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The Role of Education and Innovation in Renewable Energy Consumption in OECD and BRICS Countries

Rola edukacji i innowacji w promocji energii odnawialnej w krajach OECD i BRICS

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Abstract
Extreme climatic catastrophes and increasing emission levels demonstrate that humanity and nature are in confrontation. In this situation, the responsibility falls on intellectuals who engage in critical thinking, research, and innovation, propose solutions to problems, and bring society together to pursue a common goal. The present study assesses the role of education and Innovation in climate change mitigation in OECD and BRICS countries, where the use of renewable energy and decreasing the use of non-renewable energy are considered climate change mitigation strategies. The GMM approach is used to test the empirical model. The results indicate that increasing education and innovation levels in OECD and BRICS countries positively impact renewable energy consumption. However, the role of education and innovation in reducing the use of non-renewable energy consumption in the BRICS is insignificant, while in OECD countries, it is found significant. Thus, this study recommends that environmental education and green innovation be the focus to get sustainable development.

Key words: renewable energy, non-renewable energy, sustainable development, mitigation, intellectual human capital, OECD, BRICS

Streszczenie
Ekstremalne katastrofy klimatyczne i rosnące poziomy emisji zanieczyszczeń pokazują, że ludzkość i natura są w stanie konfrontacji. W tej sytuacji odpowiedzialność spada na intelektualistów, którzy angażują się w krytyczne myślenie, badania i innowacje, proponują rozwiązania problemów i jednoczą społeczeństwo w dążeniu do wspólnego celu. Niniejsze badanie ocenia rolę edukacji i innowacji w łagodzeniu zmian klimatu w krajach OECD i BRICS, gdzie wykorzystanie energii odnawialnej i zmniejszenie wykorzystania energii nieodnawialnej są uważane za strategie łagodzenia zmian klimatycznych. Do testowania modelu empirycznego zastosowano podejście GMM. Wyniki wskazują, że rosnący poziom edukacji i innowacyjności w krajach OECD i BRICS pozytywnie wpływa na zużycie energii odnawialnej. Jednak rola edukacji i innowacji w ograniczaniu zużycia energii nieodnawialnej w krajach BRICS jest znikoma, podczas gdy w krajach OECD jest uznawana za znaczącą. W związku

z tym niniejsze badanie zaleca, aby edukacja środowiskowa i zielone innowacje były głównym celem osiągnięcia zrównoważonego rozwoju.

Słowa kluczowe: energia odnawialna, energia nieodnawialna, zrównoważony rozwój, mitygacja, intelektualny kapitał ludzki, OECD, BRICS

1. Introduction

Climate change, catastrophic weather events, habitat devastation, species extinction, crop failure, deforestation, wildfires, drought, polar ice melting, increasing sea levels, flooding, and environmental refugees indicate that humanity and nature are at war. Climate change is one of the most serious threats that humanity has ever faced, and it is also one of the most pressing issues. Understanding the role of intellectuals can help to alleviate the growing threat of climate change. Intellectuals participate in critical thought, investigation, and contemplation about societal realities and suggest answers to societal problems (Amburn, 2009; Wolfe, 2018). To be regarded as an intellectual, a scientist, historian, philosopher, writer, or artist must be involved and engaged with the important realities of the present world, as well as participate in societal public affairs (Jennings et al., 2013; Marques et al., 2015). As a result, being labelled as an intellectual is defined by the degree of impact of the designator's motives, viewpoints, and alternatives for action and the ability to relate scholarly research to the practical considerations of fixing social problems. Intellectuals are those who turn a group of individuals into a nation and unite them behind a common goal (Chomsky, 2015; Taylor & Gutmann, 1997).

Today, economic victory is more important than conquering a piece of land. The ambition to take overall economic activity brought humanity to the verge of heartlessness. Humans want success at the cost of nature. Now humans are campaigners against circumjacent confrontation. Humans wish to surpass every barrier that comes in the way of their success. humans are cutting the tonnes of trees that have a long process to grow. Humans have no care for wildlife habitats and pollute the air with industries. Firstly, man creates a need and wakes the aspirations of people, then deludes the society into that they are selling satisfaction for their souls. This world is paying a high price in the form of floods, earthquakes, starvation, and ailments due to smog (Abas et al., 2017; Seo, 2019). In this situation, the intellectuals of society have to bear the burden of educating the people about the perils of new warfare as they have been making the opinions of society about war loss and gain and pros and cons (Livi-Bacci, 2021). Thus, in the contest between man and nature, human's defeat is written on the wall, but he is now in denial like Don Quixote (quiet or a daydreamer), happy in his thoughts of success. Many intellectuals undertook to educate people about global warming and pollution in western and developed countries. Intellectuals of oriental countries are far behind. There are some hurdles in their ways as political and economic conditions. They want to progress and argue that these countries have not polluted the environment in the past. Now, give them some leverage to grow on the cost of environmental and sustainable development (Nathaniel & Khan 2020).

The increasing industrialization and jobs are created at the cost of greenery and the destruction of biodiversity (Woldoff & Litchfield, 2021). To prevent pollution industries, firms take safety measures that cause enhancement in production costs. Developing countries are usually price-sensitive markets, and consumers cannot afford these expensive products. Furthermore, restlessness, poverty, and oppressed people in this tripartite create an ambience of agony. Developing countries have problems of unemployment, poor health facilities, scarce food and inadequate infrastructure. These problems did not let him even think about climate and sustainability challenges and perceive their seriousness. Each day of his life is like a cross sword with these necessities. People of these countries face gigantic problems such as lawlessness, terrorism, poor judicial systems. Thus, the intellectuals of these countries are solving these problems and are less concerned about climate change and sustainability (Leal Filho et al., 2019).

Life is full of motivation; humans are ambitious by design and it is a lifelong process. It gives him the strength to live life on his own terms, but it is right that excess of something is wrong. So, modern human shares different equations with our environment. Ambition has a direct proportion to emissions in our atmosphere. Maybe it sounds strange, but it can be proven by an argument of self-interested consumers and producers. The inhabitants of the modern world are too curious and want to know everything, thus they read books, newspapers, etc. These all come from trees and humans are not serious about growing trees. He wants lavish living, some uniqueness in his life. More factories come into being and share their part in the process of emission. Inmates of the present-day world are too ambitious for their cladding. Wishing to astonish others by their appearance provokes them to make something different, increasing the demand for clothes, shoes, and household items. Society's consumption and production of goods and services determine sustainable development and there is need to give attention to consumption. However, ample attention has been devoted in recent years to distilling current understanding of production-oriented improvements (Bengtsso et al., 2018; Gupta and Vastag, 2020).

Effective environmental governance is assumed to impact the Renewable energy consumption in both positive and negative manner (lyulyov,2021; Asongu, 2021). There are various strands of politics in political governance

which are linked with the certain choices of government. The pro-environment government may be more interested and inclined towards policies to boost renewable energy consumption and sustainable development, whereas the liberal capitalist government may not be eco-friendly but rather prioritise wealth generation (Mahmood, 2021). Policies regarding energy consumption from nonrenewable resources have dire consequences regarding environment and lead to higher levels of pollution and compromise intergenerational sustainability. Government initiates for climate combat through various policies such as environmental tax that can control the behavior of both consumers and producers, can play important role in discouraging ecologically harmful activities. (Baloch ,2021; Nawaz, 2021). Moreover, increased governance quality leads to inflow of green investment in the economy and budling renewable energy plants (Adedoyin, 2020). On the contrary, some studies suggest that strict government regulations in the energy sector led to an outflow of green investments, which limit the extension of renewable energy and compromises sustainable development (Boute, 2020).

GDP per capita and renewable energy consumption is evident to have a bidirectional effect (Ahmed, 2019; Matei, 2017). Renewable energy consumption is a stronger driver of growth than nonrenewable energy consumption (Awodumi, 2020; Abbasi, 2020). According to the hypothesis of Environmental Kuznets Curve (EKC), the increase in GDP per capita tends to increase the environmental degradation but in the long run environmental deterioration decreases as economy grows further (Sadorsky, 2009). A higher real GDP per capita moves the economy towards more sustainable options like renewable energy consumption. The argument is supplemented with the fact that renewable energy consumption offers efficient solutions to the problem of climate change, energy insecurity and sustainable development. Moreover, emerging economies seem to increase renewable energy consumption in the wake of energy security (Peng, 2021). Most of the studies associate international trade to investment in renewable energy programs.

Global socio-economic growth, urbanization, and population growth have led to resource exploitation and waste, increased pollution, increased food, water and energy insecurity (Avtar, 2019). Urbanization is associated with industrialization, complex infrastructure development, technological innovation and population concentration, which increases the demand for energy in both renewable and nonrenewable sources, especially in middle-income and high-income economies (O'Neill, 2012). The Industrialized countries require more efficiency in energy usage with large population, need for better infrastructure and transportation accompanied with resource availability and more capital investment than the agriculture economies. on the other hand, such infrastructure development and high energy demand in an urbanized economy may create energy wastage by traffic congestion and lack of electricity by unawareness.

This study tries to figure out the role of education and innovation in society's betterment in terms of environmental sustainability and mitigation actions. This study has taken the use of renewable energy and decreasing non-renewable energy use as a climate change mitigation strategy. This study groups the countries into OECD and BRICS countries. The purpose is meanly due to the difference in the carbon policy and approach toward climate mitigation in OECD and BRICS countries. For example, first BRICS nations frequently used their G20 influence the group on issues like climate change, energy efficiency, environmental benchmarking, and energy security. Since the group's foundation, the BRICS summits have also made several long-term climate change commitments (Larionova and Kirton, 2018). Second, the OECD is estimated to lose 0.2 per cent of GDP in 2030 and 1.1 percent in 2050 if a straight carbon tax policy is implemented, whereas Brazil, Russia, India, China and South Africa (BRICS) will lose five times as much. The OECD has been concentrating its efforts on identifying measures that could assist break the political impasse. Based on international best practices and experiences. The OECD has recognized a number of burden-sharing schemes. An emission trading permit scheme appears to be acceptable to many nations by establishing multiple emission targets and allocating emission licenses differently.

On the other hand, the BRICS countries have not been able to define such a framework. The widespread acceptance of renewable energy (RE) use requires technological advancements that enable increased production and lower unit costs of major RE energy types such as solar and wind (see e.g., Cheon and Urpelainen 2012; Bayer, Dolan, and Urpelainen 2013; Hestres, & Hopke, 2020). Given the level of innovation required in RE production, several countries have traditionally been the primary producers of RE technology advancements (Awerbuch and Sauter 2006).

2. Research Method and Data

This study uses the Generalized Method of Moments (GMM) approach due to the problem of endogeneity. GMM, proposed by Hansen (1982), is a statistical technique that is most widely used to estimate economic data. The method combines the economic data with population moment to generate estimates for the unknown parameters while excluding unnecessary and unwanted assumptions. GMM method is used to remove the problem of endogeneity. It has various optimum properties such as efficiency, consistency and asymptotical normality. GMM builds a two-step estimation technique with the assumption of residual terms being independent but not identically distributed. With this assumption, we must be sure that the instruments used in the model fulfil the orthogonality

conditions. The instruments are uncorrelated with residual terms. The two main estimators that the GMM technique employs are known as difference GMM and System GMM, proposed by Arellano and Bond (1991) and the Arellano-Bover (1995), respectively. The former estimator uses differenced observations, while the later uses both the original and differenced observations in the instrument matrices.

For the GMM method, in order for the estimators to be precisely identified, the number of instruments must be equal to the number of parameters. If the instruments are over-identified, the number of instruments is greater than the number of parameters, then GMM efficiently combines the moment condition. To test the overidentification, the J-Statistics proposed by Hansen (1982) is applied which is used for the misspecified models. In a well specified overidentified model, the J-statistics performs like chi-square with the number of overidentifying restrictions equal to the degrees of freedom.

The present study estimates equation (1) and (2) by applying the GMM approach. In equation 1, we have taken renewable energy as a dependent variable; education and innovation, GDP per capita, Government effectiveness, population and non-renewable energy consumption as independent variables.

$$lnRE = \gamma_i + \beta_1 \ln EI_{it} + \beta_5 \ln \mathrm{GPC}_{it} + \beta_2 GE_{it} + \beta_3 \ln \mathrm{POP}_{it} + \beta_4 \ln \mathrm{NRE}_{it} + \mu_{it} \quad (1)$$

and

$$lnPE = \gamma_i + \beta_1 \ln EI_{it} + + \beta_4 \ln \mathrm{GPC}_{it} + \beta_2 GE_{it} + \beta_3 \ln \mathrm{POPG}_{it} + \mu_{it} \quad (2)$$

where RE is renewable energy consumption, EI is education and innovation, POP is population, PE is primary non-renewable Energy Consumption, GPC is GDP per capita, i and t represent country and time, respectively. However, it may always be true that the cross-country differences are captured through separate intercepts.

2.1. Data and Variable Description

The renewable energy and non-renewable energy consumption data in Exajoules is taken from International Energy Agency from 2012 to 2021 for BRICS and OECD countries. The present study uses the index of education and innovation, which is the sub-index of the Global Sustainable Competitiveness index. The index of education and innovation comprises education, R&D and newly registered business is taken from Solability (https://solability.com/the-global-sustainable-competitiveness-index). Further, Government effectiveness is used as a performance of government and data of Government effectiveness is taken from Word Governance Index. The quality of policy design, implementation, and the credibility of the government's commitment to the policies are all factors in government effectiveness. It also considers the quality of public and civil services, as well as their degree of independence from political interference. The extent to which renewable energy is included as a tool for guaranteeing environmental quality will be determined by the government's commitment to successfully implementing renewable energy initiatives (Maji and Adamu, 2021). Population and GDP per capita are used as control variables, and data on these variables are taken from the World Bank.

3. Results and Discussion

We have started with descriptive statistics. Tables 1 and 2 give the descriptive results of education and innovation and renewable energy share for OECD and BRICS countries. The average education and innovation index level in OECD countries from 2012 to 2020 is 54.48. South Korea and Sweden have 73.40 and 64.78, the highest average education and innovation index level. In contrast, on average, the lowest education and innovation index is observed in Mexico and Columbia, which are 38.14 and 39.78, respectively. The average education and innovation index level in BRICS countries is 46.99. The highest index is observed in China and the lowest in India, 64.47 and 33.74, respectively. The average share of renewable energy in OECD countries from 2012 to 2020 is 13.47. Iceland and Norway have 44.65 and 40.59, the highest share of renewable energy, while on average, the lowest renewable energy share is observed in Israel and Netherlands, which is 1.68 and 4.74, respectively. The average share of renewable energy consumption in BRICS countries is 10.33. The highest level of the average share of renewable energy consumption is observed in Brazil and the lowest in South Africa, 28.91 and 1.43, respectively.

Figure 1 depict that the education and innovation are rising with time in the OECD and BRICS countries, the impact on the share of renewable energy consumption as a percentage of overall energy consumption is different. It indicates that the share of renewable energy consumption increased more compared to BRICS countries from 2012 to 2020.

The present study uses the GMM estimator to correct for bias caused by endogenous explanatory variables. For this, Dumitrescu & Hurlin (2012) test is used to check the endogeneity in variables. As this test detects endogenous repressors in a regression model because the test reveals that P-value is less than 5%, we can reject the null hypothesis that variables are exogenous. The variable GDP per capita and population are endogenous. The lag of GDP per capita and population are introduced as instruments. The validity of the instrument variable is checked through J-statistics. The results of J-Stats indicate the instruments are valid because the p-value of J-stats is greater than 0.10 (see Tables 3 and 4). The Variance inflation factor (VIF) test is used to check the multicollinearity problem among the independent variables. Multicollinearity decreases the power of model predictivity. So, it is

Table 1. The descriptive statistics (OECD countries), source: own elaboration

Country	Education and innovation Index				Share of renewable energy			
	Mean	Std deviation	Min	Max	Mean	Std deviation	Min	Max
Australia	45.97	5.47	39.90	55.00	6.52	1.40	5.08	9.40
Austria	58.40	3.45	53.20	61.80	25.32	0.63	24.67	26.68
Belgium	56.61	4.36	48.10	61.50	5.31	1.43	3.77	8.62
Canada	51.05	4.27	43.50	58.10	20.66	0.40	20.08	21.42
Chile	42.53	4.88	34.00	50.60	16.65	1.85	14.29	19.65
Colombia	39.78	3.05	35.06	44.60	21.96	1.24	20.12	23.70
Czech Republic	58.05	1.94	54.60	61.21	5.50	0.46	4.67	6.44
Denmark	62.73	4.39	55.20	67.04	21.06	3.13	16.95	26.40
Estonia	53.69	4.48	48.20	63.70	6.23	2.10	4.01	10.47
Finland	61.36	3.35	56.90	64.35	17.40	1.61	14.74	20.19
France	56.49	1.99	53.50	59.70	7.15	1.04	5.89	9.38
Germany	62.93	3.13	58.00	68.80	11.90	2.20	9.24	15.75
Greece	46.90	2.85	43.00	49.88	10.97	1.85	7.45	14.41
Hungary	49.22	5.85	36.10	57.50	3.62	0.66	2.88	5.05
Iceland	58.14	3.30	51.80	62.10	44.65	0.65	43.63	45.37
Ireland	54.53	3.85	47.20	61.26	11.45	2.96	7.87	17.07
Israel	59.62	4.25	50.70	63.00	1.68	1.27	0.46	4.60
Italy	50.02	2.91	44.80	55.10	13.98	1.21	11.71	15.64
Japan	63.94	2.49	60.40	68.50	6.98	1.41	4.93	9.47
Latvia	47.08	2.81	43.20	50.50	17.72	2.29	15.20	22.46
Lithuania	49.55	3.63	43.00	54.40	8.01	1.55	5.21	10.04
Luxembourg	55.19	4.54	49.70	62.50	5.40	2.25	2.72	10.16
Mexico	38.14	4.57	31.20	43.90	5.82	1.09	4.50	8.29
Netherlands	58.59	2.30	54.00	60.70	4.74	1.77	3.33	8.72
New Zealand	49.25	5.41	43.40	57.80	26.52	0.47	25.96	27.21
Norway	62.46	4.97	53.20	66.72	40.59	0.47	39.91	41.40
Poland	52.47	4.28	44.50	58.32	5.28	0.71	4.40	6.64
Portugal	53.36	2.48	48.80	57.20	20.13	2.32	16.69	23.19
Slovenia	60.42	4.25	51.70	68.00	12.52	1.40	10.69	15.07
South Korea	73.40	6.09	58.90	79.00	1.77	0.61	1.02	2.89
Spain	47.29	3.84	42.60	54.00	13.67	1.22	11.93	15.54
Sweden	64.78	5.44	57.00	70.80	24.81	1.79	22.41	28.42
Turkey	60.90	4.17	54.30	64.90	21.01	0.90	19.95	23.06
United Kingdom	48.38	3.41	43.80	53.84	12.05	2.18	8.53	15.40
United States	59.16	4.77	53.20	66.51	9.01	3.25	4.37	14.64
Switzerland	57.19	3.55	51.40	62.28	6.72	0.93	5.64	8.39
Total	54.71	2.19	50.75	57.27	13.74	1.14	12.36	16.20

Table 2. The descriptive statistics (BRICS countries), source: own elaboration

Country	Education and innovation index				Share of renewable energy			
	Mean	Std deviation	Min	Maz	Mean	Std deviation	Min	Max
Brazil	45.24	3.41	41.30	51.20	28.91	1.50	26.90	31.29
China	64.47	2.12	61.50	66.70	5.17	0.35	4.73	5.98
India	33.74	2.04	30.80	37.30	6.60	0.76	5.85	8.18
Russia	49.96	4.23	41.30	54.40	9.52	1.47	7.35	11.61
South Africa	41.55	14.40	32.60	79.00	1.43	0.80	0.31	2.31
Total	46.99	12.31	30.8	79	10.33	0.90	9.36	11.87

essential that there must not be serious multicollinearity. VIF test gives the correlation among the independent variables and how much variance of an independent variable is inflated by correlation with the other independent variables. The VIF test values are less than 0.10, indicating no severe multicollinearity problem.

In table 3, it is indicated from the OECD results that the coefficient of education and innovation has a positive relationship with renewable energy that is 1 percent increase in education and innovation leads to an increase in 0.312 percent in renewable energy consumption. The relationship between GDP per capita and renewable energy is positive. The coefficient of GDP per capita indicates that if there is 1% increase in GDP per capita, it will lead to 0.55 increase in renewable energy consumption. The primary energy consumption has a positive impact on the dependent variable renewable energy. The coefficient of primary energy consumption indicates that if there is 1% increase in consumption of non-renewable energy consumption, it will lead to 0.42 percent increase in renewable

energy. The relationship between Government Effectiveness and renewable energy is positive. The coefficient of Government effectiveness indicates that government performance toward increasing renewable energy use is satisfactory in OECD. The population have a positive impact on the dependent variable renewable energy. The population coefficient indicates that if there is 1% increase in population will lead to an increase of 2.33 percent in renewable energy, indicating that increasing pressure of the population is a driver of renewable energy use in OECD.

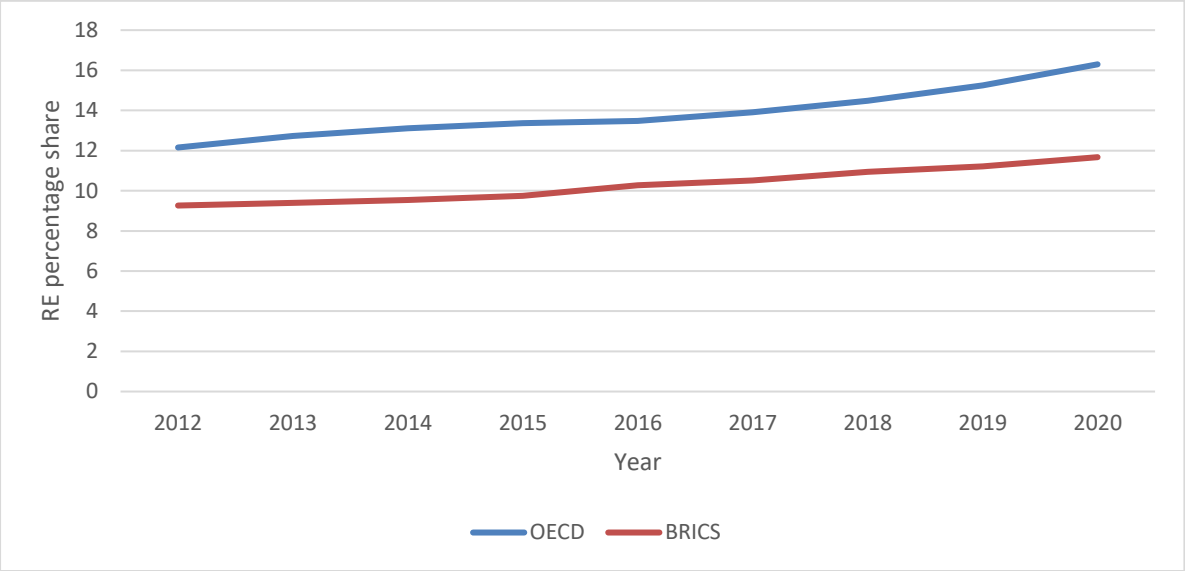

Figure 1. Share of renewable energy as a percentage to non-renewable energy consumption, source: own elaboration

It is indicated from the BRICS results that the coefficient of education and innovation has a positive relationship with renewable energy. That is 1 percent increase in education and innovation will lead to an increase of 0.763 percent in renewable energy. The relationship between GDP per capita and renewable energy is found to be negative but insignificant. The primary energy consumption shows a positive and insignificant relationship with renewable energy consumption. The impact of Government effectiveness on renewable energy is found insignificant. It indicates that government performance toward increasing renewable energy use is not satisfactory. Population in BRICS countries has negative impact on renewable energy consumption. If there is 1 percent increase in population it causes to decrease 0.386 percent renewable energy consumption. It indicates that increasing population could be the hurdle to shifting renewable energy use because of increasing the overall energy demand. This study applied the J-stats test for instruments validity and the results of J-Stats indicate the instruments are valid.

Table 3. Impact of Education and Innovation on Renewable Energy Consumption, source: own elaboration

Variables	**OECD**	**BRICS**
Education and Innovation	0.312** (0.032)	0.763* (0.053)
GDP per capita	0.554*** (0.000)	-0.643 (0.570)
Governemnt effectiveness	0.047* (0.062)	0.032 (0.980)
Population	2.334*** (0.000)	-0.386* (0.057)
Non-renewable energy consumption	2.334** (0.042)	0.312 (0.8775)
C	-7.156*** (0.000)	2.312 (0.8494)
Time fixed effect	Yes	Yes
Number of observations	252	40
J statistic	0.304	0.281
R-squared	0.982	0.972

In table 4 It is indicated from the OECD results that the coefficient of Education and Innovation (ICI) would have a negative relationship with non-renewable energy consumption. That is 1 percent increase in education and innovation will lead to a decrease in the dependent variable non-renewable energy consumption. The relationship between GDP per capita, population and the non-renewable energy consumption is insignificant. It indicates that the

government's effectiveness negatively impacts the dependent variable primary energy consumption. The coefficient indicates that if there is 1% increase in government effectiveness, it will lead to 0.21 decrease in primary energy consumption. The relationship between population and the primary energy consumption is found insignificant.

Table 4. Impact of Education and Innovation on Non-Renewable Energy Consumption, source: own elaboration

Variables	**OECD**	**BRICS**
Education and Innovation	-0.5791* (0.081)	-0.025 (0.651)
GDP per capita	-0.014 (0.849)	0.200** (0.039)
Government Effectivness	-0.215** (0.041)	0.053 (0.557)
Population	0.255 (0.302)	1.415** (0.019)
C	-0.764 (0.877)	-26.199 (0.030)
Time fixed effect	Yes	Yes
Number of observations	252	40
J statistic (p-value)	0.256	0.180
R-squared	0.975	0.972

In BRICS, the coefficient education and innovation shows a negative relationship with primary energy consumption. That is 1% increase in the education and innovation will lead to decrease of 0.02 in non-renewable energy consumption. The relationship between GDP per capita and non- renewable energy is found negative. The coefficient of GDP per capita shows that if there is 1% increase in GDPC, then it will lead to decrease of 0.2 percent in non-renewable energy. The Government Effectiveness shows an insignificant impact with the dependent variable non-renewable energy consumption. The coefficient of GE indicates that Government performance in BRICS countries is not in the favour to reduce the dependency on non-renewable energy use. The variable population have a positive impact on the primary energy consumption. The 1% increase in the population will lead to an increase of 1.4 percent in non-renewable energy.

4. Conclusion

Given the importance of intellectuals and their role in reshaping and redesigning society, the present study assesses the role of education and innovation in climate change mitigation in OECD and BRICS countries. The use of renewable energy and decreasing the use of non-renewable energy is considered a climate change mitigation strategy. The GMM approach is used to test the empirical model. The results indicate that increasing intellectual levels in OECD and BRICS countries positively impact renewable energy consumption. However, the role of intellectuals in reducing the use of non-renewable energy consumption in OECD is significant, while in BRICS countries, it is found insignificant. . The role of the government is insignificant in increasing renewable energy consumption and decreasing the use of non-renewable energy consumption in BRICS countries. Notwithstanding, the role of the government is significant to increase the use of renewable energy consumption and reduce the use of non-renewable energy consumption in OECD countries.

Further, it is revealed that the increasing population in BRICS countries put pressure on non-renewable energy consumption, while this appeared to be another way around in the OECD. Increasing the standard of living in BRICS countries cause to increase in the use of non-renewable energy. However, the increasing level of per capita income contributes to renewable energy consumption in OECD.

This study imposes responsibilities on three groups: the governments of the developed countries, which are primarily responsible for international economic policy; the organisations and individuals that shape the intellectual climate, such as this audience; and the governments of the developing countries, which are primarily responsible for economic policy in their own countries. It is challenging to accomplish sustainable development without pertinent scientific research and communicating the findings to decision-makers. Therefore, it is essential to include all spheres of society. Maybe the first officially employed tactic could be environmental education. Environmental education is firmly based on people's connection with nature, and it aims to raise people's understanding of the need to preserve and maintain it. Environmental education aims to conserve via knowledge, experience, values, and regional customs.

Thus, this study recommends that the intellectuals of BRICS countries work more on decreasing the use of non-renewable energy consumption besides improving renewable energy consumption for sustainable development.

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