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THE EFFECTIVENESS OF PIGOUVIAN TAXES IN REDUCING CARBON EMISSIONS

Abstract

Pigouvian-type environmental/carbon taxes, which aim to internalize negative externalities in the fight against global warming and climate change, are among the important policy tools. The aim of this study is to examine whether environmental taxes are effective in reducing CO_2 emissions in a sample of G7 countries. The analysis covers the period 1994–2014 due to the accessibility of environmental tax data. While the dependent variable is per capita CO_2 emission, per capita income, energy consumption, renewable energy consumption, and environmental tax are included in the model as the main explanatory variables. In line with the findings of cross-sectional dependence and heterogeneity, second-generation panel methods were preferred; after unit root and cointegration analyses, long-term coefficients were estimated using the Common Correlated Effects (CCE) approach. The findings show that there is a long-term cointegration relationship between the variables. According to the long-term coefficient estimates, the effect of income and energy consumption on CO_2 emissions is positive and statistically significant. While the impact of renewable energy consumption was found to be insignificant across the panel, the environmental tax was found to have a negative and significant effect on CO_2 emissions. Accordingly, a 1% increase in the environmental tax was found to reduce CO_2 emissions by approximately 0.23%. The results suggest that Pigouvian-type environmental/carbon taxes, when used in conjunction with complementary energy efficiency and renewable energy policies, can be an effective tool in emission reduction.

Keywords: Pigouvian tax, environmental tax, G7, panel cointegration, CCE.

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Introduction

Countries face environmental challenges that have negative impacts on sustainable development. The willingness and capacity to address environmental problems has increased globally in recent years; a clearer recognition of the impacts of environmental degradation on human well-being has highlighted the need for policy development, even if the remediation costs are high [1]. Among greenhouse gas compounds, carbon dioxide (CO_2) emissions are among the key determinants of climate change and environmental pollution. Indeed, while CO_2 accounted for approximately two-thirds of total greenhouse gas emissions in 2021, other gases such as methane also pose serious risks in terms of global warming [2]. The World Meteorological Organization's greenhouse gas reports indicate that CO_2 concentrations have historically exceeded critical thresholds compared to the pre-industrial era (wmo.int, 2024). The increase in CO_2 emissions; Rising temperatures, melting glaciers, rising sea levels, and shrinking agricultural production areas threaten economic and social well-being by causing multifaceted consequences. Therefore, societies must develop policy tools that can meet economic needs without harming the planet. Within global efforts to reduce the effects of greenhouse gas emissions, the Kyoto Protocol stands out as an important international agreement (csb.gov.tr, 1998). Countries have turned to practices such as carbon capture and storage, carbon trading, and especially carbon pricing to reduce emissions; in this context, the Pigouvian

carbon tax has emerged as one of the most common tools. The Pigouvian approach advocates for the application of a per-unit tax to internalize negative externalities such as emissions [3]. In this study, the availability of environmental tax data for the period 1994–2014 limits the data coverage. In addition to CO_2 emissions and the Pigouvian carbon tax indicator, control variables such as GDP, energy consumption, and renewable energy consumption are also included in the analyses. The motivation of the study is the importance of the selected sample in terms of global policy and the up-to-date nature of the econometric methods used. In particular, the Common Correlated Effects (CCE) cointegration estimator is expected to contribute to the literature because it offers advantages against problems such as endogeneity, non-stationarity, cross-sectional dependence, and heterogeneity. Accordingly, advanced panel econometric techniques such as cross-sectional dependence, slope coefficient homogeneity, panel unit root tests, cointegration analyses, and cointegration coefficient estimation are used in the study.

Literature review

Increasing discussions in literature in recent years have focused on the choice of effective policy instruments to reduce CO_2 emissions and promote low-carbon economies. In this context, the number of empirical investigations that complement theoretical discussions has increased, and in particular, tax-based mechanisms (carbon valuation, energy and ecological taxes) have an impact on emissions in different countries. It has been tested across groups and different econometric approaches.

The basis of the Pigouvian tax approach is A.C. Pigou [3] put it. Pigou based the application of the tax per unit on theoretical knowledge in order to "incorporate" negative external effects (for example, carbon emissions) into the market mechanism. In this context, the Pigouvian carbon tax is a tax instrument that aims to include the social cost of carbon emissions in the value, ultimately reducing emissions by changing production and consumption behavior. is explained.

In empirical literature, the results related to the effect of Pigouvian type carbon/ecological taxes on CO_2 emissions are not in exactly the same direction. A number of studies show that carbon/ecological taxes reduce CO_2 emissions and are politically effective. On the other hand, it is emphasized that tax instruments are not always successful in reducing emissions and that in some cases the results are weakened or can be observed with the deterioration of the environmental conditions. These differences are often due to the industrial structure of the countries, energy intensity, tax exemptions, institutional quality, energy prices and the method chosen (especially horizontal section stability and heterogeneity). It depends on its obligations.

Examining the empirical studies presented in Table 1, it is seen that Pigouvian-type environmental taxes mostly yield positive results in reducing CO_2 emissions. Analyses conducted on different country groups and periods show that environmental taxes are more effective, especially when supported by policies promoting renewable energy use, energy efficiency, and eco-innovation. However, it is understood that this effectiveness can vary depending on the economic structure of the countries, their energy intensity, and the tax design implemented. In this context, the findings summarized in Table 1 support the idea that environmental taxes are an important policy tool in reducing carbon emissions.

Data set, methods and econometric findings. This study examines whether environmental/carbon taxes implemented within the framework of the Pigouvian approach are effective in reducing CO_2 emissions. The analysis was conducted on a sample of G7 countries. The studies of Ghazouani et al. [4] and Bashir et al. [5] were referenced in the inclusion of control variables in the model.

Table 1. Selected empirical studies on Pigouvian carbon tax (environmental tax) and CO_2 emissions.

Author(s)	Country(ies) / Period	Econometric method	Variables (main)	Key findings
Hassan et al. (2020)	31 OECD countries / 1994–2013	Panel cointegration	Environmental tax, economic growth	Negative relationship found between environmental tax and economic growth (indirect effects possible).
[10]	10 countries / 1980–2014	FMOLS, DOLS + Granger	Energy types, urbanization, export quality, economic complexity	Non-renewable energy increases pollution; renewable energy reduces them.
[4]	9 EU countries / 1994–2018	FMOLS, DOLS	CO_2, environmental taxes, renewable energy, urban population, GDP	Environmental taxes are effective in reducing CO_2 emissions.
[6]	G7 / 1994–2014	GMM	CO_2, GDP, energy consumption, natural resource cost, economic complexity, renewable energy, environmental tax	Environmental taxes reduce CO_2 and the impact of energy consumption; the impact of renewable energy increases in some specifications.
[11]	E-7 / 1995–2018	Granger causality	Renewable energy, eco-innovation, ecological tax	Environmental taxes + eco-innovation contribute positively to reducing emissions.
[6]	25 countries / 1994–2018	Quantitative regression	CO_2, GDP, environmental tax, renewable energy, energy intensity	Environmental taxes, renewable energy and energy efficiency are key factors in reducing emissions.
[2]	35 OECD / 1995–2019	Dynamic panel threshold regression	Environmental taxes, CO_2	Environmental taxes reduce CO_2 emissions; the impact varies depending on the thresholds.

Source: Based on the [4].

In this study, the dependent variable was determined as per capita CO_2 emissions (CE; tons). The independent variables consisted of GDP per capita (GR; at 2005 constant prices), energy consumption (EN; kg per capita), renewable energy consumption (YEN; share of total energy consumption, %) and environmental tax (CV; %) as a Pigouvian environmental/carbon tax indicator. Environmental tax data was obtained from the Eurostat database; CO_2 emissions, GDP, energy consumption and renewable energy variables were obtained from the World Bank database. The availability of environmental tax data for the relevant countries for the period 1994–2014 is the main constraint limiting the analysis period. The model was constructed in logarithmic form to reduce potential scale differences between variables and minimize the risk of multicollinearity. Accordingly, the panel model is expressed as follows:

$$LCE_{it} = \alpha_i + \beta_{1i} LGR_{it} + \beta_{2i} LEN_{it} + \beta_{3i} LYEN_{it} + \beta_{4i} LCV_{it} + \varepsilon_{it}$$
$$(i = 1, \dots, 7;\ t = 1994, \dots, 2014) \qquad (1)$$

Before presenting the clinometric findings, descriptive statistics and the correlation matrix for the variables were reported. Then, cross-sectional dependence and homogeneity of slope coefficients were tested within the model; based on these results, appropriate panel unit root tests were applied to the variables. Finally, the cointegration relationship was examined and long-term coefficient estimates were reported. In accordance with this sequence, the descriptive statistics and correlation matrix values are presented in Table 2. Descriptive statistics show that the variable with the highest

volatility among the series is renewable energy consumption (REC), while the lowest volatility is observed in the GDP (GR) series. The direction and strength of the relationship between the variables were evaluated through the correlation matrix. A correlation coefficient closer to 1 indicates a strong relationship, while a coefficient closer to 0 indicates a weaker relationship [6]. In this context, the correlation between per capita CO_2 emissions (LCE), per capita income (LGR), and energy consumption (LEN) is found to be strong and positive. The correlation between LCE and renewable energy consumption (LYEN) is weak and positive. In contrast, the correlation between LCE and the Pigouvian-type environmental/carbon tax indicator (LCV) is strong and negative. This finding is consistent with the expectation that environmental/carbon taxes can function as a mechanism to reduce CO_2 emissions.

Table 2. Descriptive statistics and correlation matrix.

Variables	Number of Observations	Average	Std.	Maximum	Minimum
LCE	147	0.9984	0.1738	1.3111	0.6641
LGR	147	4.5680	0.0722	4.7456	4.4539
LEN	147	3.6565	0.1589	3.9271	3.3828
LYEN	147	0.8020	0.3645	1.3500	-0.0705
LCV	147	0.2652	0.1773	0.5563	-0.1249
Correlation Matrix					
	LCE	**LGR**	**LEN**	**LYEN**	**LCV**
LCE	1.0000	0.6233	0.8690	0.1396	-0.8214
LGR	0.6233	1.0000	0.5981	0.0459	-0.6993
LEN	0.8690	0.5981	1.0000	0.4009	-0.8661
LYEN	0.1396	0.0459	0.4009	1.0000	-0.2577
LCV	-0.8214	-0.6993	-0.8661	-0.2577	1.0000

Soucre: Based on the [4].

Examining the descriptive statistics in Table 2, it is seen that the number of observations for all variables is 147. Based on the average values, the highest level belongs to the LGR variable, and the lowest level belongs to the LCV variable. When evaluated in terms of standard deviation values, the highest volatility is observed in the LYEN variable, and the lowest volatility in the LGR variable. This indicates that renewable energy consumption exhibits a more variable structure across periods and countries, while the income variable presents a more stable appearance. Furthermore, the difference between the maximum and minimum values is relatively more pronounced, especially in the LYEN and LCV variables.

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij}^2 \sim \chi^2_{\frac{N(N-1)}{2}} \quad (2)$$

$$CD_{LM} = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \left(T\hat{\rho}_{ij}^2 - 1\right) \quad (3)$$

$$CD = \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \quad (4)$$

$$LM_{adj} = \sqrt{\frac{2}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \frac{(T-k)\tilde{\rho}_{ij}^2 - \mu_{Tij}}{\sqrt{v_{Tij}^2}} \sim N(0,1) \quad (5)$$

In equations, the LM test is first applied when the time dimension (T) is greater than the cross-sectional dimension (N) [7]. CDLM shows distortions when N > T. Since the problem of increasing deviations as N increases becomes prominent, Pesaran attempted to overcome this by developing the CD test used when N > T. Later, Pesaran et al. [7] developed the bias-corrected LMadj test. All tests are reported in this study to demonstrate consistency. Furthermore, although other tests exist for calculating cross-sectional dependence, these tests were applied for this study. Therefore, the results of the tests are presented in Table 3.

Table 3. Cross-sectional dependence findings.

Horizontal Section Dependence		
Model		
	Statistical Value	**Probability Value**
LM	54.691***	0.000
CD_{LM}	5.199***	0.000
CD	1.122	0.131
Lm_{adj}	3.640***	0.000

Source: Based on the [7].

Table 3 presents the results of the cross-sectional dependence tests. According to the findings, the probability values for the LM, CDLM, and LMadj test statistics were calculated as 0.000, and these results were found to be statistically significant. In contrast, the probability value for the CD test was 0.131, which is above the significance level. However, when evaluated generally, the significant results of the LM, CDLM, and LMadj tests indicate the existence of cross-sectional dependence among the countries comprising the panel. In other words, an economic or environmental shock occurring in one G7 country can affect other countries as well. This situation necessitates considering the mutual interaction and joint actions between countries.

Another stage evaluated as a preliminary test is homogeneity (slope coefficient homogeneity) tests. Homogeneity tests are applied to determine whether the effect of independent variables on the dependent variable is the same or different in the units (countries) that make up the panel. In the Delta tests proposed by Pesaran, the null hypothesis is "the slope coefficients are homogeneous". The test statistics are defined as follows:

$$\Delta = \sqrt{N}\frac{(\bar{S}-k)}{\sqrt{2k}} \quad (6)$$

$$\Delta_{adj} = \sqrt{N}\frac{\left(\bar{S} - E(\tilde{Z}_{iT})\right)}{\sqrt{Var(\tilde{Z}_{iT})}} \quad (7)$$

Table 4. Findings of the tests.

Slope Homogeneity		
	Statistical Value	**Probability Value**
Delta Tilde	8.833***	0.000
Delta $Tilde_{adj}$	10.358***	0.000

Source: Based on the [7].

Table 4 presents the results of the Delta Tilde and Delta Tildeadj tests applied to determine whether the slope coefficients are homogeneous. According to the findings, probability values for both tests were calculated as 0.000, and the results were found to be statistically significant at the 1% significance level. In this case, the null hypothesis (that the slope coefficients are homogeneous) is rejected, and it is concluded that the coefficients are heterogeneous among the countries comprising the panel. In other words, the effect of the independent variables on CO_2 emissions differs from country to country.

This finding shows that the effect of environmental taxes and other control variables is not the same magnitude and in the same direction across all countries. Factors such as the energy structure of the countries, the composition of industry, the scope of tax policies, institutional capacity, and the level of implementation of environmental policies may be among the main reasons for this difference. Therefore, the results obtained in Table 4 support the appropriateness of using panel data methods that take heterogeneity into account in the analysis.

According to the test findings, the null hypothesis was rejected at the 1% significance level, and the slope coefficients were found to be heterogeneous. The heterogeneity of the slope coefficients indicates that the effect of environmental taxes (Pigouvian-type carbon/environmental taxes) on CO_2 emissions in G7 countries varies from country to country. In other words, the emission-reducing effect of environmental taxes may not occur with the same magnitude and in the same direction in all countries; this situation can be related to factors such as the countries' energy mix, industrial structure, tax scope/exceptions, and policy implementation capacity.

In the test, individual statistics are calculated based on Fourier frequency, while the panel statistic is assumed to have an asymptotically normal distribution. In this test, the hypotheses are generally based on the assumption that "there is a unit root", and it is not necessary to know the break dates in advance during the modeling phase. In addition, the test provides an advantage in that it allows both sharp (sudden) and gradual breaks. The panel LM test statistic is presented in Equation (8):

$$Z_{LM}(k) = \sqrt{N}\,\frac{(P_t(k) - \xi(\kappa))}{\zeta(\kappa)} \quad \sim \quad N(0,1) \qquad (8)$$

Table 5. Fourier LM unit root test findings.

Countries	Fourier tau LM1 (k=1)	Fourier tau LM2 (k=2)	Fourier tau LM3 (k=3)
Canada	-2.9768	-1.1694	-1.0140
France	-0.2625	-0.3699	0.1572
Germany	-1.8764	-3.2443	-3.4870
Italy	0.1487	-1.9252	-2.3785
Japan	-3.7315	-3.6529	-3.9344
United Kingdom	-0.7061	-0.3312	-0.3539
USA	-1.6263	-0.7456	-0.2744
LEN			
Canada	-3.4843	-2.6934	-2.4332
France	-0.1436	-0.5428	-0.5901
Germany	-1.3337	-3.2636	-2.8882
Italy	-0.1979	-2.2571	-2.4516
Japan	-0.8968	-1.6416	-1.2017
United Kingdom	0.1450	0.0146	0.3206
USA	-3.5739	-1.1182	-1.0256
Findings			
ZLM (Statistic Value)	6.872	2.089	2.440
Probability Value	1.000	0.981	0.992
LYEN			

Canada	-1.2245	-4.0093	-2.9811
France	-1.2874	-2.2918	-1.4768
Germany	-0.7195	-0.7286	-0.7297
Italy	-0.0803	0.4683	0.2350
Japan	-1.0969	-2.9625	-1.8504
United Kingdom	0.1754	0.7582	0.6730
USA	-1.9528	-2.8259	-2.2117
Findings			
ZLM (Statistic Value)	8.900	2.043	3.551
Probability Value	1.000	0.979	0.999
LCV			
Canada	-0.6115	-0.1172	-0.5327
France	-0.8587	-1.4413	-1.2310
Germany	-1.8951	0.1405	0.6598
Italy	-1.2575	-2.3681	-1.8350
Japan	1.2958	4.2690	5.5124
United Kingdom	-3.5050	-3.5252	-2.0576
USA	-0.1194	-0.7443	-1.0765
Findings			
ZLM (Statistic Value)	8.430	6.110	8.036
Probability Value	1.000	1.000	1.000

Source: Based on the [6].

The Fourier LM unit root test results presented in Table 5 examine the stationarity properties of the series, taking structural breaks into account. According to the findings, the probability values of the ZLM statistics calculated at the panel level for both the LEN, LYEN, and LCV variables were found to be quite close to 1,000 at all frequencies. This result shows that the null hypothesis cannot be rejected and that the relevant series contain unit roots at their level values. In other words, the variables are not stationary at the level. The use of the Fourier approach is important because it allows for the consideration of possible abrupt and gradual structural breaks in the series. Therefore, the findings obtained in Table 5 make it econometrically necessary to proceed to the cointegration test to examine the long-term relationship of the variables in the analysis.

Table 6. Cointegration test findings.

	LM Statistics	**Asymptotic p-value**	**Bootstrap p-value**
Fixed	4.304	0.000	1.000
Fixed and Trending	11.067	0.000	0.564

Source: Based on the [4].

$$LCE_{it} = \alpha + 0.945\, LGR_{it} + 0.733\, LEN_{it} - 0.233\, LCV_{it} + \varepsilon_{it} \quad (9).$$

The cointegration test results in Table 6 reveal the existence of a long-term relationship between the variables used in the model. The asymptotic p-values of 0.000 in both the constant model and the constant and trend model indicate a statistically significant cointegration relationship between the variables. Considering the bootstrap p-values, the long-term relationship is particularly supported for the constant model. This finding suggests that CO_2 emissions, income, energy consumption, and environmental tax variables move together in the long run and have a permanent equilibrium relationship. In other words, although there are short-term fluctuations, these variables tend towards a common equilibrium level in the long run.

Conclusion and recommendations

Global warming and climate change are among the most critical global problems of our time, threatening economic and social

well-being in a multifaceted way. In this context, Pigouvian-type carbon/environmental taxes, based on the internalization of negative externalities, are considered among the relatively low-cost and feasible policy tools in terms of reducing emissions. However, the effectiveness of environmental taxes in reducing pollution remains a controversial area in the empirical literature. This study examined whether environmental taxes, which can be evaluated within the framework of the Pigouvian approach, are effective in reducing CO_2 emissions in the G7 countries sample. G7 countries were selected due to their net-zero targets and carbon pricing strategies; the analysis period was limited to 1994–2014 due to the accessibility of environmental tax data. Therefore, data coverage constitutes one of the main limitations of the study. Panel cointegration analysis and long-term coefficient estimation methods were used in the empirical phase. The findings show that there is a long-term cointegration relationship between the variables. When long-term coefficient estimates are examined, it has been determined that per capita income and energy consumption have a positive and statistically significant effect on CO_2 emissions. These results are generally consistent with the relevant literature. The increase in CO_2 emissions due to increased income indicates that the growth in the scale of economic activity and production in these countries can bring with it environmental costs. The increase in CO_2 emissions due to increased energy consumption can be considered an expected finding in an energy mix where fossil fuels still hold a dominant position in energy production. In terms of the main result of the study, the effect of the Pigouvian-type environmental/carbon tax on CO_2 emissions is negative and statistically significant. This finding shows that the increase in environmental taxes works towards reducing CO_2 emissions; therefore, it supports the approach of pricing carbon emissions and reflecting the cost of externalities in the market mechanism. The results obtained are largely consistent with studies highlighting the emission-reducing effect of environmental/carbon taxes. In this context, it can be said that environmental taxes can deter environmentally harmful production processes by creating an additional cost element for firms; and can encourage investments in cleaner technologies and energy efficiency with the motivation of reducing costs. However, some differences were observed in the country-specific results. In France, Germany, and the USA, the environmental tax coefficient is statistically insignificant. This situation may be related to the tax design, scope of application, exceptions, and especially the limitations of the analysis period. For example, the fact that the carbon tax in France was adopted in 2014 and the data period ended at that time may weaken the significance of the coefficient. Similarly, the later implementation of the carbon tax in Germany may also lead to the inability to detect a significant impact during the 1994–2014 period. In addition, the impact of renewable energy consumption on CO_2 emissions was found to be significant only for Germany on a country basis. Considering Germany's policies to accelerate its renewable energy transition and its long-term goals to increase the share of renewables in electricity production, this result can be considered consistent with the country's specific criteria.

REFERENCES

1. Karmaker S.C., Hosan S., Chapman A.J. Saha B.B. The role of environmental taxes on technological innovation. Energy, 2021;232:121052.
2. Al Shammre A.S., Benhamed A., Ben-Salha O., Jaidi Z. Do environmental taxes affect carbon dioxide emissions in OECD countries? Evidence from the dynamic panel threshold model. Systems, 2023;11(6):307.
3. Pigou A.C. (Ed). The economics of welfar. McMillan & Co, London. 1920.
4. Ghazouani A., Jebli M.B., Shahzad U. Impacts of environmental taxes and technologies on greenhouse gas emissions: Contextual evidence from leading emitter European countries. Environmental Science and Pollution Research, 2021;28:22758–22767.

5. Bashir M.F., Benjiang M.A., Shahbaz M., Shahzad U., Vo X.V. Unveiling the heterogeneous impacts of environmental taxes on energy consumption and energy intensity: Empirical evidence from OECD countries. Energy, 2021;226:120366.
6. Dogan E., Hodžić S., Šikić F.T. A way forward in reducing carbon emissions in environmentally friendly countries: The role of green growth and environmental taxes. Economic research-Ekonomska istraživanja, 2022;35(1):5879–5894.
7. Pesaran M.H. General diagnostic tests for cross section dependence in panels. Available at SSRN, 2004;572504. Pesaran, M. H. (2006). Estimation and inference in large heterogeneous panels with a multifactor error structure, Econometrica, 74(4): 967-1012.
8. Shahzad U. Environmental taxes, energy consumption, and environmental quality: Theoretical survey with policy implications. Environmental Science and Pollution Research, 2020;27(20):24848–24862.
9. Wang H., Wei W. Coordinating technological progress and environmental regulation in CO2 mitigation: The optimal levels for OECD countries & emerging economies. Energy Economics, 2020;87:104510.
10. Wang Z., Jebli M.B., Madaleno M., Doğan B., Shahzad U. Does export product quality and renewable energy induce carbon dioxide emissions: Evidence from leading complex and renewable energy economies. Renewable Energy, 2021;171:360–370.
11. Yunzhao L. 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, 2022;190: 309–318.

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6 saylı məktəb liseyi

KARBON EMİSSİYALARININ AZALDILMASINDA PİGOUVİAN VERGİLƏRİNİN SƏMƏRƏLİLİYİ

Xülasə

Qlobal islanma və iqlim dəyişikliyi ilə mübarizədə mənfi eksternal effektləri daxili iqtisadi mexanizmlərə daxil etməyi hədəfləyən Pigouvian tipli ekoloji/karbon vergiləri əhəmiyyətli siyasət alətlərindən biridir. Bu tədqiqatın məqsədi, G7 ölkələri nümunəsində ətraf mühit vergilərinin CO_2 emissiyalarının azaldılmasında təsirli olub-olmadığını araşdırmaqdır. Təhlil 1994–2014-cü illəri əhatə edir, çünki ekoloji vergi məlumatlarına yalnız bu dövr üçün çıxış mümkündür. Asılı dəyişən kimi adambaşına CO_2 emissiyası götürülmüş, əsas izahedici dəyişənlər kimi isə adambaşına gəlir, enerji istehlakı, bərpa olunan enerji istehlakı və ekoloji vergi modelə daxil edilmişdir. Kross-seksional asılılıq və heterogenlik nəticələrinə uyğun olaraq, ikinci nəsil panel üsulları üstün tutulmuşdur; vahid kök və kovarqasiya (cointegration) analizlərindən sonra uzunmüddətli koeffisentlər Ümumi Korelyasiya Effektləri (Common Correlated Effects – CCE) yanaşması ilə qiymətləndirilmişdir. Nəticələr göstərir ki, dəyişənlər arasında uzunmüddətli kovarqasiya əlaqəsi mövcuddur. Uzunmüddətli koeffisent qiymətləndirmələrinə görə, gəlir və enerji istehlakının CO_2 emissiyalarına təsiri müsbət və statistik əhəmiyyətlidir. Bərpa olunan enerji istehlakının təsiri panel üzrə əhəmiyyətli olmayıb, ekoloji verginin təsiri isə mənfi və əhəmiyyətli olduğu müəyyən edilmişdir. Beləliklə, ekoloji verginin 1% artırılması təxminən 0,23% CO_2 emissiyasının azalmasına səbəb olur. Nəticələr göstərir ki, Pigouvian tipli ekoloji/karbon vergiləri enerji səmərəliliyi və bərpa olunan enerji siyasətləri ilə birlikdə istifadə edildikdə, emissiyaların azaldılmasında təsirli alət ola bilər.

Açar sözlər: Pigouvian vergi, ekoloji vergi, G7, panel kovarqasiya, CCE.

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ЭФФЕКТИВНОСТЬ ПИГУОВСКИХ НАЛОГОВ В СНИЖЕНИИ ВЫБРОСОВ УГЛЕРОДА

Резюме

Пигуовские экологические/углеродные налоги, направленные на внутреннее отражение негативных внешних эффектов в борьбе с глобальным потеплением и изменением климата, являются важным инструментом государственной политики. Цель данного исследования – изучить, насколько эффективны экологические налоги в снижении выбросов CO_2 на примере стран G7. Анализ охватывает период с 1994 по 2014 гг., что обусловлено доступностью данных об экологических налогах. В качестве зависимой переменной рассматриваются выбросы CO_2 на душу населения, в модель включены основные объясняющие переменные: доход на душу населения, потребление энергии, потребление возобновляемой энергии и экологический налог. В соответствии с результатами тестов на кросс-секционную зависимость и гетерогенность были применены методы панели второго поколения; после анализа единичного корня и коинтеграции долгосрочные коэффициенты оценены с использованием подхода Общих Коррелированных Эффектов (CCE). Результаты показывают наличие долгосрочной коинтеграционной связи между переменными. Согласно оценкам долгосрочных коэффициентов, влияние дохода и потребления энергии на выбросы CO_2 является положительным и статистически значимым. Влияние потребления возобновляемой энергии оказалось незначительным, тогда как экологический налог оказывает отрицательное и значимое воздействие на выбросы CO_2. Таким образом, увеличение экологического налога на 1% приводит к снижению выбросов CO_2 примерно на 0,23%. Результаты свидетельствуют о том, что пигуовские экологические/углеродные налоги в сочетании с мерами по повышению энергоэффективности и внедрению возобновляемой энергии могут быть эффективным инструментом снижения выбросов.

Ключевые слова: пигуовский налог, экологический налог, G7, панельная коинтеграция, CCE.

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