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Environmental Taxation and Carbon Emission in G20 Nations

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ABSTRACT

Environmental taxation has emerged as a promising policy tool to combat the pressing challenge of carbon emissions and address the adverse impacts of climate change. This study presents a comprehensive analysis of environmental taxation in the G20 nations, a diverse group of major economies that collectively contribute to a significant share of global greenhouse gas emissions. The objective of this research is to assess the role of environmental taxation in influencing carbon emission levels across G20 countries. To achieve this, review of the literature on environmental taxation, and carbon emission reduction strategies in each G20 nation was conducted. Additionally, data from international databases, governmental reports, and academic studies were analysed and Johansen co-integration test was applied to test the hypothesis. It was found that environment taxation is important variable to manage CO2 emissions and to focus on sustainable growth of the nations. The findings of this research provide valuable insights for policymakers seeking to enhance the effectiveness of environmental taxation measures in their respective countries. By identifying successful policy approaches and lessons learned from G20 nations, this study contributes to a deeper understanding of how environmental taxation can play a pivotal role in addressing carbon emissions and advancing global efforts to combat climate change.

Keywords: *Environmental taxation; G20; Carbon emissions.*

1.0 Introduction

Environmental degradation and global warming are pressing issues that affect ecosystems, economies, and societies worldwide. The issue of environmental degradation and global warming has received significant academic attention, *vis-à-vis*, policy reinforcement during the last few decades (Bashir *et al.*, 2021; Tamazian *et al.*, 2009).

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The reckless pursuit of growth by economies across the world overlooking its protracted debilitating impact on environment has tremendously impacted societies and all aspects of human lives during the recent years. Underscoring the need and rationale to minimize this reckless pursuit of growth by economies, this paper intends to study the environment taxes and its impact on carbon emissions specifically in G20 nations. Environmental taxes, also known as “green taxes” or “eco-taxes” are fiscal measures designed to reduced pollution or environmental damage by taxing products or activities that harm the environment.

2.0 Review of Literature

Several studies have been conducted in order to study the role of environmental taxes to control environmental degradation (Chien *et al.*, 2021 ; Hao *et al.*, 2021). Empirical research on OECD countries showed that the implementation of environmental taxes (ERT) helps to control overall energy usage and promotes energy efficiency by encouraging policymakers, industries, and residents to promote innovation in environment related technologies (Bashir *et al.*, 2021). However, the empirical findings by Shahzad (2020) claimed that the role of ERT in dealing with carbon emission is still ambiguous, hence, requires more investigation.

Research studies have paid less attention on environmental taxes as means of environment protection. Studies also accentuate that environmental taxes are an essential tool for driving change and financing environmental protection efforts. One significant study finds the impact of renewable and non-renewable energy consumption on environment degradation (Chien *et al.*, 2021). By including environmental taxes in their study for top Asian economies the study finds that under long run estimation there is significant and negative role of environmental taxes in reducing carbon emissions. The study further reveals that for every 1% increase in the value of ET, there is a decline of 0.275% in the value of CO_2 in the top Asian economies (China, Japan, South Korea, Russia, Indonesia, Malaysia, Philippine, Singapore, Thailand and Vietnam).

A critical study (by Doğan *et al.*, 2022) examines the influence of environmental taxes on carbon emissions for the G7 countries between 1994 and 2014, along with the significance of the primary contributors to emissions, such as energy usage, economic complexity, resource rent, and economic growth. In addition, they confirmed that the marginal effects of environmental taxes on traditional energy consumption, natural resource rent, and consumption of renewable energy rise with the level of taxation in a statistically significant way. They proposed that environmental taxes effectively reduce emissions for the G7 countries. Renewable energy, eco-innovations, and environmental taxes have positive contributions towards carbon emission reduction for E−7 economies over 1995–2018 period (Yunzhao, 2021). There exists a significant volume of extant literature on carbon emissions and environment taxes but these extant studies primarily focuses on G7, E7 and OECD countries taking several variables. Hence, this present study intends to fill this research gap by focusing on environment taxes in G20 nations over the time period 1994 till 2020.

3.0 Environment Taxes

Environmental challenges are increasing the pressure on governments to find ways to reduce environmental damage while minimising harm to economic growth and facilitating sustainable future. Governments have a range of measures at their disposal, including regulations, information programmes, innovation policies, environmental subsidies and environmental taxes (OECD, 2011). Environmental pricing of goods and services through taxation leaves consumers and businesses with the flexibility to determine how best to reduce their environmental "footprint".

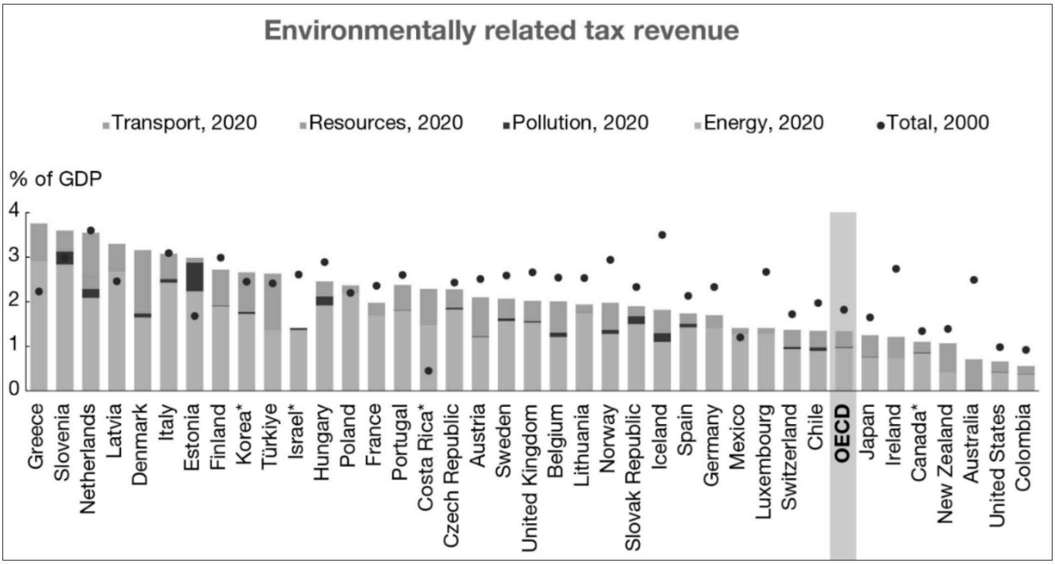
Environmental taxation refers to a range of fiscal policies designed to promote environmentally sustainable practices, reduce greenhouse gas emissions, and address various environmental challenges. Environmental taxation is often considered as an important tool to for driving change and financing environmental protection efforts. Following are the key points about environmental taxation in G20 nations:

- **Carbon Pricing:** G20 nations have implemented carbon pricing mechanisms, such as carbon taxes or cap-and-trade systems. These policies put a price on carbon emissions, aiming to discourage high-emission activities and encourage investments in cleaner technologies.
- **Renewable Energy Incentives:** Some G20 countries provide tax incentives and subsidies to promote the use of renewable energy sources, like solar, wind, and geothermal. These incentives aim to reduce dependence on fossil fuels and increase the adoption of clean energy alternatives.
- **Fuel Taxes:** G20 nations impose taxes on fossil fuels, such as gasoline and diesel. Higher fuel taxes can encourage energy-efficient practices, reduce greenhouse gas emissions, and fund environmental initiatives.
- **Plastic and Waste Management Taxes:** These countries have introduced taxes on plastic bags or packaging to discourage single-use plastics and promote recycling and waste reduction.
- **Water and Air Pollution Taxes:** Certain G20 nations have implemented taxes or levies on industries that generate significant water or air pollution. These taxes aim to internalize environmental costs and incentivize companies to adopt cleaner production methods.
- **Transportation-related Taxes:** G20 countries have implemented taxes or congestion charges on vehicles to reduce traffic, improve air quality, and promote public transportation alternatives.

- **Biodiversity and Land Use Taxes:** A few G20 nations have introduced taxes or financial incentives to protect biodiversity and encourage sustainable land use practices, such as afforestation and reforestation.
- **Aviation and Shipping Taxes:** Some G20 countries have explored or implemented taxes on aviation and shipping fuel or emissions to address the environmental impacts of these sectors.

Environment related taxes increase the cost of producing polluting products or activities and consequently, discourage their consumption and production.

Figure 1: Environmentally Related Tax Revenue



Source: OECD, 2023

Figure 1 depicts environmentally related tax revenue of 38 nations and OECD combined data covering following tax bases:

- Energy products (including vehicle fuels)
- Motor vehicles and transport services
- Measured or estimated pollution emissions to air and water, ozone depleting substances, certain non-point sources of water pollution, waste management and noise
- Management of resources: water, land, soil, forests, biodiversity, wildlife, and fish stocks.

Proportion of energy tax base is higher in ET revenue as % of GDP across all nations except Australia in which transport tax base is the highest.

4.0 Carbon Emission and Taxation

Governments all over the globe put carbon taxes on fossil fuels based on their carbon content in an effort to enhance environmental performance. There is reduction in CO2 as a result of an increase in carbon taxes (Nakata & Lamont, 2001) for Japan and by (Wissema & Dellink, 2007) for Ireland. Despite the fact that the majority of research finds evidence for the adverse impact of environment-related taxes on CO2, an increase in these taxes results in a reduction in CO2 emissions (Di Cosmo & Hyland, 2013). However, other research has found that CO2 emissions are slightly reduced by taxes related to the environment (Wier *et al.*, 2005).

5.0 Objectives

This paper intends to study the research gap by examining the role of environmental taxes in carbon emissions. Accordingly main research questions of the study are:
RQ1: What is the trend of environmental taxes levied in G20 nations?
RQ2: What is the role of environmental taxes on environmental degradation in G20 nations?

To deal with the aforesaid research questions, following concrete objectives were framed for this paper:

- To compile and study environmental taxes in all G20 nations.
- To find out carbon emissions in G20 nations over the time period.
- To find out co-integration, if any, in environmental taxes and CO_2 emissions in G20 nations.

6.0 Methodology

Data source was generated for environment related tax revenue, environment related tax revenue as a % of total tax revenue %, and environment related tax revenue per capita, USD for all G20 nations. It consists of 20 nations, these are Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Türkiye, the United Kingdom, the United States, and the European Union. Similarly, Fossil CO2 per GDP and Fossil CO2 per capita data was derived for these nations.

To meet the first objective these variables were compiled and reported by the authors for all the G20 nations except for Indonesia, Russia, Saudi Arabia, and EU. Data for these four countries was not available for the research time period. Time period for the data collection and analysis was from 1994 till 2020.

To achieve the second objective Johansen cointegration test was performed. Cointegration tests investigate possible correlations among several time series on the long term. It was performed in Excel using the XLSTAT software. Following Hypothesis was for this purpose:

H01: There is no co-integration of tax revenue as % of GDP with Fossil CO_2 G20 countries.

7.0 Analysis of Results

Table 1 depicts that for the year 2022, amongst all the G20 nations Italy has the highest ET_{GDP}, ET_{TR}, and ET_{PC}, whereas, US, China, Australia and Brazil have lowest ET_{GDP} and ET_{TR}.

Table 1: Overview of Environmental Taxes in the G20 Nations

S. No.	Country	Environment related tax revenue, % GDP ET_{GDP}*1	Environment related tax revenue as a % of total tax revenue %, ET_{TR}*2	Environment related tax revenue per capita, USD ET_{PC}*3
1	Argentina	1.75	5.84	289.03
2	Australia	0.56	2.12	265.54
3	Brazil	0.72	2.28	96.46
4	Canada	1.11	3.56	497.11
5	China	0.84	4.2	137.18
6	France	2.38	5.18	949.8
7	Germany	1.71	4.45	816.72
8	India	1.22	17.47	79.42
9	Indonesia	NA	NA	NA
10	Italy	3.08	7.2	1103.29
11	Japan	1.25	6.2	505.74
12	Republic of Korea	2.66	11.38	986.17
13	Mexico	1.43	8.03	244.15
14	Russia	NA	NA	NA
15	Saudi Arabia	NA	NA	NA
16	South Africa	2.92*	10.11*	355.53*
17	Türkiye	2.63	11.01	748.13
18	United Kingdom	2.03	6.29	824.52
19	United States	0.66	2.58	384.16
20	European Union	2.20	5.40	NA

*1 *Environment related tax revenue as a share of each country's gross domestic product (GDP).*

*2 *Environment related tax revenue as a share of each country's total tax revenue.*

*3 *Environment related tax revenue per inhabitant. US-Dollar, converted at 2010 purchasing power parities.*

Source: Compiled by the authors from compare your country, 2022

Table 2 showed that France, UK, Italy, EU, Brazil and Germany have lowest Fossil CO_2 per GDP and South Africa and China have the highest Fossil CO_2 per GDP for the year 2020.

Table 2: Carbon Emission in G20 Nations, Year 2020

S. No.	Country	Fossil CO_2 per GDP	Fossil CO_2 per capita
1	Argentina	0.20	3.88
2	Australia	0.31	15.22
3	Brazil	0.15	2.11
4	Canada	0.31	14.43
5	China	0.51	8.20
6	European Union	0.14	5.91
7	France	0.10	4.26
8	Germany	0.15	7.72
9	India	0.29	1.74
10	Indonesia	0.18	2.09
11	Italy	0.13	5.03
12	Japan	0.21	8.39
13	Mexico	0.18	3.05
14	Russia	0.43	11.64
15	Saudi Arabia	0.38	16.96
16	South Africa	0.64	7.41
17	South Korea	0.28	12.07
18	Turkey	0.17	4.83
19	United Kingdom	0.11	4.66
20	United States	0.23	13.68

Source: Compiled by the authors from Crippa et al., 2021

To scrutinize long term relationship of the variables, Johansen cointegration test was applied based on VAR. Co-integration means to show how the relationship between ET_{GDP} and Fossil CO_2 per GDP in the long run. The results of the test are given in Table 2, figures are computed for the variables Environment related tax revenue, % GDP ET_{GDP} and Fossil CO_2 per GDP for the time period 1994 till 2020.

Both Trace test and maximum Eigen value test are given in the Table 3 with the test statistic, critical value and p value at 5% level of significance.

Co-integration was found between ET_{GDP} and Fossil CO_2 per GDP for Australia, China, France, Germany, UK and US. All of these countries are developed nations except China which is the richest developing country in 2021. However, no co-integration was found between ET_{GDP} and Fossil CO_2 per GDP for Argentina, Brazil, Canada, India, Italy Japan, Korea, Mexico, South Africa and Turkey. Most of these nations are developing countries except Canada, Italy, Japan and Turkey.

Table 3: Co-integration Test Results

No. of CE(s)	Eigen Value	Trace Stat.	Critical Value	P-Value	Eigen Value	Max. Statistic	Critical Value	P-Value	Results
Argentina									
None	0.331	10.513	12.321	0.099	0.331	9.245	11.225	0.109	Trace test & Lambda max test indicates 0 cointegrating relation(s) at the 0.05 level
Atmost 1	0.054	1.268	4.130	0.304	0.054	1.268	4.130	0.304	
Australia									
None	0.398	16.092	12.321	0.011	0.398	12.184	11.225	**0.034**	Trace test Lambda max test indicates 1 cointegrating relation(s) at the 0.05 level.
Atmost 1	0.150	3.908	4.130	0.057	0.150	3.908	4.130	0.057	
Brazil									
None	0.063	1.649	12.321	0.973	0.063	1.628	11.225	0.958	Trace test & Lambda max test indicates 0 cointegrating relation(s) at the 0.05 level
Atmost 1	0.001	0.020	4.130	0.907	0.001	0.020	4.130	0.907	
Canada									
None	0.297	9.513	12.321	0.141	0.297	8.815	11.225	0.129	Trace test & Lambda max test indicates 0 cointegrating relation(s) at the 0.05 level
Atmost 1	0.028	0.698	4.130	0.463	0.028	0.698	4.130	0.463	
China									
None	0.408	15.935	12.321	0.012	0.408	11.517	11.225	**0.044**	Trace test Lambda max test indicates 1 cointegrating relation(s) at the 0.05 level.
Atmost 1	0.182	4.418	4.130	0.042	0.182	4.418	4.130	**0.042**	

France									
None	0.584	22.037	12.321	0.001	0.584	21.933	11.225	**0.000**	Trace test Lambda max test indicates 1 cointegrating relation(s) at the 0.05 level.
Atmost 1	0.004	0.104	4.130	0.791	0.004	0.104	4.130	0.791	
Germany									
None	0.409	15.692	12.321	0.013	0.409	13.129	11.225	**0.023**	Trace test Lambda max test indicates 1 cointegrating relation(s) at the 0.05 level.
Atmost 1	0.097	2.563	4.130	0.129	0.097	2.563	4.130	0.129	
India									
None	0.221	8.741	12.321	0.185	0.221	6.249	11.225	0.322	Trace test & Lambda max test indicates 0 cointegrating relation(s) at the 0.05 level
Atmost 1	0.095	2.492	4.130	0.135	0.095	2.492	4.130	0.135	
Italy									
None	0.248	7.552	12.321	0.274	0.248	7.139	11.225	0.238	Trace test & Lambda max test indicates 0 cointegrating relation(s) at the 0.05 level
Atmost 1	0.016	0.413	4.130	0.584	0.016	0.413	4.130	0.584	
Japan									
None	0.280	10.758	12.321	0.090	0.280	8.214	11.225	0.161	Trace test & Lambda max test indicates 0 cointegrating relation(s) at the 0.05 level
Atmost 1	0.097	2.544	4.130	0.131	0.097	2.544	4.130	0.131	
Korea									
None	0.275	9.297	12.321	0.152	0.275	8.038	11.225	0.172	Trace test & Lambda max test indicates 0 cointegrating relation(s) at the 0.05 level
Atmost 1	0.049	1.259	4.130	0.306	0.049	1.259	4.130	0.306	
Mexico									
None	0.144	6.114	12.321	0.422	0.144	3.886	11.225	0.647	Trace test & Lambda max test indicates 0 cointegrating relation(s) at the 0.05 level
Atmost 1	0.085	2.228	4.130	0.160	0.085	2.228	4.130	0.160	
South Africa									
None	0.120	3.971	12.321	0.715	0.120	3.202	11.225	0.756	Trace test & Lambda max test indicates 0 cointegrating relation(s) at the 0.05 level
Atmost 1	0.030	0.769	4.130	0.438	0.030	0.769	4.130	0.438	
Türkiye									
None	0.317	11.717	12.321	0.063	0.317	9.526	11.225	0.098	Trace test & Lambda max test indicates 0 cointegrating relation(s) at the 0.05 level
Atmost 1	0.084	2.191	4.130	0.164	0.084	2.191	4.130	0.164	

United Kingdom									
None	0.670	31.543	12.321	0.000	0.670	27.731	11.225	**0.000**	Trace test Lambda max test indicates 1 cointegrating relation(s) at the 0.05 level.
Atmost 1	0.141	3.813	4.130	0.060	0.141	3.813	4.130	**0.060**	
United States									
None	0.691	28.370	12.321	0.000	0.691	28.149	11.225	**0.000**	Trace test Lambda max test indicates 1 cointegrating relation(s) at the 0.05 level.
Atmost 1	0.009	0.221	4.130	0.695	0.009	0.221	4.130	**0.695**	

8.0 Research Implications

This study contributes to the existing literature by examining the co-integration between environmental taxes and CO_2 emissions. Previous studies have focused only on OECD nations and selected developed and developing nations taking variables like energy consumption, innovation and human capital, whereas, special focus is given on environmental taxes on CO_2 emissions in this study. The findings suggest that environmental taxes are co-integrated with CO_2 emissions. Certain developed nations have significant long-term co-integration between these two variables. These are Australia, France, Germany, UK and US.

9.0 Policy Implications

In terms of policy suggestions, this study provides useful insights for governments to deal with deteriorating environment, in which pricing through taxation should be emphasized. This might help in improving the industrial structure of the economy to achieve SDGs.

Environment taxation in various sectors can lead to discourage activities that lead to increased carbon emissions. It can change the investment and consumption behaviour by focusing on cost-effective and environment friendly means of production.

Uniform environment taxes with few exceptions should be emphasised by the governments. Tax applied on a uniform basis also minimises the costs of compliance for taxpayers and the costs of administration for government, and reduces the opportunities for tax evasion.

10.0 Conclusion

In order to address environmental issues, environmental tax is indeed critical. When taxes are well-designed and levied at an appropriate rate, they can be quite effective. The success of environmental taxation depends on the public’s acceptance as well as on the provision of information, openness, and certainty. To create the most effective and efficient environmental policy package, taxes may need to be paired with other tools.

In conclusion, this study shows that environmental taxation is important variable to manage CO_2 emissions and to focus on sustainable growth of the nations. However, co-integration does not identify the direction of relationship among variables; further study can capture this by applying causality test.

References

Bashir, M. F., MA, B., Shahbaz, M., Shahzad, U., & Vo, X. V. (2021). Unveiling the heterogeneous impacts of environmental taxes on energy consumption and energy intensity: Empirical evidence from OECD countries. *Energy*, *226*. Retrieved from https://doi.org/10.1016/j.energy.2021.120366

Chien, F., Sadiq, M., Nawaz, M. A., Hussain, M. S., Tran, T. D., & Le Thanh, T. (2021). A step toward reducing air pollution in top Asian economies: The role of green energy, eco-innovation, and environmental taxes. *Journal of Environmental Management*, *297*. Retrieved from https://doi.org/10.1016/j.jenvman.2021.113420

Crippa, M., Guizzardi, D., Solazzo, E., Muntean, M., Schaaf, E., Monforti-Ferrario, F., Banja, M., Olivier, J.G.J., Grassi, G., Rossi, S., Vignati, E. (2021). GHG emissions of all world countries, EUR 30831 EN, *Publications Office of the European Union*, *Luxembourg*, 2021. Retrieved from doi:10.2760/173513

Di Cosmo, V., & Hyland, M. (2013). Carbon tax scenarios and their effects on the Irish energy sector. *Energy Policy*, *59*, 404-414. Retrieved from https://doi.org/10.1016/j.enpol.2013.03.055

Doğan, B., Chu, L. K., Ghosh, S., Diep Truong, H. H., & Balsalobre-Lorente, D. (2022). How environmental taxes and carbon emissions are related in the G7 economies? *Renewable Energy*, *187*, 645–656. Retrieved from https://doi.org/10.1016/j.renene.2022.01.077

Hao, L. N., Umar, M., Khan, Z., & Ali, W. (2021). Green growth and low carbon emission in G7 countries: how critical the network of environmental taxes, renewable energy and human capital is? *Science of the Total Environment*, *752*, 141853.

Nakata, T., & Lamont, A. (2001). Analysis of the impacts of carbon taxes on energy systems in Japan. *Energy Policy*, *29*(2), 159–166. Retrieved from https://doi.org/10.1016/S0301-4215(00)00104-X

OECD. (2011). *Environmental taxation a guide for policy makers.*

OECD. (2023). *Policy Instruments for the Environment Database*. Retrieved from https://www.oecd.org/environment/indicators-modelling-outlooks/policy-instruments-for-environment-database/

Shahzad, U. (2020). Environmental taxes, energy consumption, and environmental quality: Theoretical survey with policy implications. *Environmental Science and Pollution Research, 27*(20), 24848-24862.

Tamazian, A., Chousa, J. P., & Vadlamannati, K. C. (2009). Does higher economic and financial development lead to environmental degradation: Evidence from BRIC countries. *Energy Policy*, *37*(1), 246–253. Retrieved from https://doi.org/10.1016/j.enpol.2008.08.025

Wier, M., Birr-Pedersen, K., Jacobsen, H. K., & Klok, J. (2005). Are CO_2 taxes regressive? Evidence from the Danish experience. *Ecological Economics*, *52*(2), 239–251. Retrieved from https://doi.org/10.1016/j.ecolecon.2004.08.005

Wissema, W., & Dellink, R. (2007). CGE analysis of the impact of a carbon energy tax on the Irish Economy. *Ecological Economics*, *61*(4), 671-683.

Yunzhao, L. (2022). Modelling the role of eco innovation, renewable energy, and environmental taxes in carbon emissions reduction in E−7 economies: evidence from advance panel estimations. *Renewable Energy*, *190*, 309-318. Retrieved from https://doi.org/10.1016/j.renene.2022.03.119