EMPIRICAL APPROACH OF THE EFFECTS OF CLIMATE CHANGE ON THE ECONOMY: EVIDENCE FROM WESTERN BALKANS

Liza Alili Sulejmani
International Balkan University, North Macedonia, liza.alili@ibu.edu.mk
Arta Thaci
South East European University, North Macedonia, thaciarta@gmail.com

Abstract: Undoubtedly, global warming is one of the main debatable topics among politicians, scholars, academicians, being discussedeverywhere and by everyone. Having into consideration that one of the main factors of the global warming are the greenhouse gas emissions, where carbon dioxide represents 76% of these emissions, the main aim of this paper is to analyse the effects of the CO_2 emissions as well as other greenhouse gas emissions on the economy and society.
In addition, a panel analysis has been conducted, where OLS, Fixed and Random effects models are used in order to check the impact of the CO_2 emissions on the GDP per capita of developing countries of Western Balkans region, for the last three decades.
Finally, the main conclusions and consequences from the negative impact of the CO_2 emissions on the society, economy and growth of the developing countries have been highlighted as well as several important suggestions have been stated for emphasising and addressing the problems that we will be facing soonbecause of the global warming.
Keywords: Climate change, economy, society, CO_2emissions

1. INTRODUCTION

Global warming is not just threatening our planet and people, but it also represents a serious threat for the world economy, which highlights the need of a serious effort and collaboration between the public and private sector in order to create different efficient methods for producing the goods and services with the purpose of boosting sustainable growth of the countries. Climate change is not just a problem for the nature, it has several impacts in environment and people. This could not be more than correct, since we are all aware of the fact that the life on our planet it is supported from the light that comes from the sun, which is needed for the plants to grow and to provide energy and give life to people and other living creatures in the planet. This energy that comes in our planet from the sun, is what represents the climate and weather of our planet, where the Earth by absorbing the needed received energy from the sun, radiates the rest of the energy to the space. Yet, in the atmosphere of Earth there exist some gases known as greenhouse gases, where CO2 is one of them and take that radiated energy and keep it on the atmosphere, by doing so it makes the Earth warmer and warmer, thus causing the phenomenon what we all know so far called “Global warming”.
Dee facto, by being such serious risk for the people and environment, it also represents a crucial illness that has disrupted the stability of the global economy and in their recent reports World Bank (2019;2020) is warning countries that by 2030, climate change will enhance about 100.000.000 people into poverty. In addition, UN – World Population prospects (2019) report highlights that the effects of climate change will reduce productivity, increase poverty, destroy infrastructure, increase unemployment. There are numerous factors that have been contributing to the global warming, yet CO2 emissions are one of the crucial factors that have influenced the global warming and its negative effects on the economy, environment and society.
Having into consideration the crucial importance of the climate change and its effects on the economy as well as the highlighted attention of the policymakers, scholars, academicians, the main aim of this paper is to investigate and analyse the effects of the CO2 emissions on the GDP per capita of the countries of Western Balkan region (excluding Kosovo) for the time - period 1993 – 2020. In this regard, several panel regressions models have been utilized to determine this effect as well as for comparison purposes among the findings of the models. Thus, Ordinary Least Square (OLS), Fixed effects (FE) and Random effects (RE) models have been used in this regard. At the end, in order to check which of the models is the most appropriate and fit for this analysis, the Hausman Taylor test has been conducted for such purpose, suggesting the RE model as the base model for interpretation and recommendations of this research.
Last but not least, the structure of this study is organized as follows: in the first section called “Introduction”, it is highlighted the importance of the topic and the aim of this research, in the second section are presented important and recent empirical studies that are conducted on this topic and their findings are discussed, in the third section it is

explained the research methodology of this study, the third section explain and interprets the findings of the empirical analysis while the fifth or last part is dedicated to the main conclusions and findings of this research.

2. LITERATURE REVIEW

Due to the highlighted importance as well as the mentioned crucial importance of the actions needed to be addressed for the global warming and its negative impacts, plenty of scholars and academicians have been trying to address this issue in their research and thus there are many existing papers that have been dealing with the problematic of climate change and its effects on different sectors, one of which is the economic growth. More interesting about the relationship between CO2 and economic growth is the fact that in the literature there are present mixed and controversy results regarding such nexus in developed and developing countries. Thus, there are plenty of papers that suggest that CO2 emissions have positive impact on the economic growth (Li 2022; Onofrei et al 2022; Zhang et al. 2021; Baz et al. 2021) and some that claim a negative relationship between CO" and economic growth (Garcia et al. 2020)

Onofrei et al (2022) have been investigating the nexus between CO2 and economic growth for 27 EU countries for the time period 2000 – 2017, by using DOLS technique. Their findings highlight a strong long run cointegration between GDP per capita and CO2 in these countries for the analysed period. On the other hand, Li (2022) have been investigating the relationship between CO2 and economic growth in BRIC countries ang suggest that there exist a positive relationship between CO2 and economic growth in these countries for the analysed period.Further, Bilan et al. (2019) have also beeninvestigating the effects of the CO2 emissions on the economic growth and confirmed the existence of a strong long run relationship between these variables, while Jiang and Guan (2016) such positive significant relationship between CO2 emissions and GDP per capita is due to the rapid grow of the CO2 emissions from the coal.

Contrary to the positive significant relationship between CO2 emissions and economic growth, there are also papers that claim a negative association between CO2 emissions and economic growth in developed and developing countries (Garcia et al. 2020).

3. RESEARCH METHODOLOGY

Considering the main purpose of this research thus, to analyse the relationship between CO2 emissions and economic growth for the Western Balkan region, secondary annual data have been collected from the World Bank for the period 1993 – 2020.

In this regard, several panel regressions models have been utilized to determine this effect as well as for comparison purposes among the findings of the models. Thus, Ordinary Least Square (OLS), Fixed effects (FE) and Random effects (RE) models have been used in this regard. At the end, in order to check which of the models is the most appropriate and fit for this analysis, the Hausman Taylor test has been conducted for such purpose, suggesting the RE model as the base model for interpretation and recommendations of this research.

Furthermore, the first table shows the variables and the source of the data where have been collected as well as their definition and acronyms.

Table 1. Definitions, acronyms and source of the data.

Variable	definition	acronym	source
CO2 emissions	Emissions from the Carbon Dioxide present in the atmosphere	co2	World Banka
GDP per capita	Gross Domestic Product per capita	gdp_cap	World Bank

Source: authors' calculations.

In the following table are presented the descriptive statistics information for the dependent variable GDP er capita and independent variable – CO2 emissions. Furthermore, in the table are illustrated information about the number of the total variables for CO2 and GDP per capita, as well as the mean values of this variables. In addition, the values of standard deviation are presented as well as the maximum and the minimum value of the CO2 and GDP per capita.

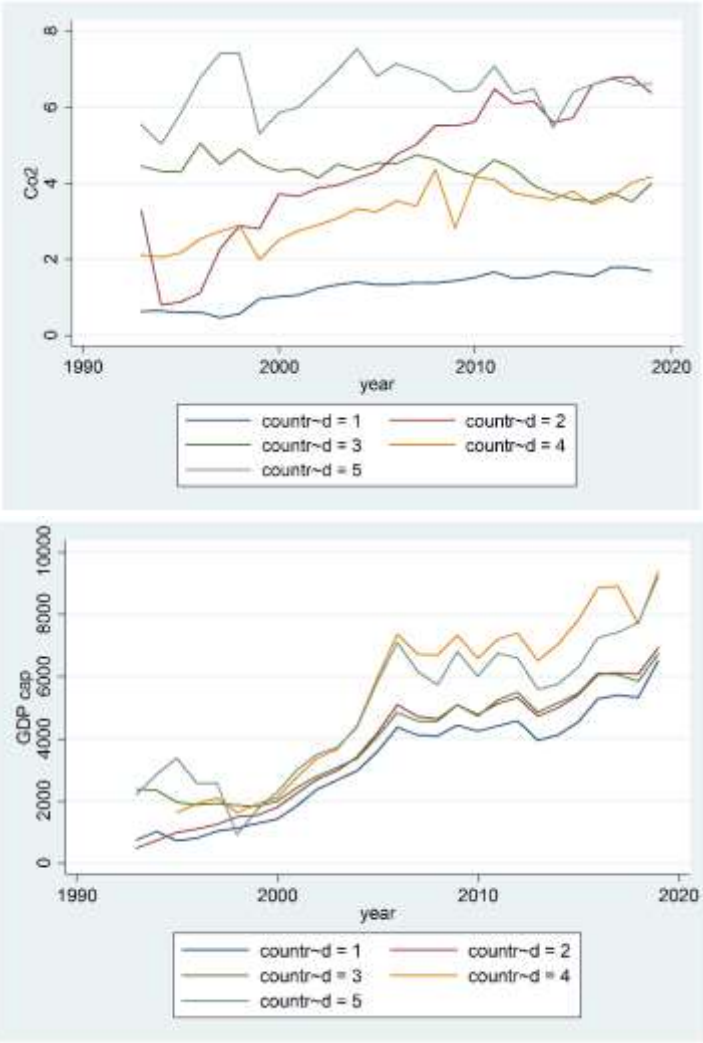
Table2. Summery of the descriptive statistics.

Variable |	Obs	Mean	Std. Dev.	Min	Max
co2 |	135	3.942	1.959	0 .4669	7.550
gdpcap |	133	4241.15	2177.65	487.476	9367.01

Source: authors calculations.

Further, in oder to have a better illustration of the trends of the Carbon dioxide emissions as well as the Gross Domestic product per capita in the countries such as Albania, Bosnia & Herzegovina, Montenegro, North Macedonia and Serbia for the time period 1993 – 2020, the following graphs represent the trends of these variables for the indicated countries and time spin.

Graph1. Trends of CO2 and GDP per capita in Western Balkan, 1993 – 2020.



Source: authors calculations.

4. EMPIRICAL RESULTS

As was already indicated, the main aim of this research study was to investigate the relationship between Carbon dioxide emissions and economic growth for the countries of Western Balkans (excluding Kosovo) for the time period 1993 – 2020. In this regard, several panel regression techniques have been used, like OLS, Fixed and Random effects model in order to determine such relationship for this region, for the time frame 1993 – 2020.

In addition, the results from the Housman Taylor test determine the Random effects model to be the appropriate base model, based on which are interpreted the findings of this research. Furthermore, the following table represents the

results from the Random effects model, where we can see that the findings suggest a strong positive relationship between CO2 emissions and GDP per capita in this region, for the time period 1993 – 2020.

Table3. Random effects model results

Random-effects GLS regression				Number of obs =	133	
Group variable: country_id				Number of groups =	5	
R-sq:				Obs per group:		
within = 0.3007				min =	25	
between = 0.2252				avg =	26.6	
overall = 0.1651				max =	27	
				Wald chi2(1) =	42.11	
corr(u_i, X) = 0 (assumed)				Prob > chi2 =	0.0000	
gdpcap	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
co2	899.7939	138.6612	6.49	0.000	628.023	1171.565
_cons	692.1739	701.3264	0.99	0.324	-682.4005	2066.748
sigma_u	880.78282					
sigma_e	1718.3396					
rho	.20806886	(fraction of variance due to u_i)				

Source: authors calculations.

5. CONCLUSIONS

Having into consideration the recent crucial situation with the global warming and the effects that climate change it is causing in the planet, weather environmental, economical or social, there is no doubt that immediate actions and policies need to be planned and addressed in order to reduce and eventually to stop such negative effects in the long run. Thus, in this regard, the main objective of this paper is to determine the relationship between Carbon dioxide emissions as one of the most important greenhouse gas emissions that is causing the global warming in the atmosphere on the economic growth of the Western Balkan region (excluding Kosovo) for the last 30 years. In this regard, several panel regression models were used, an at the end Hausman Taylor test was conducted in order to determine the appropriate model among OLS, FE and RE model. Finally, the Hausman test results revealed that Random effects model is the appropriate model that is fitting best this analysis and the findings suggest that there exist a strong positive relationship between CO2 emissions and GDP per capita in the countries of Western Balkans (excluding Kosovo) for the analyzed time period 1993 – 2020.

Such results indicate that immediate measures regarding CO2 tax policies should be taken in these countries, as well as supportive climate change actions in order to reduce CO2 emissions in this region. Finally, it is also suggested that actions regarding the raise of awareness of the populations should be included together with the above mention actions to be taken.

REFERENCES

Baz, K., Cheng, J., Xu, D., Abbas, K., Ali, I., Ali, H., et al. (2021). Asymmetric Impact of Fossil Fuel and Renewable Energy Consumption on Economic Growth: A Nonlinear Technique. *Energy* 226, 120357. doi:10.1016/j.energy.2021.120357

Bilan, Y., Streimikiene, D., Vasylieva, T., Lyulyov, O., Pimonenko, T., & Pavlyk, A. (2019). Linking between Renewable Energy, CO_2 Emissions, and Economic Growth: Challenges for Candidates and Potential Candidates for the EU Membership. *Sustainability* 11 (6), 1528. doi:10.3390/su11061528

Garcia, L. E., Illig, A., & Schindler, I. (2020). Understanding Oil Cycle Dynamics to Design the Future Economy. *Biophys. Econ. SustSustainability* 5, 15. doi:10.1007/s41247-020-00081-4

Jiang, X., & Guan, D. (2016). Determinants of Global CO_2 Emissions Growth. *Appl. energy* 184, 1132–1141. doi:10.1016/j.apenergy.2016.06.142

Li, F., Chang, T., Wang, M-C., & Zhou, J. (2022). The Relationship between Health Expenditure, CO_2 Emissions, and Economic Growth in the BRICS Countries—Based on the Fourier ARDL Model. *Environ. Sci. Pollut. Res.* 29, 1–20. doi:10.1007/s11356-021-17900-w

Onofrei, M., Vatamanu, A.F., & Cigu, E. (2022). The Relationship Between Economic Growth and CO_2 Emissions in EU Countries: A Cointegration Analysis. *Front. Environ. Sci.* 10:934885. doi: 10.3389/fenvs.2022.934885

Pao, H.-T., & Tsai, C.-M. (2010). CO2 Emissions, Energy Consumption and Economic Growth in BRIC Countries. *Energy policy* 38 (12), 7850–7860. doi:10.1016/j.enpol.2010.08.045

United Nations (2015). Transforming our world: the 2030 Agenda for sustainable development. Resolution adopted by the General Assembly on 25 September 2015 (A/RES/70/1).

World Population Prospects (2019). United Nation, Department of Economic and Social Affairs, https://population.un.org/wpp/publications/files/wpp2019_highlights.pdf

World Urbanization Prospects: The 2018 Revision: key facts. Available at https://population.un.org/wup/Publications/Files/WUP2018-KeyFacts.pdf

Zhang, Z., Chen, Y. H., & Wang, C. M. (2021). Can CO_2 Emission Reduction and Economic Growth Be Compatible? Evidence from China. *Front." Energy Res.* 9, 315. doi:10.3389/fenrg.2021.693767