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Green Fiscal Policy through Natural Resource Taxation - The Case of the European Union and Bosnia and Herzegovina

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GREEN FISCAL POLICY THROUGH NATURAL RESOURCE TAXATION – THE CASE OF THE EUROPEAN UNION AND BOSNIA AND HERZEGOVINA

ABSTRACT

The European Green Deal and the Sofia Declaration on the Green Agenda for the Western Balkans emphasise sustainable natural resource management, biodiversity conservation, and the transition to a circular economy as central priorities in pursuing climate neutrality. The main objective is to improve management practices and prevent the overexploitation of natural resources while recognising the critical importance of ecosystem services. This priority is equally relevant for Bosnia and Herzegovina, considering its rich yet vulnerable natural capital, high dependence on natural resources for economic activities, and the need to align with EU environmental standards and sustainable development goals as part of its EU integration process. Across Europe, market-based policy instruments reinforcing the polluter-pays principle, such as environmental taxes, particularly resource taxes, have become increasingly favoured as tools for pollution control and natural resource management.

This paper explores the relationship between resource taxes and resource productivity within the green and circular economy context, focusing on the EU member states and Bosnia and Herzegovina from 2014 to 2023. Using a panel dataset and static panel regression models – including pooled Ordinary Least Squares (OLS), Fixed Effects (FE), and Random Effects (RE) – the study examines whether fiscal instruments, especially resource taxes, are associated with improvements in resource productivity and progress toward EU environmental performance targets. The expected findings will provide empirical insights into the role of fiscal policy in supporting the green transition and identify potential pathways for Bosnia and Herzegovina to fulfil its commitments under the Sofia Declaration for the Western Balkans, the European Green Deal, and relevant national strategies.

Keywords: *resource taxes, environmental taxes, resource productivity, circular economy, panel regression, European Union, Bosnia and Herzegovina, Sofia Declaration on the Green, European Green Deal.*

JEL: H21, H22, H23, C23, O44, Q54

1. INTRODUCTION

The growing global population, expanding economy, rapid urbanisation and a growing middle class have increased the demand for resources such as materials, water and land, putting pressure on these natural resources (UNEP, 2024). The current utilisation of natural resources, especially non-renewable resources, is not sustainable for the environment (considering climate change, biodiversity loss, and natural resource degradation) (Wilts & O'Brien, 2018). Recent events and changes in global geopolitics continue to impact how resources are managed. In the last few years, the Covid-19 pandemic and recent global inflation have highlighted the vulnerability of the global supply chain of material resources (also referred to as “materials”), as well as the need to secure the supply of essential materials while reducing materials demand at the same time. This has been reflected in resource policy developments, particularly on energy use, plus business actions to restructure supply chains and reduce supply disruption risks. Companies and countries are investing in extraction and processing projects in producing countries. Alongside the vulnerability of supply chains, material demand (including materials classed as “critical”) is expected to continue increasing in the coming decades (UNEP, 2024). This will be in order to feed an increasing population with changing models of consumption and to supply the materials required for goods, infrastructure and services, as well as for the deployment of the clean energy transition.

The global average of material demand *per capita* was 8.4 tonnes in 1970 and grew to 12.2 tonnes *per capita* in 2020. Material demand grew in line with GDP but rose significantly faster than the population. This has resulted in stagnant material efficiency in the global economy and increased consumption and material living standards. It is worth noting that the acceleration of global material extraction since 2000 has coincided with a slowdown in GDP and population growth. One driver of this phenomenon is likely to be the disproportionate concentration of GDP growth in economies transitioning from an agrarian-based to an urban-industrial economic mode, which is particularly intensive in material and energy use (Krausmann *et al.*, 2008). Biomass growing and harvesting, mineral and fossil resource extraction, and processing of materials, fuels and food accounted for more than 55% of global greenhouse gas emissions in 2022 and more than 60% if land-use change impacts are considered. This is a further increase compared to 2015 (reference year GRO 2019), demonstrating that climate mitigation efforts have neglected material-resource-related impacts. Growing and harvesting biomass (crops and forestry) contributed over 90% to global biodiversity loss and water stress. Few industrial sectors – food-related sectors (agriculture, retailers, and food services), wood-related industries (forestry, construction) and increasingly biochemicals – are responsible for the bulk of biodiversity loss and should be primarily targeted by policy. The extraction of resources and processing for food, materials, and fuels emitted many times more CO_2 emissions than the target would allow for all human activities combined and greatly exceeds targets for biodiversity loss. A transition to a circular and sustainable bioeconomy is critical, given the growing environmental impacts of biomass resources for all impacts. Reducing overconsumption, animal-based food, and food waste would bring co-benefits for all environmental impacts. Conversion (and strong intensification) of biodiversity and carbon-rich natural systems should be avoided and reversed. Since the availability of sustainable biomass is limited, biomass should be used in cascades and in long-term applications with biogenic carbon storage effects, replacing materials with significant impacts. Climate mitigation efforts have so far focused too little on agriculture, resource extraction, and processing and urgently need to be directed to this issue. Otherwise, the Paris Agreement goals cannot be achieved. This includes creating a circular economy to decrease the impacts of resources, whereby attention needs to be paid to sustainability and clean cycles (UNEP, 2024).

Resource efficiency is argued to be an indispensable element in this context, as earlier development patterns have led to prosperity, but through intensive and often inefficient resource use. Efficient use of available resources emerges as an imperative, not only because of their scarcity and the need to preserve them for future generations but also to reduce environmental impacts. A resource-efficient economy is, therefore, necessary. A resource-efficient economy (particularly a circular one) is an economy where economic development and growth are not achieved at the expense of natural resources' value, diversity, and quality. In developing a resource-efficient economy, the challenge lies in the fact that both the public and businesses perceive the use of ecosystem services as if their supply were unlimited. This challenge is related to the fact that these goods and services are not properly valued in the market (mostly taken for granted and treated as “free” goods) (UNDP, 2014). As a result, ecosystems are often overused, degraded, and polluted, negatively affecting human activities' long-term sustainability and resilience to external shocks.

In the effort to promote resource productivity, all policies must integrate sustainability principles. A policy mix that combines industrial, regulatory, R&D, and innovation instruments should also be developed with environmental, fiscal, and financial policies, public purchases, *etc*. Work is underway to develop specific fiscal and monetary policy instruments. Within this policy mix approach, particular attention will be placed on fiscal policies. Because they affect prices, fiscal policies constitute a potentially effective structural instrument for guiding markets and the behaviour of economic agents. In fact, the extensive literature on environmental policy clearly advocates market instruments based on prices and taxes (Vence & López Pérez, 2021). Economically, policies seek to ensure the sustainable usage of natural resources and manage associated costs. Socially, the aim is to distribute the goods produced through these resources and materials equitably (Abbas, 2024). Nevertheless, policy formulation for resource efficiency is still at a very early stage in EU Member States, with some notable exceptions (Wilts & O'Brien, 2018). Most countries were found to have a relatively long tradition of energy and waste policy. However, regarding material resource efficiency, many and varied institutional arrangements are in place, and several ministries are involved, with overlapping responsibilities and competencies.

Building upon the established understanding of resource productivity within the European context, this paper aims to bridge critical gaps by examining the role of resource taxes. The paper provides a rationale for such policies and develops guidelines for policymaking and managing the transition toward resource-efficient economies. Relying on the established understanding of resource productivity in the European context, this study examines the potential effects of resource taxes on improving resource productivity. Using panel data for EU countries and Bosnia and Herzegovina over the period 2014-2023 and conducting panel regression analysis, this research extends existing frameworks to better understand how resource taxes contribute to environmental quality, thereby offering policymakers valuable insights tailored to this context.

The rest of the paper is structured as follows. The first part of the paper presents previous research and theoretical background on the impact of resource taxes on resource productivity. The second part of the paper outlines the empirical research methodology, including the selection of variables and data sources, and econometric models used for the analysis. The third part of the paper provides the results and discussion. The last part of the paper provides the conclusions and recommendations, summarising the key research findings and offering policy suggestions.

1.1. Previous research and theoretical background

Many authors have investigated the effects of environmental taxes in various contexts (Piciu & Trică, 2012; Ligthart, 1998; Keen, 2023; Dahmani, 2023; Morley, 2010; Kalaš *et al.*, 2025; Socci *et al.*, 2024; Tchapchet-Tchouto, Koné, & Njoya, 2022; Gyamfi, 2022, *etc.*). However, the literature examining the impact of resource taxes remains limited.

Some authors have explored the influence of resource taxation on the progress of the circular economy. In this context, Deserno and Sterk (2025) examine how resource taxation can promote circular economy development in 30 European countries over the period 1995-2021. They find that resource taxes have a positive effect on resource productivity. Yet the effects differ across countries, indicating that taxation can support circularity but must account for other influencing factors. Further, Bahn-Walkowiak and Wilts (2017) emphasise that designing effective policy mixes for resource efficiency faces conceptual and practical challenges within multi-level governance systems. They argue that contrary to the ideal of a coherent top-down design, real-world policy development is often shaped by *ad hoc* coalitions, fragmented responsibilities, and institutional incoherence among resource, waste, and energy policies. Their findings highlight that policy implementation depends not only on theoretical rationales but also on institutional capacities, coordination mechanisms, and the competences of actors responsible for managing "policy mixes". Moreover, they note that the transition from resource efficiency strategies to circular economy frameworks within the EU has been hindered by limited policy integration and the absence of binding targets. This suggests that the effectiveness of resource taxation and related instruments depends on institutional alignment, cross-sectoral coordination, and credible long-term policy frameworks. Additionally, Mushafiq and Prusak

(2023) analyse EU-27 countries and demonstrate that higher resource productivity generally reduces environmental degradation, with effects differing across sub-samples depending on material footprint levels. Boadway and Flatters (1993) discuss the rationale for resource taxation, emphasising that special resource taxes aim to capture resource rents for the public sector, justified by efficiency and equity considerations. Building on this rationale, Amundsen (2024) provides an overview of Norway's resource rent taxation system, showing how such taxes have been applied to oil, natural gas, hydropower, wind power, and aquaculture, and highlighting that resource rents vary across sectors and over time, with future rents from fossil fuels expected to decline as renewable energy expands. This sectoral perspective is complemented by the broader cross-country evidence of Abbas *et al.* (2024), who analyse 39 resource-rich economies over the period 2000-2022. Their findings indicate that resource-based environmental taxation and green innovation significantly reduce the ecological footprint, while mineral trade and natural resource rents increase it. Taken together, these studies suggest that resource taxation not only captures rents for redistribution but can also serve as a tool to promote ecological sustainability when combined with innovation-driven strategies. However, studies examining the effects of resource taxes on resource productivity as an indicator of sustainability are lacking. To address this gap in the research literature, the present study investigates how resource taxes improve resource productivity in European Union countries, as well as Bosnia and Herzegovina.

Natural resources (biomass, fossil fuels, metals, non-metallic minerals, land, and water) are directly or indirectly linked to all 17 Sustainable Development Goals (SDGs). The way societies use natural resources through linear consumption and production patterns determines the trajectories of environmental impacts and human well-being. Unsustainable consumption and production patterns are identified as the common thread of the triple planetary crisis. The triple planetary crisis is a science-based framework adopted by the United Nations system that refers to three interlinked global environmental crises: climate change, biodiversity loss, and pollution (UNEP, 2024). The imperative for sustainable growth has become increasingly evident due to global resource constraints and environmental pressures (Malatyinszki, Zéman & Géza-Kálmán, 2025). For the contexts where resource use is expected to grow to enable dignified living, the aim should be relative decoupling (where resource use increases more slowly than human well-being outcomes). For all contexts, impact decoupling is a precondition for any resource use trajectory to be considered sustainable (limiting environmental and health impacts to levels agreed in MEAs). Domestic Material Consumption has been selected by the Inter Agency Expert Group (IEAG) for Sustainable Development Goals indicators as the basis for monitoring progress towards SDG 12.2, which calls for the sustainable management of natural resources. This role has both strengths and weaknesses. Its role as an indicator of the total waste potential that must ultimately be sunk back into the environment within a nation's territory is valuable, and it cannot be replaced by consumption-based measures such as material footprint. On the other hand, it is currently used for the SDGs in a highly aggregated form (typically one or at least four individual material categories), lumping together materials with radically different environmental impacts per tonne. Finally, it is crucial to use DMC with a consumption-based measure (UNEP, 2024). The ratio of GDP to DMC, resource productivity, oversimplifies sustainability analysis since its numerator and denominator are not independent. Fossil fuels belong to the four main material categories used to calculate the resource use and the global and national resource productivities, and for example, construction activities, cement production and the use of buildings are not only material but also energy-intensive. Measures to increase resource efficiency or reduce resource use often directly impact energy use and CO2 emissions in many ways.

Time is of the essence when it comes to finding new renewable energy sources, cutting down on energy usage, and making efficient use of the limited resources available. Achieving maximum resource efficiency is necessary for sustainable growth on a worldwide level in the long run (Kirikkaleli & Agyemang, 2025). The general motivation behind resource policies is primarily twofold: firstly, to address the risks associated with environmental damages occurring throughout the entire life cycle of resource use (negative externalities); and secondly, to capitalise on opportunities arising from potential eco-innovation, provided that material purchasing costs can be reduced and redirected into new processes, products, and system innovations. Such eco-innovation may involve material flow innovation (Bleischwitz, 2010).

Improvements in resource productivity can be achieved through structural change in the economy away from resource-intensive primary and manufacturing sectors to service-sector activities or outsourcing of material-intensive processes to countries abroad. Many policy instruments are available to regulate natural resource management and promote resource efficiency. In Europe, market-based instruments that reinforce the polluter-pays principle, such as environmental taxes, are increasingly favoured as tools for pollution control and sustainable resource management. These instruments create price differentials, making secondary or recycled resources more competitive (Deserno & Sterk, 2024).

The rationale for conventional environmental taxation is optimal taxation theory. In this theory, the principles of a "good tax system" are equity (vertical and horizontal), economic efficiency (does not distort the allocation of free market resources), and easy administration (management efficiency). The social planner's goal is to choose the tax system that maximises the representative consumer's welfare, knowing that the consumer will respond to whatever incentives the tax system provides. Absent any market imperfection, such as a pre-existing externality, it is best not to distort the choices of that consumer at all. This theory involves a narrow focus on individual consumer welfare and very unrealistic assumptions. It is challenging, if not impossible, to calculate the taxes and rates necessary to guarantee optimality in resource allocation and equity. On the contrary, it can be argued that any tax introduces a distortion in equity and allocation of resources; the question is how much and in which direction (Vence & López Pérez, 2021). The existing taxation system penalises labour-intensive activities, including many circular activities (*e.g.*, repair, maintenance, reuse, recycling, and remediation services), in contrast with the resource-intensive activities of the linear economy or the (robotised) manufacture of new products. Waste and resource use could be significantly reduced by decreasing the consumption of new material and energy resources, increasing the offer and consumer demand for circular activities (*e.g.*, reuse, repair, and maintenance) and, of course, recycling waste and returning it to the processing cycle (Vence & López Pérez, 2021). In the definition of Eurostat (2013), environmental taxes, *i.e.*, tax[es] whose tax base is a physical unit (or a proxy of a physical unit) of something that has proven, specific negative impact on the environment, can be divided into energy, transport, pollution, and resource taxes.

Natural resources are typically subject to taxation under the income tax system and special resource taxes. Properly designed income taxes attempt to include capital income on a uniform basis. However, in most countries, the income tax treats resource industries more favorably than most other industries through favourable treatment of such capital expenses as depletion, exploration and development, and the cost of acquiring resource properties (Boadway & Flatters, 1993). Over the past decade, resource taxation has received growing attention, with implementation advocated by various stakeholders. At EU level, the Commission emphasises the need to revise taxes and subsidies that distort the real costs of resource use. Resource taxation is also frequently debated at national and sectoral levels, like in Germany. Some European countries have already implemented resource taxes for specific materials, such as natural aggregates in Sweden, Denmark, and the UK (Deserno & Sterk, 2024).

2. METHODOLOGY OF THE EMPIRICAL RESEARCH

2.1. Selection of variables and data sources

This paper investigates the effects of resource taxes on resource productivity, using data from EU countries and Bosnia and Herzegovina for the period 2014-2023, sourced from Eurostat and national statistical reports. The selected independent variable is resource taxes, while the dependent variable is resource productivity. Resource taxes constitute the core explanatory variable. They include taxes linked to the extraction or use of natural resources, such as water, forests, wild flora and fauna, since these activities contribute to the depletion of natural resources. All taxes designed to capture the resource rent from the extraction of natural resources are excluded. Similarly, land taxes are excluded from the scope, except for specific levies related to the conversion of landscapes (*e.g.*, deforestation). Most land taxes are classified as property taxes and belong to the ESA category D.51 (taxes on income). Data are expressed in million EUR.

Resource productivity, expressed in euros per kilogram (EUR/kg), measures the gross domestic product (GDP) generated per kilogram of material consumed. It serves as an indicator of resource efficiency, with higher values reflecting the ability to generate greater economic value with lower material input. Domestic Material Consumption (DMC) reflects the material consumption within the national economy, covering biomass, fossil fuels, minerals, and metal ores (domestic extraction and imports), excluding exported materials (including materials embodied in exported products). The DMC variable is based on the Economy-wide Material Flow Accounts (EW-MFA) methodology, in line with Regulation (EU) No. 691/2011 of the European Parliament and of the Council on European environmental economic accounts, particularly Annex III – Module for EW-MFA.

In addition to these key variables, the study incorporates several control variables to enhance the reliability of the model estimation results. The selected control variables are GDP *per capita* and the share of energy from renewable sources. The volume index of GDP *per capita* in Purchasing Power Standards (PPS) is expressed relative to the EU average, which is set equal to 100. An index value above 100 indicates that a country's GDP per capita is higher than the EU average, while a value below 100 indicates the opposite. This index is frequently used to compare the economic well-being of populations. However, GDP includes components and transactions that may be less relevant for assessing households' current material well-being. PPS is the technical term used by Eurostat to denote a common currency that eliminates differences in price levels between countries, enabling meaningful comparisons. PPS values are derived by dividing a country's economic aggregates in national currency by the respective purchasing power parities (PPPs). These data are primarily designed for cross-country comparisons, rather than time-series analyses.

Gross final renewable energy consumption refers to the amount of renewable energy used for electricity, heating, cooling, and transport in EU Member States. It is expressed as a share of gross final energy consumption. The Renewable Energy Directive (2009/28/EC) defines gross final energy consumption as the energy commodities delivered for energy purposes to final consumers (industry, transport, households, services, agriculture, forestry, and fisheries), including the consumption of electricity and heat by the energy sector for electricity and heat production, as well as transmission and distribution losses. This indicator is a headline metric for monitoring progress towards the objectives of the Eighth Environment Action Programme (8th EAP). In particular, it contributes to monitoring progress towards the sustainable energy goals of Article 2.f of the 8th EAP, which requires the promotion of environmental aspects of sustainability and the significant reduction of key environmental and climate pressures associated with the Union's production and consumption patterns, especially in energy, industry, buildings and infrastructure, mobility, tourism, international trade, and the food system (EEA, 2025).

2.2. Econometric model

Three panel models were employed to evaluate the relationship between resource taxes and resource productivity. Specifically, pooled OLS, fixed effects, and random effects models were estimated to assess which regression specification best fits the data. Model adequacy was examined using the Hausman test, and the Breusch–Pagan test will be applied if conditions require it.

The following regression equation represents the general model for static panels:

$$RESPROD_{i,t} = \alpha_{i,t} + \beta_0 RESTAX_{i,t} + \beta_j Control_{i,t} + \varepsilon_{i,t} \quad (1)$$

where *i* and *t* are the individual and the year, respectively, α is a constant term, β is a parameter to be estimated, ε is a random error term, RESPROD is the resource productivity, *RESTAX* is the resource taxes, and *control* denotes the control variables.

Control variables are the GDP *per capita* and the share of energy from renewable sources.

3. RESULTS AND DISCUSSION

As previously stated, the primary purpose of this study was to investigate the relationship between resource taxes and resource productivity in EU countries and Bosnia and Herzegovina. The standard measures of resource taxation were considered at the country level and were enhanced by incorporating indicators relevant to sustainable economic growth. Furthermore, the broader impact of national-level resource tax policies on improving resource productivity was examined. This section presents the empirical results of the research.
The following table provides descriptive statistics for the observed variables.

Table 1. *Descriptive statistics*

Variable	Obs.	Mean	Std. dev.	Min.	Max.
RESPROD	228	1.9617	1.3384	0.2995	7.4285
RESTAX	226	77.8844	119.7934	0	450.0000
GDPPC	228	101.6579	47.8016	31.0000	280.0000
RENEWAB	227	24.6770	12.5755	4.4710	66.3930

Source: Authors' calculations using StataMP 17 software

The table presents descriptive statistics for the key variables used in the study. RESPROD (resource productivity) has an average value of 1.96, with a minimum of 0.30 and a maximum of 7.43, indicating substantial variation across countries. RESTAX (resource taxes) shows a mean of 77.88 and a wide dispersion (standard deviation 119.79), reflecting differences in tax policies among the observed countries. GDPPC (GDP *per capita*) averages 101.66, ranging from 31 to 280, capturing economic heterogeneity. Finally, RENEWAB (share of renewable energy) has a mean of 24.68%, with values ranging from 4.47% to 66.39%, illustrating varying levels of renewable energy adoption.

As shown in Table 2, RESPROD positively correlates with resource taxes (r = 0.3666) and GDPPC (r = 0.7030). These results suggest that higher resource taxation and income levels increase resource productivity.

Table 2. Correlations between the variables

Variable	RESPROD	RESTAX	GDPPC	RENEWAB
RESPROD	1.0000	0.3666	0.7030	-0.3694
RESTAX	0.3666	1.0000	-0.0013	-0.1160
GDPPC	0.7030	-0.0013	1.0000	-0.2598
RENEWAB	-0.3694	-0.1160	-0.2598	1.0000

Source: Authors' calculations using StataMP 17 software

Gujarati (2003) noted that if the correlation between the independent variables is larger than ± 0.8, we can conclude that severe multicollinearity problems exist. As shown in the correlation matrix, such a level of correlation does not exist in the model, and the variance inflation factor (VIF) test presented in Table 3 results confirm that model (1) does not suffer from the multicollinearity problem.

Table 3. Multicollinearity diagnostics (VIFs test)

Variable	VIF	1/VIF
RENEWAB	1.09	0.91896
GDPPC	1.07	0.93148
RESTAX	1.01	0.98549
Average	1.06	–

Source: Authors' calculations using StataMP 17 software

Table 4 presents the results of the panel regression analysis using OLS, FE, and RE models. RESTAX and GDPPC have positive and statistically significant coefficients across all models, indicating that higher resource taxation and *income per capita* are associated with higher resource productivity. The coefficient for RENEWAB is negative in the OLS model but positive in both FE and RE models, suggesting that accounting for country-specific effects changes the estimated impact of renewable energy on RESPROD.

Table 4. Results of panel regression analysis

Variable	**OLS model (a)**	**Fixed-effect model (b)**	**Random-effect model (c)**
RESTAX	0.0038893 (0.0004452)***	0.0057466 (0.0011603)***	0.0054415 (0.0009432)***
GDPPC	0.0186683 (0.0011585)***	0.0111141 (0.0025506)***	0.0158311 (0.0021810)***
RENEWAB	-0.0165781 (0.0043799)***	0.0589841 (0.0057881)***	0.0455128 (0.0056429)***
Constant	0.1713142 (0.1941725)	-1.062676 (0.2924499)***	-1.20131 (0.3175861)***
Observations	225	225	225
Number of IDs	–	23	23
Adj. R^2	0.6471	0.4710	0.4501

Note: Significance levels of 1%, 5% and 10% are denoted by ***, ** and *, respectively.
Source: Authors' calculations using StataMP 17 software

Table 5 shows the Hausman test results comparing FE and RE models. The results indicate that the FE model is preferred. This implies that unobserved country-specific effects are correlated with the regressors, and the FE model provides consistent estimates.

Table 5. Hausman test (FE vs. RE)

Variable	**FE Coef. (b)**	**RE Coef. (B)**	**Difference (b-B)**	**Std. err. of difference**
RESTAX	0.0057466	0.0054415	0.0003052	0.0008165
GDPPC	0.0111141	0.0158311	-0.004717	0.0016625
RENEWAB	0.0589841	0.0455128	0.0134712	0.0026249

Source: Authors' calculations using StataMP 17 software

The estimated FE model can be expressed as follows:

$$RESPROD_{i,t} = -1.0627 + 0.00575RESTAX_{i,t} + 0.01111GDPPC_{i,t} + 0.05898RENEWAB_{i,t} + \varepsilon_{i,t}$$

According to this specification, a one-unit increase in RESTAX or GDPPC is associated with an increase in RESPROD, and the share of renewable energy contributes positively to resource productivity after controlling for country-specific effects. These results are consistent with the findings of Deserno and Sterk (2025), who also report that resource taxation can be an effective policy instrument in enhancing circular economy progress. Furthermore, both studies highlight that the effectiveness of resource taxation may depend on complementary policy measures, such as renewable energy incentives, waste management regulations, or broader environmental tax reforms. This could explain why RENEWAB shows a positive and significant association with resource productivity in our fixed-effects model, suggesting potential policy synergy between fiscal and energy transition measures.

4. CONCLUSIONS AND POLICY RECOMMENDATIONS

This study provided insights into the potential of resource taxes as a fiscal instrument to enhance resource productivity. However, as Bleischwitz (2010) emphasises, the complexity of addressing the various barriers and drivers associated with sustainable resource management, the likelihood of trade-offs among competing policy objectives, and the involvement of multiple actors suggest that no single instrument is sufficient; instead, a comprehensive policy mix is required. Despite the currently low levels of resource taxation, the findings indicate that resource taxes positively affect resource productivity, at least in the short term, and therefore appear to support the transition towards a circular economy. Nevertheless, the results demonstrate that other influencing factors must be considered while designing economic and environmental policy. These findings are consistent with Deserno and Sterk (2025), highlighting that resource taxation can contribute to circularity. Furthermore, in line with Abbas *et al.* (2024), integrating resource taxation with green innovation can significantly mitigate the negative environmental impacts associated with resource dependence, enhancing ecological sustainability.

One limitation of this study lies in the measurement of resource productivity, which has several dimensions. Firstly, resource use is measured only in terms of physical weight, which does not adequately capture resource value, scarcity, or environmental impacts. Secondly, only domestic resource consumption is considered, while global resource flows, imports, and exports may significantly influence actual resource efficiency and sustainability. Thirdly, the analysis does not incorporate all possible socio-economic and institutional factors across countries, which may also affect the effectiveness of resource taxation.

In the context of these findings, effective policy design should integrate resource taxes within a broader fiscal framework that promotes green innovation and circular processes to maximise resource productivity and reduce environmental footprints. Resource taxation should be coupled with measures that incentivise research and development in sectors that utilise natural resources and differentiated based on resource type, scarcity, and ecological impact to ensure efficient and equitable allocation. Additionally, international resource flows should be monitored and incorporated into policy planning to accurately assess resource productivity, particularly within a global circular economy. In contrast, harmonisation with international policies should be considered. Resource taxes must be implemented alongside complementary regulatory measures, public investments in sustainable infrastructure, consumer education, and incentives for circular business models. A gradual implementation approach with continuous monitoring and adjustment is recommended, as abrupt or excessive taxation could lead to unintended socio-economic consequences.

In summary, resource taxation demonstrates significant potential to enhance resource productivity and facilitate the transition towards a circular economy. Its effectiveness, however, depends on strategic integration with policies promoting green innovation, sustainable production, and careful consideration of global resource flows. Effective resource policy must address multiple dimensions of sustainability – ecological, economic, and social – to ensure long-term resource sustainability and contribute meaningfully to achieving the SDGs.

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