	4.084193	1.396245	25.09425
Minimum	2.309560	3.933138	1.156881	22.62020
Std. Dev.	0.087346	0.031803	0.070025	0.777713
Skewness	1.449725	-0.092507	0.062162	-0.117157
Kurtosis	5.013698	3.887096	1.867655	1.605553

The following table displays the descriptive statistics of the variables that were used. The mean value is a representation of the average value acquired by each variable. To be more specific, the mean deviation values for CO2, GEN, REN, and EDU are as follows: 2.435106, 4.011152, 1.262754, and 24.06372, respectively. By utilizing the median, one is able to determine the middle value of each variable. On the other hand, finding the highest and lowest values for each variable can be done by looking at the maximum and minimum values at the same time. Taking a look at the standard deviation allows one to quantify the degree to which each variable deviates from the representative sample mean. This statistic, zero (0), represents the average skewness. In light of this, the kurtosis values for CO2, GEN, REN, and EDU are 2.305055, 2.236666, 2.041427, and 1.396008, respectively, which indicates that the distribution is negative.

Kurtosis quantifies the deviation from a normal or mesokurtic distribution by measuring the degree of thickness or flatness of the series' distribution. The kurtosis values of 5.013698, 3.887096, 1.867655, and 1.605553 indicate that CO2 and GEN are more significant than 3, while REN and EDU are lower than 3. Nevertheless, we can attribute these values to CO2, GEN, REN, and EDU. However, they mirror a normal distribution is platykurtic, and platykurtic implies that this series will have a

lower value below its sample mean and is going to have a lot of values that are lower than 5.013698, 3.887096, 1.867655, and 1.605553.

Figure 5



According to Fig. 5, CO2 is on a downward sloppy; by 1998, it shows an upward sloppy. For Gender, there is a downward sloppy, but by 1999, an upward sloppy was not balanced. Renewable Energy fluctuated throughout the years; for EDU, there was a download sloppy, but by 1999, there was upward sloppy, but started fluctuating by 2010.

Table 11. Unit root test – Russia

variables	**ADF**	**RALS-ADF**	ρ^2
CO2	-2.59	-2.84	0.92
EDU	-2.40	-2.48	0.93
GEN	-2.64*	-1.61	0.84

REN	-2.53	-4.99***	0.61
∆CO2	-3.08**	-3.24*	0.97
∆EDU	-4.66***	-4.94***	0.90
∆GEN	-3.36**	-3.65**	0.72
∆REN	-7.81***	-10.89***	0.67

Table 12. RALS cointegration test results- Russia

Methods	K	Test statistics	$\boldsymbol{\rho^2}$
EG	0	-4.29*	–
RALS-EG	0	-4.37**	0.86

Note that: Significance at the 1%, 5%, and 10 percent levels is denoted by ***, **, and *, accordingly. -3.58, -2.93, and -2.60 are the respective values for three percent, five percent, and ten percent of the African Development Fund (ADF). -3.75 is the critical value for the RALS-ADF, -3.30 is the critical value for the 5%, and -3.05 is the critical value for the 10%.

When we look at the table of results for the unit root test, which is located up there, we can see that all of the variables are integrated at level I(1) initial differences. In the course of the ARDL test, it was noticed that all variables across the BRICS countries were integrated by means of first differencing. This included the CO2 emissions from Russia. This indicates that the variables were integrated in the order of I(1), which resulted in distinct outcomes for each variable. This is what this means; The results of the unit root test indicate that the null hypothesis, which asserts that the series does not have a stationary level, ought to be denied. This is indicated by the fact that the test was done under the theory of a continuous trend.

According to the findings of an additional analysis of the unit root test that was carried out at the level and 5% significance level, the variables reveal stationarity at the 1st

difference. The unit root test results for Brazil, Russia, India, China, and South Africa indicate—the variables are stationary at initial differences I(1), which is comparable to the situation in which a trend is seen. In addition, numerous variables exhibit stationarity at the 5 percent and 10 % levels of significance, accordingly.

As a result, the analysis reaches the conclusion that the series is non-stationary, which enables the null hypothesis to be rejected successfully. As can be seen in the table that is shown above, the alternative hypothesis that the series exhibits stationarity at the first difference is supported by the observed data at both the 5 percent and 10 percent significance levels. This finding assures that the study's assessments of the long-term and short-term correlations among the variables within the BRICS economies will be accurate. It does this by building a solid footing for future ARDL modeling and cointegration investigations, which will be conducted in the future.

Table 13. Bounds Test

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	5.590817	10%	2.37	3.2
K	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
			Finite Sample:	
Actual Sample Size	30		n=30	
		10%	2.676	3.586
		5%	3.272	4.306
		1%	4.614	5.966

LONG RUN ARDL RESULTS

Table 14. ARDL long-run and short-run results

Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LGEN	2.909140	1.366303	2.129205	0.0442
LREN	-2.165470	2.833702	-0.764184	0.4525
LEDU	-0.121882	0.139942	-0.870951	0.3928
C	-3.627167	5.997155	-0.604815	0.5512

Table 15. Short Run ARDL Results

Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(LGEN)	0.918108	0.219216	4.188149	0.0004
D(LEDU)	0.031918	0.018139	1.759662	0.0918
CointEq(-1)*	-0.142881	0.024942	-5.728496	0.0000

NOTE: "***" "**" denotes significance at 1 percent and 5 percent accordingly, SC=Schwarz criterion, HQC = Hanna-Quinn criterion, AIC = Akaike info criterion, DW = Durban Watson.

The table presents the results of an ARDL analysis for both long-run and short-run connections among the factors. The coefficient values for the factors within the long-run condition show the quality and course of their effect on the subordinate variable, with an increment in "LGEN" by 1 unit driving to an approximately 0.0442 increment within the subordinate variable, an increment in "LEDU" by 1 unit being associated with an increment of around 0.3928 within the subordinate variable, and an increment of 1 unit in "LREN" being linked to an increment of almost 0.4525 within the subordinate variable. Within the short-run equation, the coefficients give an understanding of the quick alterations taken after a change within the free factors, with "COINTEQ01" having a coefficient of -0.142881, proposing a negative effect on the subordinate variable within the brief term, the variable "D(LGEN)" having a coefficient of 0.918108, showing that a 1 unit change in its esteem leads to a

diminishing of around 0.0918 within the subordinate variable, "D(LEDU(-3))" showing coefficients of 0.031918.

Figure 6. Normality Test

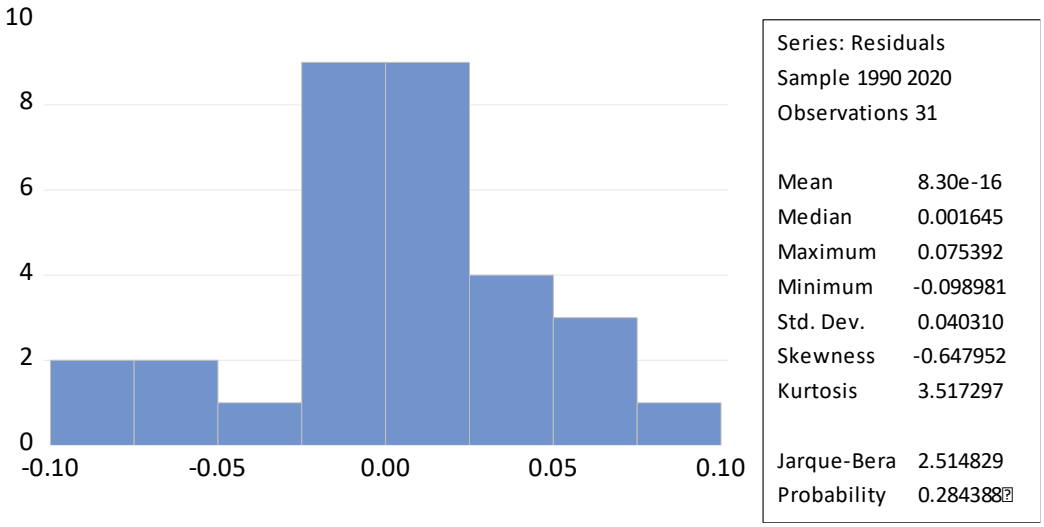


Figure 6 displays both the alternative hypothesis and the null hypothesis. The alternative hypothesis posits that disturbances frequently deviate from a normal distribution, while the null hypothesis asserts that they adhere to it. Since the probability value is more than 0.05 (0.284388), we can conclude that the disturbances indeed conform to a normal distribution.

Figure 7. CUSUM TEST

The CUSUM and CUSUMSQ methods are utilized in this investigation in order to diagnose stability. Tanizaki (1995) states that the research parameters are stable if the blue lines in the CUSUM and CUSUMSQ plots fall inside the limitations provided by the 2 red lines at a significance level of 5%. This indicates that the blue lines are stable. On the other hand, blue lines that deviate from the boundaries are used to illustrate study parameters that are shown to be unstable. Taking into consideration the outcomes of the CUSUM and CUSUMQ tests, it would appear that the stability tests were passed by the model utilized in this work. There is no difference between the

blue line and the red line at the 5% significance level in either of the tests.

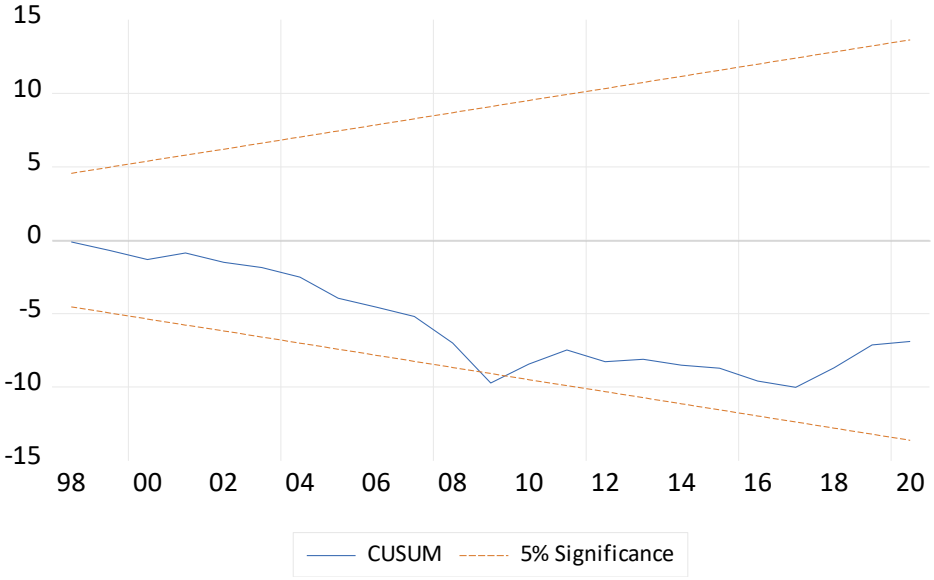
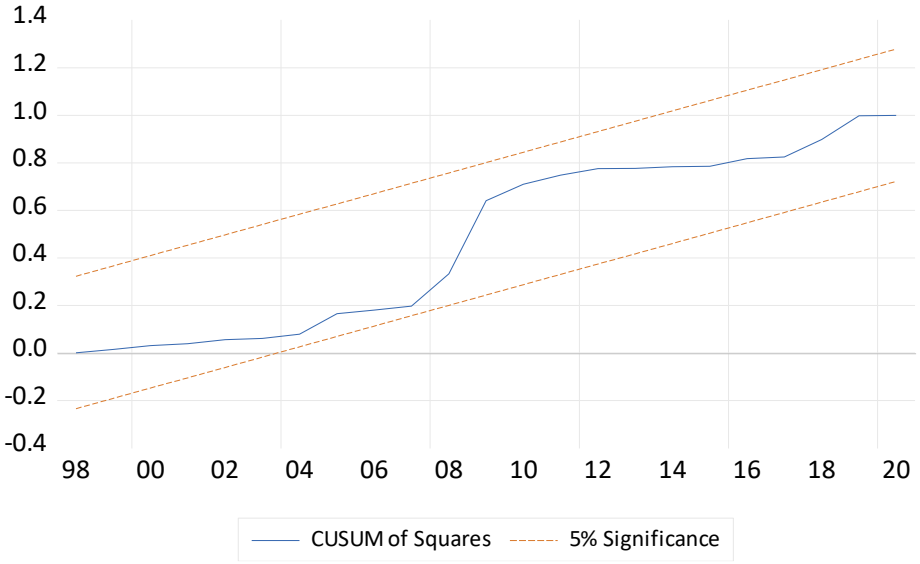


Figure 8. CUSUM OF SQUARE TEST



INDIA

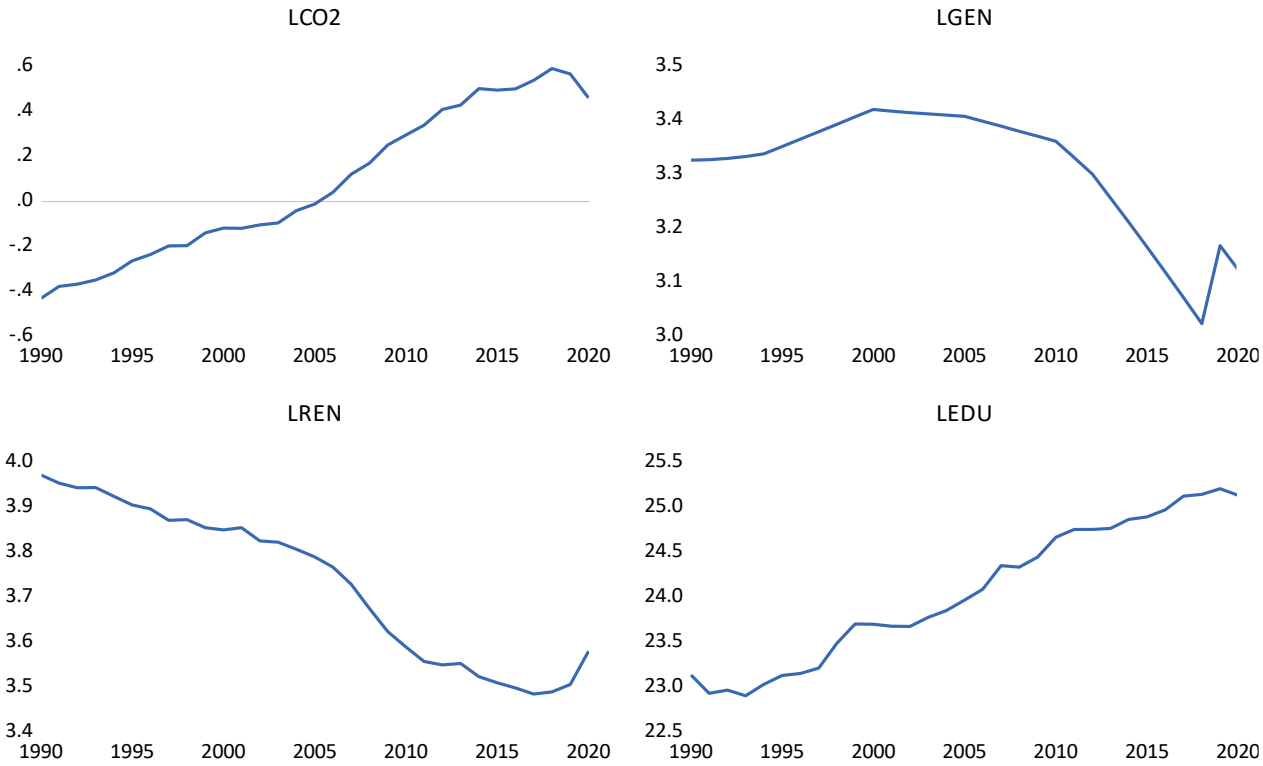
Table 16. Descriptive Statistics

	LCO2	LGEN	LREN	LEDU
Mean	0.071164	3.311102	3.731030	24.04964
Median	-0.015864	3.349694	3.787819	23.96109
Maximum	0.585337	3.418251	3.969348	25.19458
Minimum	-0.434712	3.022277	3.483392	22.89802
Std. Dev.	0.334058	0.112623	0.170194	0.777487
Skewness	0.145091	-1.184083	-0.189960	-0.015939
Kurtosis	1.570890	3.195009	1.451723	1.587796

The mean value provides us with the average values of each variable, and the descriptive statistics of the variables employed are displayed in the table above. CO2, GEN, REN, and EDU each had a mean deviation of 0.071164, 3.311102, 3.731030, and 24.04964, respectively. The mean deviation for EDU was not recorded. We are able to determine the value of each variable's midway by performing the calculation known as the median. While doing so, the max and min values of each variable reveal the extremes of that variable separately. Taking a look at the standard deviations of each variable allows us to determine how far away each variable is from the mean of the sample. When the value is zero, it implies that the skewness is usual. As a result, we can observe that the variables in question adhere to a negative distribution, as indicated by the kurtosis values of 1.587796, 1.570890, 3.195009, and 1.451723 for CO2, GEN, REN, and EDU, respectively. Kurtosis values of 1.587796, 3.195009, 1.451723, and 1.570890 indicate that the distribution of the series is thick and flat. This is the conclusion that can be drawn from such a measurement. Although a score of three implies a normal or mesokurtic distribution, the values in question are lower than that. CO2, GEN, REN, and EDU are all words that can be pronounced correctly. On the other hand, they exhibit a platykurtic normal distribution, which indicates that there will be a great number of values that are lower than 0.071164, 3.311102,

3.731030, and 24.04964, respectively, and that the series will have a value that is lower than its sample mean.

Figure 9



According to Fig. 9, CO2 shows an upward sloppy; by 2018, it shows a downward sloppy. For Gender, it shows a balance sloppy, but by 2010, there's a downward sloppy; by 2019, it shows an upward sloppy. For Renewable Energy, there's a download sloppy, but by 2020, there's upward sloppy; Education Expenditure shows a downward sloppy, but by 1994 there's an upward sloppy.

Table 17. Unit root test -India

variables	**ADF**	**RALS-ADF**	ρ^2
CO2	-0.79	-2.60	0.63
EDU	-1.04	-1.41	0.84
GEN	-3.28**	-0.26	0.68

REN	-1.75	-1.64	0.97
∆CO2	-2.67*	-3.12*	0.71
∆EDU	-4.30***	-4.92***	0.89
∆GEN	-4.65***	-3.84***	0.69
∆REN	-2.61*	-3.07*	-.92

Note that: The symbols ***, **, and * represent statistical significance value at level of 1%, 5%, and 10%, accordingly. The 1%, 5%, and 10% essential values for the ADF are -3.58, -2.93 and -2.60 respectively. The critical values for the RALS-ADF at significance levels of 1%, 5%, and 10% are -3.75, -3.30, and -3.05 correspondingly.

Table 18. RALS cointegration test results- India

Methods	K	Test statistics	$\boldsymbol{\rho^2}$
EG	0	-4.65**	–
RALS-EG	0	-4.19**	0.82

Note: The symbols ***, **, and * represent the levels of significance at 1 percent, 5 percent, and 10 percent accordingly. The variable K represents the optimal lag length determined through recursive statistics. The essential values at 1%, 5%, and 10% for the EG test are -5.02, -4.32, and -3.98 respectively. Similarly, the critical values at 1%, 5%, and 10% for the RALS-EG test are -4.80, -4.19, and -3.88 respectively.

In accordance to the findings of the unit root test, which are presented in the table that is shown above, all variables are integrated at level I(0) and initial differences accordingly. It was observed during the ARDL test that all variables across the BRICS countries were integrated at first differences. This included the amount of carbon dioxide (CO2) emissions that were generated in India. The fact that distinct outcomes were achieved for each variable demonstrates that the variables were integrated at I(1), as demonstrated by this. As a result of the findings of the unit root test, which were carried out at a constant with a trend, the validity of the null hypothesis, which asserts that the series does not have a stationary level, is called into question.

Additional analysis of the unit root test carried out at the level of 5% significance indicates that the variables are stationary at the 1st difference level. This conclusion was reached after the test was utilized. As can be observed from the results of the unit root test, which are in agreement with the trend scenario, the variables are stationary at first differences I(1) for the BRICS nations, which are comprised of South Africa, Brazil, Russia, India, and China. To add insult to injury, stationarity is demonstrated by a few variables at both the 5 percent and 10 percent significance levels.

The investigation comes to the conclusion that the series are non-stationary, which means that the null hypothesis is shown to be incorrect. This finding is supported at both the 5% and 10% significance levels, as can be seen in the table that is located above. The alternative hypothesis asserts that the series are stationary whenever the first difference is taken into consideration. This finding is significant as it provides a robust basis for the subsequent ARDL modeling and cointegration analysis, ensuring the reliability of the study's long and short term relationship assessments among the variables within the BRICS economies.

Table 19. Bounds Test

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	18.75031	10%	2.37	3.2
K	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
			Finite Sample: n=35	
Actual Sample Size	27			

10%	2.618	3.532
5%	3.164	4.194
1%	4.428	5.816
	Finite Sample: n=30	
10%	2.676	3.586
5%	3.272	4.306
1%	4.614	5.966

Table 20. ARDL long-run and short-run results

Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LGEN	0.007768	0.037794	0.205539	0.8423
LREN	-2.088209	0.148284	-14.08245	0.0000
LEDU	0.030020	0.021239	1.413437	0.1952
C	7.169602	0.974255	7.359063	0.0001

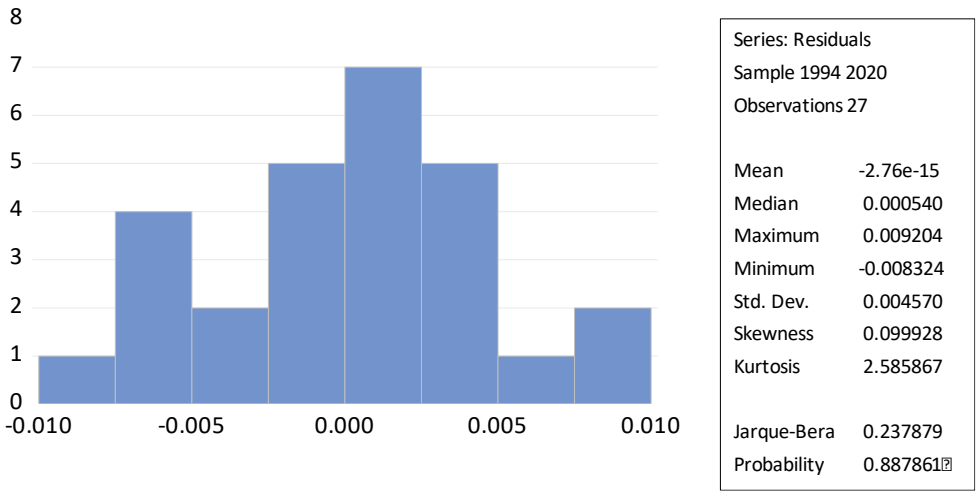
Table 21. Short Run ARDL Results

Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(LGEN)	0.037303	0.106897	0.348964	0.7374
D(LGEN(-1))	0.809187	0.240595	-1.889086	0.0735
D(LREN)	-2.749815	0.390674	-7.038639	0.0002
D(LREN(-1))	1.039690	0.338865	3.068152	0.0181
D(LEDU)	0.142488	0.036795	3.872435	0.0061
D(LEDU(-1)	-0.185731	0.059297	-3.132203	0.0166
CointEq(-1)*	0.009658	0.008725	1.106894	0.3049

NOTE: "***,**" denotes significance at 1% and 5% accordingly, SC=Schwarz criterion, HQC = Hanna-Quinn criterion, AIC = Akaike info criterion, DW = Durban Watson.

The table presents the results of an ARDL analysis for long-run and short-run connections among the factors. The coefficient values for the factors within the long-run condition show the quality and course of their effect on the subordinate variable, with an increment in "LGEN" by 1 unit driving to an approximately 0.007768 increment within the subordinate variable, an increment in "LEDU" by 1 unit being associated with an increment of around 0.030020 within the subordinate variable, and an increment of 1 unit in "LREN" being linked to a decrement of almost 2.088209 within the subordinate variable. Within the short-run equation, the coefficients give an understanding of the quick alterations taken after a change within the free factors, with "COINTEQ01" having a coefficient of -0.337522, proposing a negative effect on the subordinate variable within the brief term, the variable "D(LGEN)" having a coefficient of 0.249067, showing that a 1-unit change in its esteem leads to a diminishing of around 0.249067 within the subordinate variable, "D(LEDU(-3))" and "D(LREN(-3))" showing coefficients of 1.314965.

Figure 10. Normality Test



As seen in Figure 10, the alternative hypothesis states that disturbances do not follow a normal distribution, whereas the null hypothesis asserts that disturbances follow a normal distribution. Considering that the probability value is bigger than 0.05 (0.887861), this lends credence to the adoption of the null hypothesis, which states that the disturbances are distributed according to a normal distribution.

Figure 11. CUSUM TEST

This study uses the CUSUM and CUSUMSQ methods to diagnose stability. If the blue lines in the CUSUM and CUSUMSQ plots fall within the bounds established by the two red lines at a 5% significance level, it means that the study parameters are stable, according to Tanizaki (1995). On the flip side, unstable study parameters are shown by blue lines that stray from the bounds. It appears that the stability tests were passed by the model utilized in this work, according to the results of the CUSUM and CUSUMQ tests. The blue line stays inside the red lines at the 5% significance level in both tests.

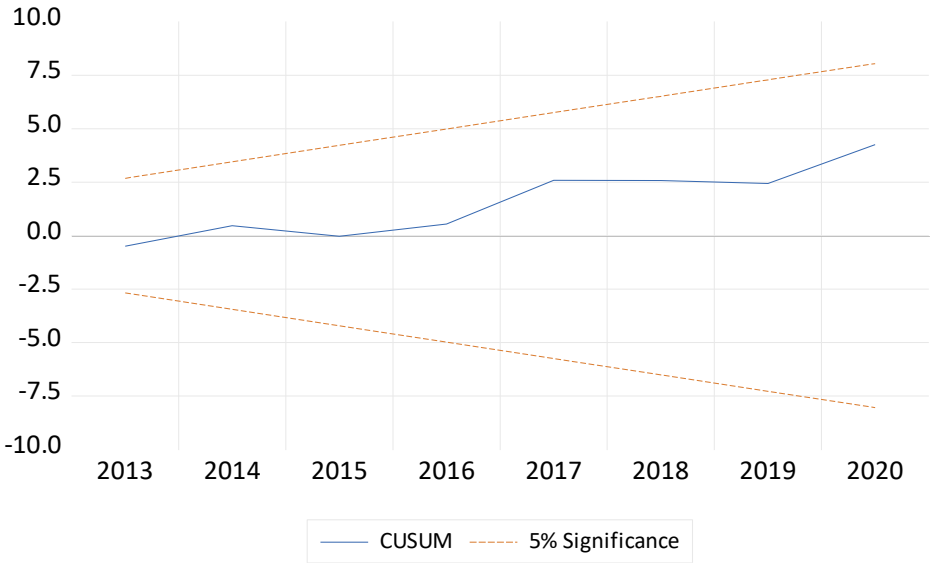
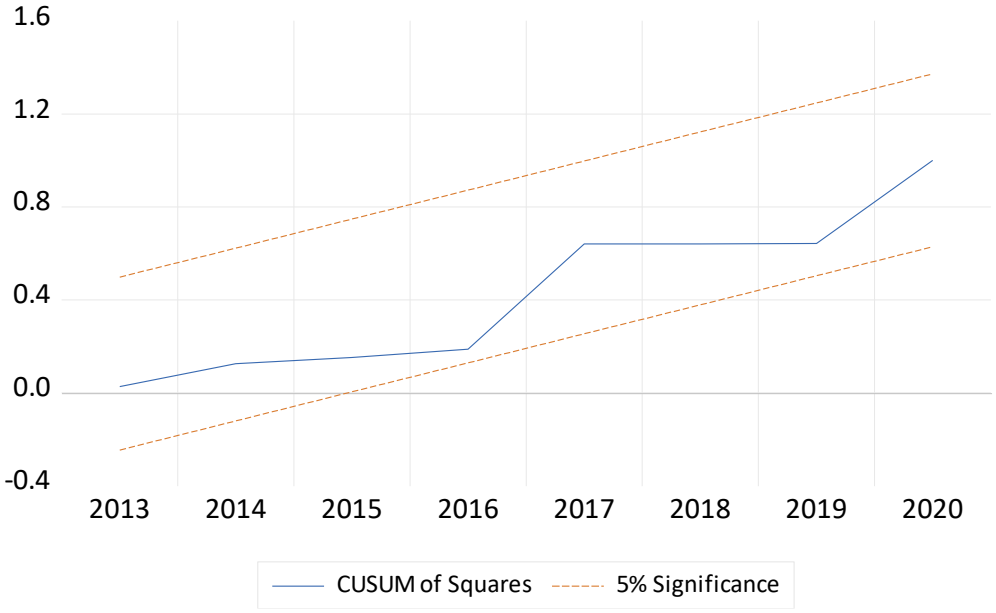


Figure 12. CUSUM OF SQUARE TEST



CHINA

Table 22. Descriptive Statistics

	LCO2	LGEN	LREN	LEDU
Mean	1.419973	4.204625	2.970077	24.55101
Median	1.496873	4.207867	2.858766	24.42785
Maximum	2.048485	4.291705	3.523710	26.28909
Minimum	0.649481	4.079214	2.428336	22.58034
Std. Dev.	0.505788	0.063913	0.417324	1.260778
Skewness	-0.091619	-0.147541	0.049085	-0.087201
Kurtosis	1.355393	1.628759	1.253387	1.652047

Both the mean value and the table that is shown above provide us with descriptive statistics of the variables that were used. The mean value provides us with the average values for each variable. When it comes to CO2, GEN, REN, and EDU, the mean deviations are as follows: 1.419973, 4.204625, 2.970077, and 24.55101 per cent, respectively. We are able to determine the value of each variable's midway by performing the calculation known as the median. On the other hand, the maximum and minimum values for each variable are the ones that display the highest and lowest values for that variable. With the use of the standard deviation, we are able to determine the degree to which the sample means differ from one another for each variable. When the value is zero, it implies that the skewness is usual. The values of kurtosis for CO2, GEN, REN, and EDU are 1.355393, 1.628759, 1.253387, and 1.652047, respectively, which indicate that the distribution is satisfactory across all variables. Kurtosis is a statistical metric that can be used to characterize the smoothness or thickness of the distribution of a series. There is a normal or mesokurtic distribution because the kurtosis values of 1.355393, 1.628759, 1.253387, and 1.652047 are all less than 3, which suggests that the distribution is normal. Since this is the case, we are able to assert that the CO2, GEN, REN, and EDU do not exhibit kurtosis. However, they mirror a normal distribution that is platykurtic, and platykurtic

implies that this series will have a lower value below its sample mean and is going to have a lot of values that are lower than 1.355393, 1.628759, 1.253387, and 1.652047.

Figure 13

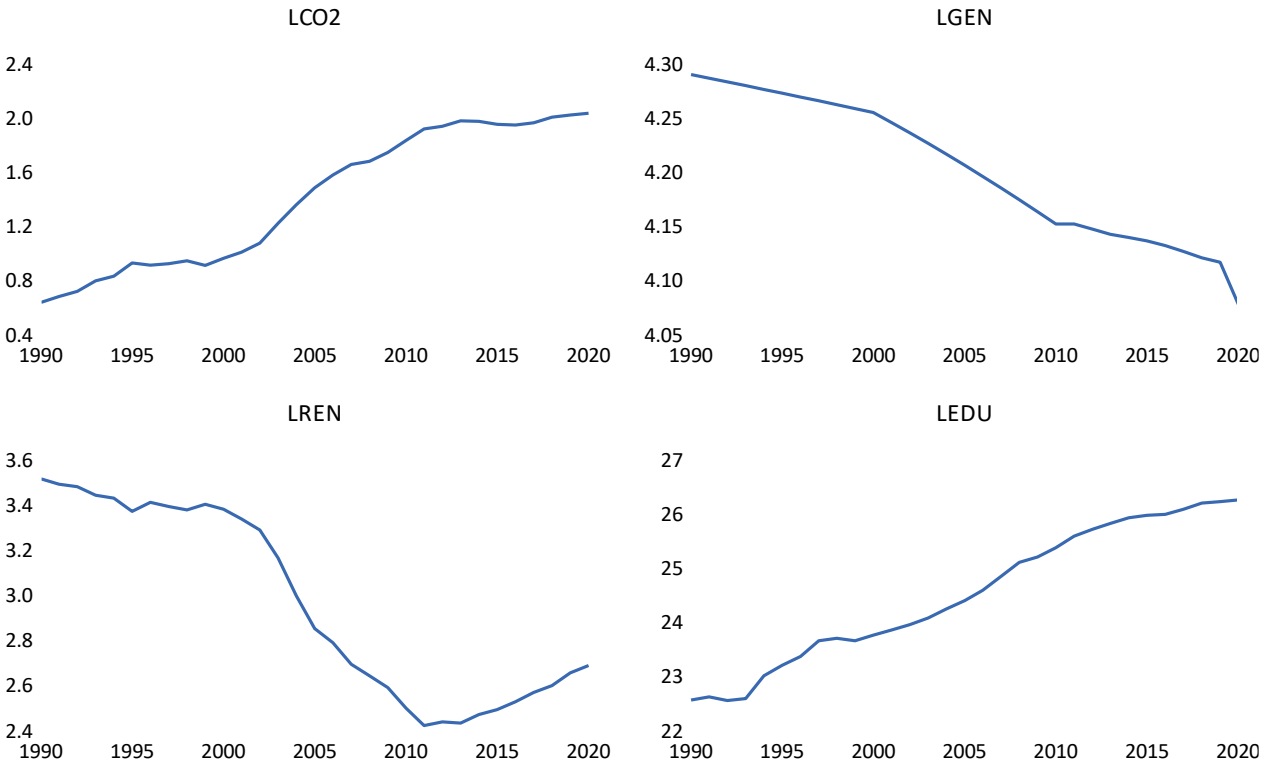


Figure 13 shows that CO2 is moving in an upward sloppy curve. There is a sloppy downhill flow for gender. While Renewable Energy has a sloppy download, there is an upward sloppy by 2010. There is a haphazard increase in spending on education.

Table 23. Unit root test results- China

variables	**ADF**	**RALS-ADF**	ρ^2
CO2	-0.56	-0.91	0.67
EDU	-0.13	-0.43	0.93
GEN	-1.38	-0.92	0.63
REN	-1.39	-1.98	0.89
ΔCO2	-2.61*	-3.78***	0.69

∆EDU	-2.60*	-3.08*	0.94
∆GEN	-2.66*	-3.17*	0.76
∆REN	-2.84*	-3.25*	0.97

Note that: ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. The 1%, 5%, and 10% critical values for the ADF are -3.58, -2.93 and -2.60 respectively. The 1%, 5%, and 10% critical values for the RALS-ADF are -3.75, -3.30 and -3.05 respectively.

Table 24. RALS cointegration test results- China

Methods	K	Test statistics	$\boldsymbol{\rho^2}$
EG	0	-3.98*	–
RALS-EG	0	-4.02*	0.81

Note: The symbols ***, **, and * represent the levels of significance at 1%, 5%, and 10% respectively. The variable K represents the optimal lag length determined through recursive statistics. The essential values at 1%, 5%, and 10% for the EG test are -5.02, -4.32, and -3.98 respectively. Similarly, the critical values at 1%, 5%, and 10% for the RALS-EG test are -4.80, -4.19, and -3.88 respectively.

In accordance with the outcome of the unit root test, which are presented in the table that is located above, all variables are integrated at level I(0) and initial differenciation accordingly. During the ARDL test, it was observed that all variables across the BRICS countries were integrated at first differences. This included the amount of CO2 emissions that China generated. The fact that distinct outcomes were achieved for each variable demonstrates that the variables were integrated at I(1), as demonstrated by this. As a result of the findings of the unit root test, which were carried out at a constant with a trend, the validity of the null hypothesis, which asserts that the series does not have a stationary level, is called into question.

Additional analysis of the unit root test carried out at the level of 5% significance indicates that the variables are stationary at the first difference level. This conclusion was reached after the test was utilized. As can be observed from the results of the unit root test, which are in agreement with the trend scenario, the variables are stationary

at first differences I(1) for the BRICS nations, which are comprised of South Africa, Brazil, Russia, India, and China. To add insult to injury, stationarity is demonstrated by a few variables at both the 5% and 10% significance levels.

The study comes to the conclusion that the series are not stationary, which means that the null hypothesis is shown to be incorrect. It also adds support to the counter-hypothesis that the series display stable behavior at the first difference level, as seen in the table above, at 5% and 10% significance levels. This is the case regardless of whether the significance level is 5% or 10%. This discovery, which offers a solid foundation for the subsequent ARDL modeling and cointegration analysis, ensures the reliability of the study's long and short term connection evaluations among the variables within the BRICS economies. These assessments were conducted in order to determine the relationships between the variables.

Table 25. Bounds Test

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	33.818113	10%	2.37	3.2
k		5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
			Finite Sample:	
Actual Sample Size	27		n=35	
		10%	2.618	3.532
		5%	3.164	4.194
		1%	4.428	5.816
			Finite Sample: n=30	
		10%	2.676	3.586
		5%	3.272	4.306
		1%	4.614	5.966

Table 26. ARDL long-run and short-run results

Variables	Coefficient	Std. Error	t-Statistic	Prob.
LGEN	-8.891632	1.112593	-7.991806	0.0000
LREN	-0.047648	0.072768	-0.654796	0.5310
LEDU	-0.033629	0.031743	-1.059404	0.3204
C	39.84890	5.233969	7.613515	0.0001

Table 27. Short Run ARDL Results

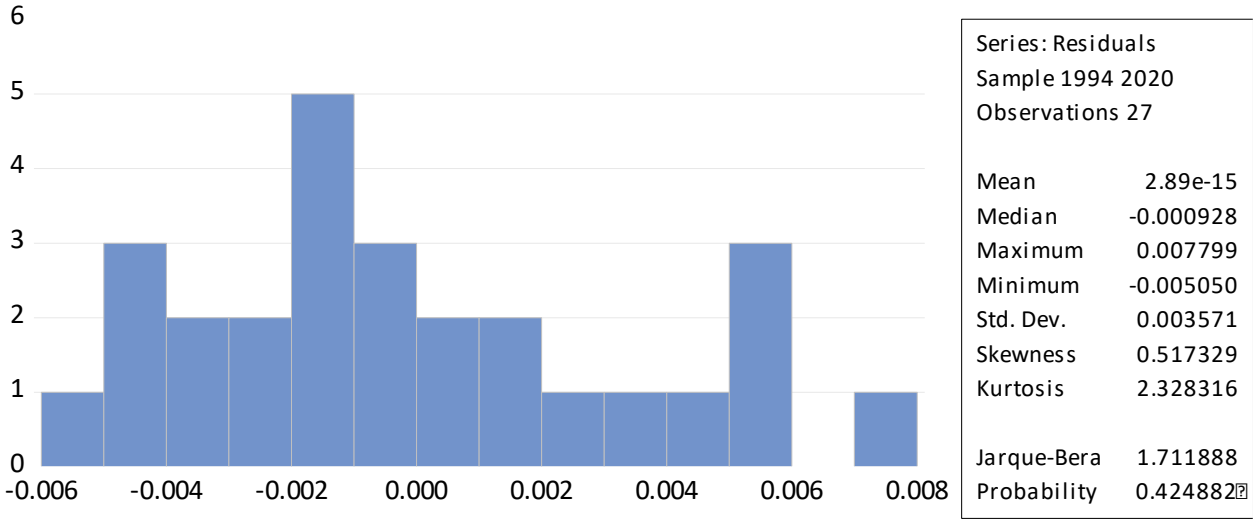
Variables	Coefficient	Std. Error	t-Statistic	Prob.
D(LGEN)	0.329693	0.403622	0.816835	0.4377
D(LGEN(-1))	-3.068925	1.362222	-2.252882	0.0543
D(LREN)	-0.557620	0.097175	-5.738280	0.0004
D(LREN(-1))	0.143583	0.144061	0.996679	0.3481
D(LEDU)	-0.059342	0.063227	-0.938549	0.3754
D(LEDU(-1))	0.141545	0.050296	2.814266	0.0227
CointEq(-1)*	0.017602	0.016525	1.065184	0.3179

NOTE: "***,**"denote significance at 1% and 5% accordingly, SC=Schwarz criterion, HQC = Hanna-Quinn criterion, AIC = Akaike info criterion, DW = Durban Watson.

The table presents the results of an ARDL analysis for long-run and short-run connections among the factors. The coefficient values for the factors within the long-run condition show the quality and course of their effect on the subordinate variable, with an increment in "LGEN" by 1 unit driving to an approximately -8.891632 decrement within the subordinate variable, an increment in "LEDU" by 1 unit being associated with a decrement of around -0.033629 within the subordinate variable, and an increment of 1 unit in "LREN" being linked to a decrement of almost -0.047648 within the subordinate variable. Within the short-run equation, the coefficients give an understanding of the quick alterations taken after a change within the free factors, with "COINTEQ01" having a coefficient of -0.337522, proposing a negative effect on the

subordinate variable within the brief term, the variable "D(LGEN)" having a coefficient of 0.249067, showing that a 1-unit change in its esteem leads to a diminishing of around 0.249067 within the subordinate variable, "D(LEDU(-3))" and "D(LREN(-3))" showing coefficients of 1.314965.

Figure 14. Normality Test



As shown in Fig 14, the null hypothesis states that disturbances are usually distributed, and the alternative hypothesis states that disturbances are not normally distributed. Since the probability value is more significant than 0.05, which is (0.424882), we accept our null hypothesis that the disturbances are normally distributed.

Figure 15. CUSUM AND CUSUMSQ

In order to diagnose stability, this study used the CUSUM and CUSUMSQ methodologies. According to Tanizaki (1995), if the blue lines in the CUSUM and CUSUMSQ plots fall within the confines provided by the 2 red lines at a significance level of 5%, this indicates that the research parameters are stable. This is the recommendation made by Tanizaki. On the other hand, blue lines that deviate from the boundaries are used to illustrate study parameters that are shown to be unstable. According to the results of the CUSUM and CUSUMQ tests, it would appear that the model that was utilized in this investigation was successful in passing the stability tests. Even when the significance level is set at 5%, the blue line in both tests remains inside the boundaries that are specified for the red lines.

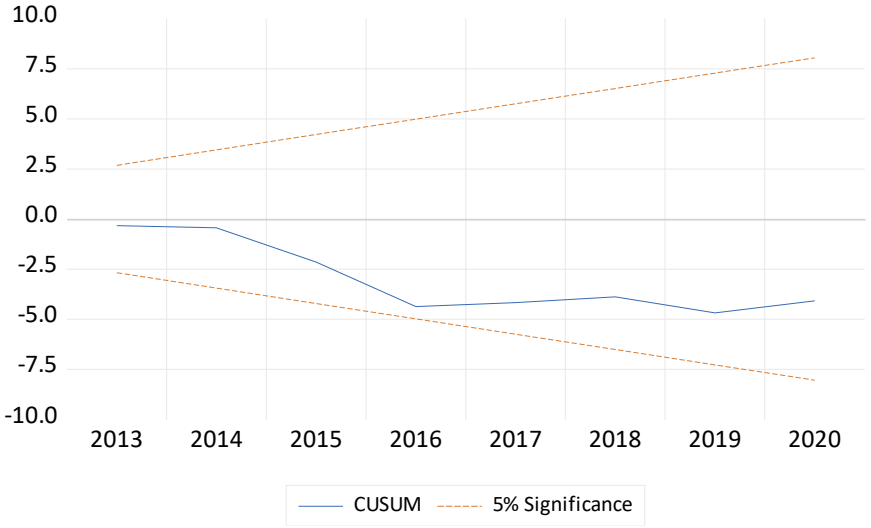
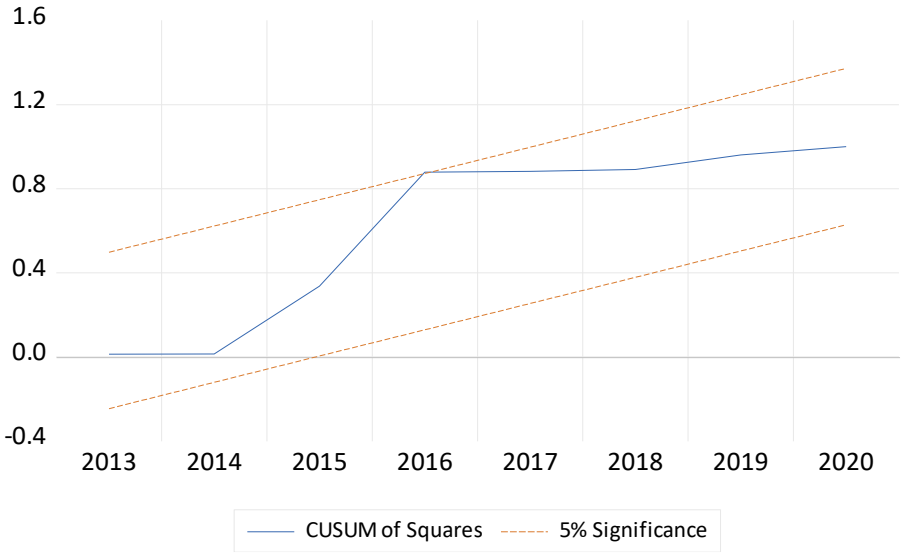


Figure 16. CUSUM OF SQUARE TEST



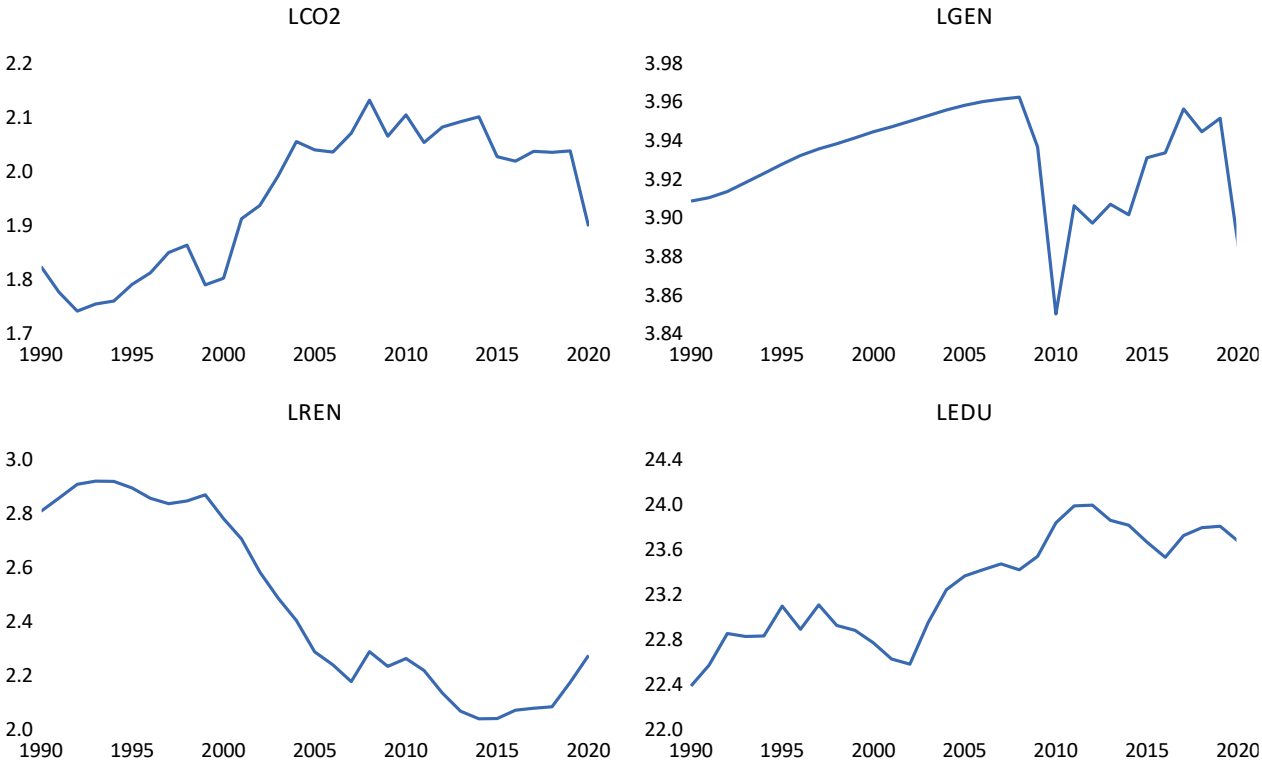
SOUTH AFRICA

Table 28. Descriptive Statistics

	LCO2	LGEN	LREN	LEDU
Mean	1.953349	3.930943	2.466438	23.28073
Median	2.020831	3.936228	2.292535	23.37250
Maximum	2.133770	3.962982	2.922624	24.00041
Minimum	1.743588	3.850764	2.043814	22.39624
Std. Dev.	0.128258	0.025915	0.335546	0.477737
Skewness	-0.325964	-1.044190	0.193030	-0.113883
Kurtosis	1.531374	4.092228	1.343970	1.709188

The table above displays the descriptive statistics of the variables utilized. The mean value offers insights into the average values of each variable. The average deviations for CO2, GEN, REN, and EDU are 1.953349, 3.930943, 2.466438, and 23.28073 correspondingly. The median indicates the value that precisely divides each of the variables into two equal halves. The maximum and minimum values, however, offer data regarding the uppermost and lowermost values for each variable. The standard deviation of each variable indicates the extent to which it differs from the sample mean. Conversely, the usual skewness value is zero (0). The variables CO2, GEN, REN, and EDU exhibit a negative distribution, as evidenced by their respective kurtosis values of 1.531374, 4.092228, 1.343970, and 1.709188. The kurtosis values of 1.531374, 4.092228, 1.34397, and 1.709188 are used to quantify the thickness or flatness of the distribution of the series. The kurtosis values are below 3, suggesting a normal or mesokurtic distribution. Nevertheless, the figures 1.531374, 4.092228, 1.343970, and 1.709188 surpass the threshold of 3. Platypustic refers to a series that exhibits values below its sample mean, with a significant percentage of values falling below these values. The CO2, GEN, REN, and EDU variables have a platykurtic distribution, which can be described as a normal distribution. This implies that the series will encompass a range of values that are lesser than the aforementioned values.

Figure 17



According to Fig. 17, CO2 is downward and sloppy; by 1998, it started fluctuating. For Gender, a slight line is moving towards the line, but by 2010, there is a downward sloppy; the same year, 2010, it experienced an upward sloppy and started fluctuating. For REN, there's a download sloppy; for Education, it's fluctuating.

Table 29. Unit root test - South Africa

variables	**ADF**	**RALS-ADF**	ρ^2
CO2	-1.37	-1.00	0.91
EDU	-1.56	-1.61	0.87
GEN	-2.60*	-5.06***	0.75
REN	-1.55	-1.13	0.97
ΔCO2	-4.74***	-4.67***	0.88

ΔEDU	-3.68***	-3.95***	0.89
ΔREN	-2.75*	-3.14*	0.94

The asterisks ***, **, and *, respectively, are used to indicate significance at the levels of 1%, 5%, and 10%, respectively. -3.58, -2.93, and -2.60 are the respective values for three percent, five percent, and ten percent of the African Development Fund (ADF). -3.75 is the critical value for the RALS-ADF, -3.30 is the critical value for the 5%, and -3.05 is the critical value for the 10%.

Table 30. RALS cointegration test results- South Africa

Methods	K	Test statistics	$\boldsymbol{\rho^2}$
EG	0	-4.26*	–
RALS-EG	0	-4.16*	0.90

Note:***, **, and * indicate the significance in 1%, 5% and 10%, respectively; K shows the optimum lag length found using recursive statistics; the 1%, 5% and 10% essential values for the EG test are -5.02, -4.32 and -3.98 respectively; the 1%, 5%, and 10% critical values for the RALS-EG test are -4.80, -4.19 and -3.88 respectively.

Based on the unit root test findings displayed in table 29 above, all variables are found to be integrated at level I(0) and require starting differences. The ARDL test results indicated that all variables related to the BRICS countries, including South Africa's level of CO2 emissions, were integrated at the first difference. The distinct outcomes obtained for each variable indicate that the variables were integrated at I(1), as evidenced by this. The unit root test, conducted under constant with a trend conditions, raises doubts about the validity of the null hypothesis that the series lacks a stationary level.

Further examination of the unit root test conducted at a significance threshold of 5% reveals that the variables show stationarity when differenced once. This conclusion was derived following the utilization of the test. The unit root test outcome indicate that the variables for the BRICS states are stationary at initial differences, denoted as I(1), which aligns with the trend scenario. Furthermore, stationarity is confirmed by a small number of variables at both the 5% and 10% significance thresholds, exacerbating the already negative situation.

The analysis concludes that the series are non-stationary, hence rejecting the null hypothesis. Furthermore, it provides evidence for the different hypothesis that the series exhibit consistent patterns when observed at the first difference level, as indicated in the aforementioned table, with statistical significance at both the 5% and 10% levels. This holds true irrespective of whether the significance level is set at 5% or 10%. This finding establishes a strong basis for the subsequent ARDL modeling and cointegration research, ensuring the dependability of the study's evaluations of long and short term connections among the variables inside the BRICS economies. The purpose of these assessments was to ascertain the correlations between the variables.

Table 31. Bounds Test

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	3.092943	10%	2.37	3.2
K	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
			Finite Sample: n=35	
Actual Sample Size	27			
		10%	2.618	3.532
		5%	3.164	4.194
		1%	4.428	5.816
			Finite Sample: n=30	
		10%	2.676	3.586
		5%	3.272	4.306
		1%	4.614	5.966

Table 32. ARDL long-run and short-run results

Variables	Coefficient	Std. Error	t-Statistic	Prob.
LGEN	-4.185753	3.713228	-1.127255	0.2800
LREN	-0.821277	0.486423	-1.688402	0.1152
LEDU	-0.259394	0.335148	-0.773970	0.4528
C	26.49078	22.95714	1.153923	0.2693

Table 33. Short-run results

Variables	Coefficient	Std. Error	t-Statistic	Prob.
D(LGEN)	0.193529	0.343287	0.563754	0.5795
D(LGEN(-1))	0.603680	0.347648	1.736469	0.0987
D(LREN)	-0.044535	0.130844	-0.340368	0.7373
D(LREN(-1))	-0.660788	0.135821	-4.865125	0.0001
D(LEDU)	0.099812	0.047956	2.081348	0.0512
CointEq(-1)*	-0.004165	0.007700	-0.540948	0.5948

NOTE THAT: "***,**" amount to significance at 1% and 5% accordingly, HQC = Hanna-Quinn criterion, AIC = Akaike info criterion, SC=Schwarz criterion, DW = Durban Watson.

The table presents the ARDL analysis results for long-run and short-run connections among the factors. The coefficient values for the factors within the long-run condition show the quality and course of their effect on the subordinate variable, with an increment in "LGEN" by 1 unit driving to an approximately -4.185753 decrement within the subordinate variable, an increment in "LEDU" by 1 unit being associated with an increment of around -0.259394 within the subordinate variable, and an increment of 1 unit in "LREN" being linked to a decrement of almost -0.821277 within the subordinate variable. Within the short-run equation, the coefficients give an understanding of the quick alterations taken after a change within the free factors, with "COINTEQ01" having a coefficient of -0.004165, proposing a negative effect on the subordinate variable within the brief term, the variable "D(LGEN)" having a coefficient of 0.193529, showing that a 1-unit change in its esteem leads to a

diminishing of around 0.5795 within the subordinate variable, "D(LEDU)" and "D(LREN)" showing coefficients of 0.099812 and -0.044535 respectively.

Figure 18. NORMALITY TEST

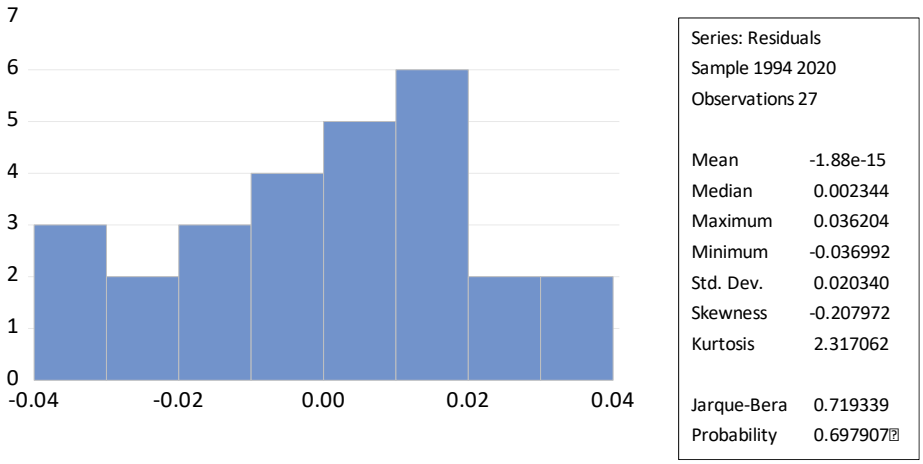


Figure 18 illustrates the two hypotheses that could be considered: one hypothesis asserts that disturbances follow a normal distribution, whereas the other hypothesis asserts that the opposite is true. In light of the fact that the probability value is more than 0.05 (0.697907), we are ready to do away with the null hypothesis suggesting that deviations obey a normal distribution.

Figure 19. CUSUM AND CUSUMSQ

To diagnose stability, this study employs the CUSUM and CUSUMSQ methodologies. According to Tanizaki (1995), when the blue lines in the CUSUM and CUSUMSQ plots meet the red lines at a 5% significance level, it indicates that the research parameters are stable. In contrast, lines in blue that extend beyond the borders indicate study parameters that are unstable. Results from the CUSUM and CUSUMQ stability tests indicate that the model used in this study was stable. Assuming a significance level of 5%, the blue line in both tests remains contained inside the red lines.

CUSUM TEST

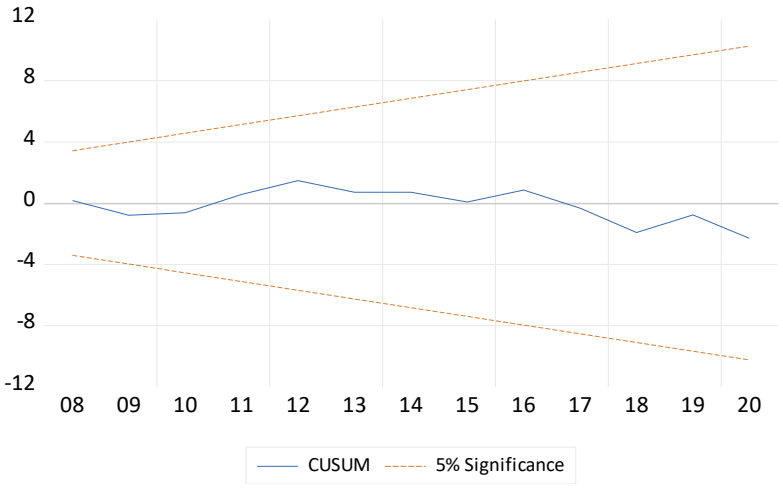
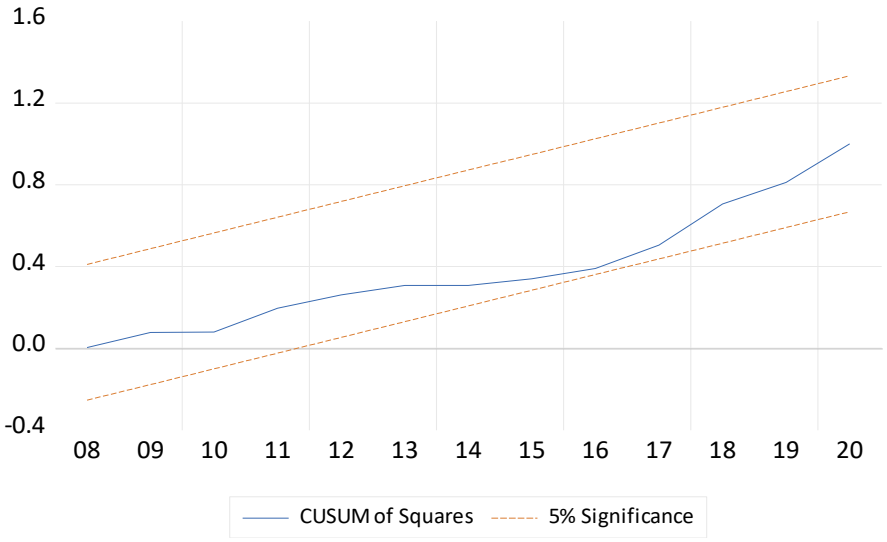


Figure 20. CUSUM OF SQUARE TEST



7.1: Discussion

The long-term dynamics in BRICS economies unveil a noteworthy relationship: Gender equality (GE), education expenditure (EU), and renewable energy resources from nature contribute positively to lower CO2 releases. As more people are treated fairly, spend money on learning, and use renewable energy sources, CO2 air pollution levels will increase over time. Looking at the short-run numbers for "COINTEQ01," "D(LGEN)," "D(LEDU(-3))," and "D(LREN(-3))" gives very important information about how quickly changes in these factors affect CO2 emissions. This complex mix shows that we need careful actions in policy, finding a tricky middle ground between goals for the environment and socio-economic development, specifically with BRICS.

Spending more money on education in the country will significantly help reduce environmental damage. As more people learn about environmental problems, it will help find ways to reduce CO2 release. So, we need to spend more on education so people know about environmental issues. This will also help in cutting down CO2 pollution over time. This solves the first issue of the study. This investigation finding match other investigations showing that more education can help cutback emissions of CO2 in the environment (Monroe et al., 2019; Anderson, 2013).

More women in high positions like a board of directors or CEO will help make rules that are friendly to the Earth and push ways that are good for the environment to limit how much GHG we release. The 2019 World Economic Forum report says that women make up only 7.9% of board directors for public companies in China (Raport, 2020). This outcome answers the second question in the study. So, getting more women involved in making decisions will help cutback emissions of CO2 because they care a lot about saving the environment.

Using REN sources leads to less emissions of CO2, according to long-term data from the ARDL model. There is a strong correlation at the1%,5%, and 10% significance levels between emissions of CO2 and the use of REN sources.

Therefore, the conclusion that can be derived from this is that it is possible to achieve a cutback in emissions of CO2 by raising the amount of REN sources to the overall quantity of energy that is utilized.

There will be an increase in the amount of pollutants that have characteristics of greenhouse gases, like CO2, if these sources contribute less to our infinite consumption. According to the findings of a study that focused on the BRICS states (Dong et al., 2017), the growing utilization of REN sources is one factor that contributes to the reduction of CO2 emissions. According to a number of studies (Waheed et al., 2018; Zhang et al., 2017), the utilization of REN sources makes a contribution to the cleanliness of the environment and reduces the amount of CO2 pollution. In accordance with the findings of these studies, the amount of carbon dioxide (CO2) that is discharged into the atmosphere is decreased when a greater proportion of renewable energy is utilized as the ultimate source of energy. The outcomes of this study are consistent with these investigations. It is demonstrated that a reduction in emissions of CO2 can be accomplished by expanding the usage of renewable energy sources rather than other possibilities, which is the third topic that is addressed in the study.

Brazil

The challenge of- formulating policies that are effective is brought into focus by this comprehensive perspective on the interdependencies that exist between socio-economic elements and CO2 emissions. Recognizing that a one-size-fits-all strategy would not be adequate, it asks for initiatives in Brazil that are context-specific and customized to the specific circumstances of the country. Through this conversation, the necessity of achieving a balance between environmental and developmental objectives is brought to light, as is the significance of making strategic investments in educational institutions. Furthermore, it urges for a decisive shift towards renewable energy sources as a crucial component of attaining sustainable growth in the country. This point is emphasized throughout the document. The discussion, in its essence, places an emphasis on the delicate equilibrium that must be maintained in the process of policymaking in order to effectively harmonize economic expansion with environmental protection within the specific socio-economic framework of Brazil.

RUSSIA

The results of the investigation into the socio-economic aspects and CO2 emissions in Russia add an additional layer of complexity to the correlations that were anticipated on the basis of the findings. The unexpected findings about gender equality and

renewable energy bring into question the common assumptions that have been made, despite the fact that the connection between education expenditure and reduced CO2 emissions is in line with what was anticipated.

Given these results, it is clear that it is of utmost importance to formulate policies that are specifically tailored to the extraordinary conditions that exist in Russia. The unexpected findings underscore the necessity for techniques that take into consideration the specific subtleties of the Russian setting. This is in contrast to the adoption of broad and universal strategies. The complications that are involved with gender equality and renewable energy suggest that a policy response that is more targeted and nuanced is required.

INDIA

The findings suggest that putting more focus and resources into programs in India that are related to renewable energy has the potential to result in considerable reductions in the amount of carbon dioxide emissions into the atmosphere. Consequently, this suggests that a transition towards energy sources that are sustainable and friendly to the environment can make a significant contribution to efforts to save the environment. In addition, the findings shed insight on the intrinsic complexities that are characteristic of the relationships that exist between socio-economic determinants and environmental effects. The linkages that have been identified are complex, which suggests that a number of different elements interacting with one another are responsible for determining the environmental impact of socio-economic activity. When it comes to designing policies that are relevant to sustainable development in India, this intricacy highlights how important it is to take into consideration many elements and the intricate interactions between individuals.

CHINA

The findings of the study shed light on a connection that is both obvious and significant between the decrease of CO2 emissions in China and the promotion of gender equality. Specifically, there is a discernible reduction in carbon emissions that occurs in tandem with the advancement of gender equality. The implication of this is that fostering equitable involvement and inclusivity in society, particularly with regard to gender,

can play a significant part in the process of making decisions and engaging in actions that are ecologically sensitive.

On the other hand, the conclusions are not as conclusive when it comes to the correlations between education expenditures and renewable energy sources. It has been discovered that there is a negative correlation between the utilization of renewable energy sources and the emission of carbon dioxide, which suggests that relying more on renewable energy sources is connected with lower levels of carbon emissions. The fact that this association does not have statistical significance, on the other hand, indicates that the evidence for this connection is not very strong based on the study that is currently being conducted. In a similar vein, it has been hypothesized that increases in education spending have a negative influence on carbon dioxide emissions. This suggests that higher investment in education could potentially lead to a reduction in carbon emissions. On the other hand, the statistical significance of this link is called into question, which indicates that there is uncertainty over the model's capacity to accurately reflect the actual impact.

SOUTH AFRICA

The implications of these findings for the linkages between gender equality, renewable energy, education expenditures, and carbon dioxide emissions are not only curious but also fascinating. The unanticipated negative link with gender equality calls for additional investigation, whereas the anticipated negative relationships with renewable energy and education expenditure are in line with the overarching objectives of environmental sustainability. The absence of statistical significance stresses the importance of exercising caution when reaching conclusive conclusions and draws attention to the complexity of the interactions between these variables.

In conclusion, out of the countries discussed, Brazil stands out for its significant advancements in gender equality, renewable energy, and educational expenditures. The correlation between gender equality and the utilization of renewable energy sources is in line with the objective of reducing CO2 emissions. Furthermore, the unexpected correlation between investment in education and the release of CO2 emissions may imply the need to prioritize education as a means of tackling environmental concerns.

Although every country exhibits a distinct combination of outcomes, Brazil is notable for its favorable connections with crucial parameters that contribute to reduced CO2 emissions. Brazil's position as a prominent contender for sustainable development policies that effectively reconcile environmental and socio-economic objectives within the BRICS economies is significant.

CHAPTER VIII

CONCLUSION AND RECOMMENDATION

Extensive research was done to understand the intricate linkage of various socio-economic factors and their effects on environmental conservation. It involved analyzing the impact of gender equality in decision-making roles, renewable energy, and education expenditure on emission of CO2 in the BRICS states.

Secondary time series data spanning three decades since 1990 supported the inquiry. The inquiry was supported by a thorough analysis of secondary time series data covering three decades from 1990 to 2020. The chosen timeline was deliberately selected to cover a wide range of time to see the changing dynamics of the studied variables and their influence on emissions of CO2 in the middle of substantial global and regional economic, social, and environmental transformations.

The research highlighted the importance of each variable to CO2 emissions. The study examined the impact of women in environmental and energy sector governance to understand gender equality. REN was investigated as a crucial component in lowering emissions of CO2, while the expenditure on education was analyzed to evaluate its contribution to increasing environmental awareness and sustainable practices.

Consistent with previous research, this study made extensive use of econometric models and tests. The ARDL Bound Test, the ECM, the CUSUM, and the CUSUMSQ tests were among the tests that were included in this category. These qualities were extremely important for both the analysis and the comprehension of the short and long term relationships that existed between the variables. In order to determine whether or not the data were stationary, the first phase in the methodology of the investigation began with the execution of a unit root test analysis. In order for the ARDL model to function properly, this stage was necessary.

8.1: Finding

The study revealed a linkage between CO2 emissions and gender-related issues in certain countries. This points out gender disparities in total energy consumption and contribution to GW, leading to more atmospheric carbon dioxide. Differences in employment, household chores distribution, and culture lead men to produce more

carbon dioxide than women. The results reveal the need for policy interventions and strategies addressing the gender dimension of climate mitigation. According to the study, the decrease in emission of co2 is ascertained due to the implementation of RE deployment. It shows us that nations with a high percentage share of renewables in their energy composition tend to have fewer CO2's. The results point out that in fighting against the menace, transitioning to renewable sources should be the primary approach. Hence, the study reveals a link between education expenditure and CO2 emissions reduction. It shows that nations that invest more in education are able to allocate resources more effectively, which ultimately results in a greater awareness and comprehension of environmental challenges, including climate change.

Consequently, these countries exhibit lower per capita CO2 emissions. The findings underscore the need for governments to prioritize education and awareness campaigns on sustainable development and environmental conservation. The research demonstrates differences in how the male-female, green energy, education costs, and carbon dioxide components interact depending on the nation or region. The study indicated that some countries are far ahead regarding their performance in carbon dioxide emission reduction, gender equality, renewable energy deployment, and education. This is due to different frames of policies, the institutional capacity, and various socio-economic attributes. Therefore, the results show what particular problems exist in each country regarding climatic change. This revealed that addressing gender and women's concerns is critical in climate change interventions. Policymakers must focus on closing the gap between men and women regarding energy access, jobs, and decision-making for the enhanced success of their climate policy projects and programs. It involves, among others, boosting the involvement of female folk in the REN industry, facilitating shared provision of education and training opportunities, and undertaking gender-specific studies on the effect of climate change. This may underline the need to raise the move towards cleaner energy sources. The study's insights on education expenditure and CO2 emissions reduction emphasize the long-term benefits of investing in education for sustainable development. Governments will prioritize integrating climate change and environmental education into school curricula, promoting vocational training in green sectors, and fostering public awareness campaigns. This agrees with findings from a study conducted by Qamar uz Zaman, Zilong Wang et al.

In this investigtion of the economics of the BRICS states, some of the major topics that are discussed are gender, renewable energy, educational expenditures, and carbon dioxide emissions. Using an advanced panel data model encompassing 1998 to 2020, we have successfully uncovered profound insights of utmost importance for formulating sustainable policies and promoting global environmental stewardship.

Based on the Fisher Panel Cointegration framework, the study's comprehensive examination has shown the intricate network connections interconnecting these variables. Throughout our exploration of cross-sectional dependence evaluations, unit root tests, and cointegration studies, we have thoroughly understood the interaction between gender, ren, education expenditure, and emissions of CO2 across different economies and throughout time.

The results of these efforts suggest a comprehensive set of recommendations that go beyond mere theoretical speculation. The recommendations presented in this study are based on ARDL's long-run and short-run analyses. These recommendations offer practical strategies for effectively utilizing gender-responsive policies, integrating renewable energy, improving education, fostering cross-regional cooperation, and promoting REN empowerment.

The acknowledgment of gender as a catalyst and recipient of sustainable practices, along with the factual verification of the crucial function of REN in reducing CO2 emissions, establishes a basis for a future characterized by heightened environmental awareness. Education plays a pivotal role in facilitating this process, as it cultivates the ability to make well-informed choices and promotes the development of a sustainable mindset within society. The prospects of cross-BRICS alliances underscore the potential for concerted action to address shared environmental concerns effectively.

Upon contemplation of the insights derived from this study, it becomes evident that the process from gathering data to implementing models highlights the interdisciplinary character of our undertaking. This endeavor surpasses limitations as it encompasses the fields of environmental science, gender studies, RENdynamics, and educational factors. By adopting an interdisciplinary approach, we have enhanced our comprehension of the intricate and subtle connections that influence the dynamics of our global environment.

In addition to providing an outlet for intellectual discourse, the findings of this investigation have the potential to shape policy, transform societal frameworks, and foster sustainable, ecologically aware development. When considering the BRICS context, it is essential to analyze factors such as gender, renewable energy, education expenditure, and greenhouse gas emissions. By evaluating these aspects, a comprehensive understanding of potential results can be obtained, as each element has a significant part in shaping a more promising future. The comprehensive examination of the panel dataset spanning from 1998 to 2020 has provided valuable insights, shedding light on our trajectory and offering guidance toward a collective aspiration of transforming sustainable development from an abstract notion into a tangible existence.

8.2: Policy Recommendation

The extensive analysis and subsequent findings of this investigation give useful perception that can guide policy decisions regarding the effect of gender, REN, and education investment on emissions of CO2 in the economies of the BRICS nations. These findings should be taken into consideration when making policy decisions. Prioritizing REN integration should be considered paramount and warrants primary attention. Understanding the importance of their relationship is vital to effectively utilize the association between REN sources and carbon dioxide emissions reduction. Policies must be robust and enforced to promote and facilitate REN sources in the economies of the BRICS nations. These methods help streamline policy-making on relevant matters. These methods enable the facilitation of policy on such issues.

Secondly, it is imperative to emphasize the importance of promoting climate strategies inclusive of gender considerations. This entails recognizing the interconnectedness between gender dynamics and carbon emissions and advocating for policymakers to develop climate policies responsive to gender concerns. Such policies should aim to facilitate equal involvement of women in REN initiatives and decision-making processes related to the environment.

Thirdly, it is imperative to raise investment in education for sustainability. This is supported by the strong association between education expenditure and decreased carbon emissions, highlighting the necessity of allocating resources towards enhancing environmental education initiatives that promote awareness of climate

change, comprehension of renewable energy (REN), and implementation of sustainable lifestyles.

In addition, it is advisable to promote Cross-BRICS Collaboration, which entails utilizing collective discoveries within BRICS nations to tackle shared environmental issues through collaborative technology transfer, knowledge sharing and joint research initiatives. This approach enhances the effectiveness of individual sustainability endeavors.

Furthermore, executing policies that promote the empowerment of REN is of utmost importance. The presence of causal links highlights the necessity of implementing focused strategies to foster the development of the REN sector. These strategies aim to expedite the advancement of REN by implementing more efficient legislation, attracting private investments, and making significant progress in research and development.

Lastly, the importance of Continuous Monitoring and Reporting cannot be overstated, as it is crucial to establish robust monitoring and reporting systems to evaluate gender representation, REN adoption rates, and education expenditure allocation. These mechanisms are essential for maximizing policy interventions' impact and promoting effectiveness and adaptability. The study yields a profound understanding of complex correlations linking gender, renewable energy, educational expenditure, and emissions of CO2 within the economies of the BRICS states. Governments and stakeholders can accomplish their shared sustainable development goals by following these guidelines. By implementing this approach, we can lessen the detrimental consequences of climate change, promote economic growth, provide practical decision-making tools, and create a cleaner and more robust future. The interaction of these variables offers potential avenues for policy intervention and interdisciplinary cooperation in tackling global concerns at a regional level.

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THE IMPACT OF GENDER, RENEWABLE ENERGY, AND EDUCATION EXPENDITURE ON CO2 EMISSIONS: EVIDENCE FROM BRICS ECONOMIES

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APPENDICES

NEAR EAST UNIVERSITY

SCIENTIFIC RESEARCH ETHICS COMMITTEE

09.10.2023

Dear Ayantayo Rukayat Olaide

Your project **"The Impact of Gender, Renewable Energy, and Education Expenditure on CO2 Emissions"** has been evaluated. Since only secondary data will be used, the project does not need to go through the ethics committee. You can start your research on the condition that you will use only secondary data.

Prof. Dr. Aşkın KİRAZ

The Coordinator of the Scientific Research Ethics Committee