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RESEARCH ARTICLE

Environmental taxation in Europe: What does it depend on?

Concetta Castiglione^{1,2}, Davide Infante^{2*}, Maria Teresa Minervini² and Janna Smirnova²

Abstract: The present work adds to the existing literature the analysis of the determinants of environmental taxation in European economies. Using a pooled panel data, we consider various groups of factors influencing environmental taxation referring to production and consumption, environmental performance and the quality of governance of European countries, taking into account their heterogeneity. We argue that in order to function, environmental taxation policy should rely on the virtuous interrelationship between economic development and institutional enforcement, which contributes to enhancing the process of environmental renaissance.

Keywords: H23—externalities, redistributive effects, taxes and subsidies, Q56—environment and development|trade sustainability|accounting, O52—Europe, O1—economic development

1. Introduction

In the economic literature, there has been a new wave of interest in the role of environmental taxation as an active policy of environmental protection. This interest mostly comes from the results achieved by the application of this policy in many countries, particularly in so-called eco-leader

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PUBLIC INTEREST STATEMENT

Environmental taxation is one of the most diffused policy instruments in Europe. While the effects of this policy are well documented in the literature, its determinants are still left in the shade. The empirical model takes into account the factors that influence environmental taxation, such as production and consumption processes, environmental performance and governance quality of 24 European countries. It is argued that in order to obtain a functional taxation policy, regulators should take advantage of the interrelationship existing between economic growth and institutional enforcement. In the model, institutions are considered through the quality of the regulator and expenditure on environmental protection. The former is proved to be an important determinant of taxation in all countries. The latter is important for countries with mature industrial and service sectors and not for countries that present delayed development or former transition economies. This could be due to still weak institutions that limit the application of policies in these economies.

European economies. Among the advantages of this policy, some factors are particularly highlighted by empirical and theoretical models. These are environmental renaissance, internalisation of external costs, environmental incentives and an increase in tax revenues. These factors are part of the basis for the Environmental Tax Reform proposed by the European Environment Agency (2005). The aim of the reform is to shift the burden of taxation from “goods” (such as capital and labour) to “bads” (such as polluting factors). Therefore, to consider environmental taxation as a tool that not only corrects negative externalities but also reduces general taxation distortions, thus improving social welfare (Ekins, Pollitt, Summerton, & Chewpreecha, 2012). However, the disadvantages of environmental taxation policy are also taken into consideration when referring to the maintenance of the rights to pollute, the increase in fiscal pressure, the decrease in the competitiveness and consumption, a provision of incentives for rent-seeking activities and the uncertain effects of double dividend hypothesis (Eisenack, Edenhofer, & Kalkuhl, 2012; Svendsen, Daugbjerg, Hjøllund, & Pedersen, 2001; Wier, Birr-Pedersen, Jacobsen, & Klok, 2005).

In evaluating the application of environmental taxation policy, a better understanding of taxation itself is needed. In fact, while the effects of this policy are well discussed, the argument of the determinants of taxation is still left in the shade (Anger, Bohringer, & Lange, 2006; Ward & Cao, 2012). A better understanding of the main factors that influence this policy instrument is necessary for it to function effectively. Therefore, the contribution of this paper is to investigate the determinants of environmental taxation using a panel of European countries for the period from 1996 to 2012.

Environmental taxes were introduced in Europe in the beginning of the 1990s and they have become one of the most commonly used environmental policy instruments. The impact of taxes on environmental quality and on economic performance is a topic addressed by numerous studies (Ekins, 1999; Ekins & Barker, 2001; European Environment Agency, 2005; Kosonen, 2010; Scrimgeour, Oxley, & Fatai, 2005 among others). These studies evidenced the positive impact of environmental taxation in European economies. The examples of positive impact can refer to the tax on carbon dioxide emissions, the tax on leaded petrol, taxes on waste and waste treatment, traffic congestion charges, vehicle excise duties among others (Leicester, 2006; Sartzetakis, Xepapadeas, & Petrakis, 2012; Vehmas, 2005). Some of the European countries have also recorded a positive impact of environmental taxation on economic performance. These are eco-leaders such as Denmark, the Netherlands, Norway and Sweden that not only have contributed to environmental progress but also have gained in economic performance by recycling the revenues obtained from environmental taxation back into the economy, thereby reducing income taxes and increasing investments (Scrimgeour et al., 2005).

Instead of concentrating on the effects of environmental taxation, a few studies emphasise the factors responsible for the efficacy of this policy instrument (Castiglione, Infante, & Smirnova, 2012; Ekins & Barker, 2001; Scrimgeour et al., 2005; Muller & Sterner, 2006). Although these studies mainly consider the applicability of environmental taxation, they also provide some hints to identify possible factors that influence this policy. Based on the existing literature, we shall attempt to identify the most likely determinants of environmental taxation.

2. Empirical model, data and methodology

We consider environmental taxation revenues as the variable reflecting environmental taxation policy. Three categories of factors influencing environmental taxation revenues are taken into account. The first are factors regarding production and consumption processes. The second regards the environmental quality of European countries. Finally, the third category summarises factors reflecting the quality of governance.

There is considerable evidence of the importance of the degree of economic development for environmental awareness (Dasgupta, Mody, Roy, & Wheeler, 2001; Dinda, 2004; Galeotti, Lanza, & Pauli, 2006), demonstrating that economic growth increases the demand for environmental protection. Obviously, economic growth also implies an increase in the demand of goods and services that leads to the increase in energy intensity of the economy. As a consequence, the

compatibility between economic growth and the environment can be supported only by functioning environmental policies. To reflect these factors, among the determinants of environmental taxation of the first group, we consider such variables as per capita income and energy saving.

When considering environmental quality, we should keep in mind both positive and negative tendencies. The first is the production of pollution and emissions coming from any activity related to production and consumption processes. We approximate these factors by the indicator of municipal waste generation and the release of sulphur emissions, which is one of the important sources of air pollution. Positive trends in environmental quality are considered through the indicator of primary energy production from renewable sources.

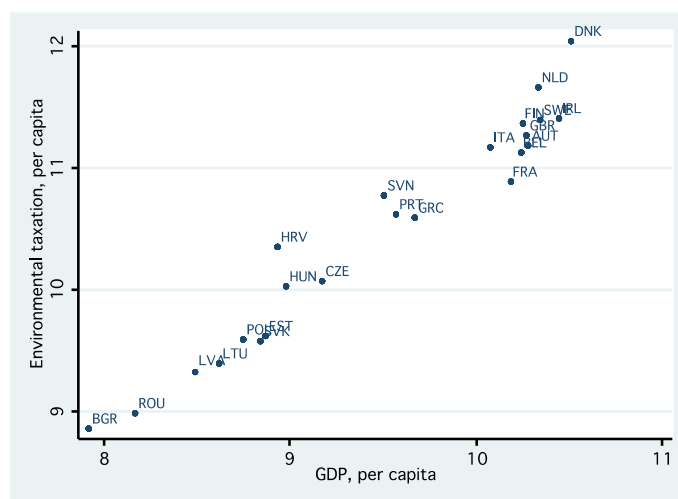
Finally, as underlined in the literature, the institutional context plays a crucial role in the implementation of environmental policies (Bhattarai & Hammig, 2004; Dasgupta et al., 2001; Fredriksson, List, & Millimet, 2003). Of particular importance for the implementation of environmental policies is governance quality. In fact, environmental protection can hardly be implemented without state intervention (Castiglione et al., 2012), while the functionality of regulation depends on the strength of the institutional context (Infante & Smirnova, 2009). Moreover, as it is known, institutional strength is closely related to the degree of economic development (Acemoglu, Johnson, & Robinson, 2001; Giménez & Sanaú, 2007; Welsch, 2004), and hence reinforces the positive impact on the environment. For these reasons, we include the governance indicator among the determinants of environmental taxation such as the index of regulatory quality, which is one of the indicators of institutional context (Kaufmann, Kraay, & Mastruzzi, 2010). The indicator varies from -2.5 to $+2.5$, where greater values correspond to a stronger ability of government to formulate and implement policies and regulations. Finally, environmental protection expenditure, as an indicator of environmental awareness of society, is also taken into account. The description of variables used in the analysis and the sources of data are reported in Table 1.

Given the widely accepted evidence on the heterogeneous economic, environmental and institutional performance of European countries, we divide the sample into three groups. The first group (G1) includes market economy countries with mature industrial and service sectors (Austria, Belgium, Denmark, France, Finland, the Netherlands, Sweden and the United Kingdom); the second group (G2) refers to market economy countries that present delayed development at national or regional levels (Greece, Ireland, Italy and Portugal); former transition economies (Bulgaria, Croatia, Czech Republic,

Table 1. Variables description and sources

Variables	Description	Source
<i>EnvTax</i>	Total environmental tax revenues, percentage of GDP	Eurostat (2014)
<i>GDP</i>	GDP (constant prices), per capita	Eurostat (2014)
<i>EnConsSav</i>	Energy saving in primary energy consumption, thousand tons of oil equivalent	Eurostat (2014)
<i>SO2</i>	Sulphur oxides emissions, tons	Eurostat (2014)
<i>Wst</i>	Municipality waste generated, kg per capita	Eurostat (2014)
<i>RenewEnerg</i>	Primary renewable energy production, thousand tons of oil equivalent	Eurostat (2014)
<i>RegQual</i>	Regulatory quality, measured in units ranging from -2.5 to $+2.5$, with higher values corresponding to better regulatory quality	Kaufmann (2014)
<i>PubExp</i>	Environmental protection expenditure, per capita (constant prices)	Eurostat (2014)

Figure 1. The relationship between environmental taxation revenues and income.



Estonia, Hungary, Lithuania, Poland, Romania, Slovakia and Slovenia) are included in the third group (G3). The selection of countries was conditioned by data availability.

Data analysis reveals the expected heterogeneity among the three groups of countries. Figure 1 shows the relation between environmental taxation revenues and per capita GDP. It can be noted that the G1 group with higher levels of income presents greater environmental taxation revenue per capita compared to the G2 group. Former transition countries with lower levels of income demonstrate lower levels of environmental taxation as compared with the other two groups. This confirms that countries at the advanced stage of economic development enhance their environmental protection policies. Important differences also lie in all three categories of the indicators. For example, for production and consumption indicators, energy saving decreases from G1 to G3 group. The same can be said about governance quality indicators, such as regulatory quality, that are lowest for G3, which confirms a still weak institutional context of former transition economies. Taking the environmental quality indicator of environmental expenditure, a similar divergence between the groups can be noted.

In order to evaluate environmental taxation determinants, we estimate a pooled panel data model for three groups of countries:

$$EnvTax_{it} = \alpha_0 + \sum_{j=1}^2 \alpha_j x_{jit} + \sum_{j=3}^5 \alpha_j \gamma_{jit} + \sum_{j=6}^7 \alpha_j z_{jit} + \varepsilon_{it} \quad (1)$$

where $EnvTax_{it}$ is environmental taxation; x_{it} is a vector of determinants reflecting production and consumption processes: per capita income (GDP), primary energy consumption saving ($EnConsSav$); γ_{it} is a vector of determinants of environmental quality: sulphur emissions (SO_2), municipal waste

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
<i>EnvTax</i>	385	0.97886	0.24240	0.16551	1.64229
<i>GDP</i>	391	9.49765	0.81696	7.54960	10.62133
<i>EnConsSav</i>	391	3.34447	1.10266	1.33500	5.56720
<i>SO2</i>	368	11.97669	1.27756	8.95416	14.67756
<i>Wst</i>	385	-9.93222	1.04154	-11.9129	-8.00556
<i>RenewEnergy</i>	391	7.70778	1.105545	5.12694	9.94107
<i>RegQual</i>	391	1.12715	0.48928	-0.16072	2.07664
<i>PubExp</i>	291	4.06358	1.31747	-0.99425	6.61376

Note: Variables are expressed in logs.

generation (*Wst*) and production of primary renewable energy (*RenewEnergy*); finally, z_{it} includes the indicators that belong to governance strength: regulator quality (*RegQual*) and environmental expenditure (*PubExp*). A summary of sample statistics is presented in Table 2.

3. Results and discussion

The estimated results of our model are displayed in Table 3. The second and third columns report the results for the G1 group; the fourth and fifth columns report the results for the G2 group, while the last two columns show the results for the G3 group. Dealing with panel data, we considered the difference between random and fixed effect models (Cameron & Trivedi, 2009). To estimate Equation 1, we preferred the random effects model since dividing the sample into three groups of countries according to their economic characteristics prevents potential correlation between country-specific effects and the explanatory variables.

The upper part of the table presents the estimations for the determinants reflecting production and consumption processes. The effect of per capita income (*GDP*) on environmental taxation is positive and highly significant in the G1 and G2 groups. This confirms the relationship existing between the degree of economic development and environmental awareness. Countries that are in the advanced stage of economic development invest more on environmental protection. However, the impact of *GDP* on *EnxTax* is higher in the G2 group, since the magnitude of the parameter is 0.742, while in G1, it is equal to 0.307. Interestingly, environmental taxation of the G3 group is not influenced by the income variable. This could be the result of the delayed application of environmental policies in former transition countries. In fact, while G1 and G2 economies have a mature environmental taxation system, G3 countries are still at the initial stage of this policy application, which makes it unaffected by the changes in *GDP*. The confirmation of this result can be found when considering the difference in the levels of environmental taxes collected in the three groups of countries, with about 15% less in G3 as compared to G1 and less than 8% as compared to G2.

Expected results are obtained regarding the primary energy consumption saving variable (*EnConsSav*). The contribution of this determinant for environmental taxation in all groups is negative and statistically significant. The result is straightforward, given that energy saving has a positive impact on environmental quality, reducing emission levels and, therefore, decreasing environmental tax

Table 3. Determinants of environmental taxation in G1, G2 and G3

Variable	G1		G2		G3	
	Parameter	t-Statistics	Parameter	t-Statistics	Parameter	t-Statistics
<i>Production and consumption</i>						
<i>GDP</i>	0.307**	2.02	0.742***	3.40	0.086	0.75
<i>EnConsSav</i>	-0.309*	-1.91	-0.642***	-4.42	-0.312**	-2.17
<i>Environmental quality</i>						
<i>SO2</i>	0.183***	4.08	0.145***	2.53	-0.006	-0.14
<i>Wst</i>	0.005	0.04	-0.626***	-3.36	-0.291**	2.25
<i>RenewEnergy</i>	0.009	0.53	-0.009	-0.12	0.019	0.24
<i>Governance indicators</i>						
<i>RegQual</i>	0.236***	3.85	0.191***	4.21	0.168*	1.68
<i>PubExp</i>	0.087**	2.31	-0.285***	-3.43	-0.030	-1.28
<i>Constant</i>	-3.889*	-1.85	-10.91***	-4.03	-1.900	-1.18

*Test statistic significance at the 10% level.

**Test statistic significance at the 5% level.

***Test statistic significance at the 1% level.

payment. Interestingly, this impact has higher magnitude in G2 group (-0.642) compared with other two groups where the impact is equal to -0.309 and -0.312 for G1 and G3 countries, respectively.

The central part of Table 3 reports the estimation for environmental quality indicators. The proxy of polluting factors, such as sulphur emissions (SO_2), being sources of environmental taxation, has a positive and statistically significant impact on environmental taxation with similar magnitude in G1 and G2 groups, while it is not statistically significant in G3 group. Weakly enforced environmental policy of G3 group could be the reason why SO_2 has no impact on taxation. An unexpected result is achieved when waste generation (Wst) is considered. This variable has no influence on environmental taxation in G1 group, while it is negatively significant for G2 and G3 groups, with higher impact in G2 (-0.626) compared with G3 (-0.291). This finding could also indicate the insufficient enforcement of environmental policy, since greater amount of waste is not found to be reflected in smaller environmental taxation revenues. Primary production of energy from renewable sources ($RenewEnergy$), such as photovoltaic, biomass, wind energy and other sources, has no significant impact on environmental taxation in all groups. Clearly, the production of energy from alternative sources is expected to reduce the production of energy from consolidated polluting sources. However, it should be noted that environmental taxation revenues are often utilised to enhance the diffusion of renewable sources of energy. The non-significant impact of renewable energy production on environmental taxation can be the result of this mechanism.

The lower part of Table 3 takes into account the governance quality indicators. Results show the institutions' matters for environmental taxation. The variable of regulatory quality ($RegQual$) that reflects perceptions of the ability of government to formulate and implement policies and regulations is positive and statistically significant in all groups. The highest impact (0.236) is found in the G1 group, while the influence is found to be less for the other two groups (0.191 and 0.168 for G2 and G3, respectively). This demonstrates that the reinforcement of the quality of governance is crucial for the application and the enforcement of environmental protection policy. In turn, government environmental spending ($PubExp$) that is aimed to protect the environment has, as expected, a positive and significant role (even though with a low magnitude of 0.087) for environmental taxes in G1 group, while it is not significant for the G3 group. This is in line with our hypothesis of heterogeneity in environmental policies among European countries, where market economy countries have access to more resources to invest into environmental protection, while former transition countries are still lagging behind in introduction, application and enforcement of environmental taxation. An unexpected result is achieved for G2 group, where government environmental spending is found to have a negative influence on environmental taxation. This could mean that the countries of this group are not able to take an advantage of environmental protection investments on environmental taxation.

4. Conclusions

Progress in environmental quality can be only the consequence of effective policies of environmental protection. The aim of this work is to investigate one of the most utilised environmental policy tools, i.e. environmental taxation. In particular, we check for the determinants of environmental taxation for a panel of 24 European countries for the period from 1996 to 2012.

Environmental taxation is still considered to be a controversial policy instrument. On the one hand, environmental taxes are proved to be a functional policy that has already given its positive contribution in terms, first of all, of pollution reduction and in terms of economic performance, especially in the most virtuous European countries. On the other hand, environmental taxation is often found to be responsible for distortions in production and consumption processes, undermining economic performance. In order to evaluate the role that environmental taxation plays for the environment and for economic development, it is crucial to understand the factors that may influence this policy instrument. The existing literature on environmental issues does not give an exhaustive explanation of environmental taxes determinants. Our work aims to open a discussion on this important issue.

We search for the environmental taxation determinants by concentrating on three groups of factors. The first group includes the variables responsible for consumption and production processes; the second group refers to the factors that reflect environmental quality; the indicators of the quality of governance are included in the third group. The countries of the sample, in turn, are also divided into three groups in order to highlight the heterogeneity existing of European economies depending on the degree of economic development, environmental awareness and quality of institutions.

Our findings are in line with studies that demonstrate the interdependence of economic development and environmental quality, emphasising the role of institutional enforcement (Castiglione et al., 2012; Cole, 2007; Culas, 2007; Dutt, 2009; Leitão, 2010). The model demonstrates the importance of production and consumption indicators expressed as income per capita and of energy consumption saving for all groups. In turn, environmental quality determinants, such as pollution and waste generation, may determine environmental taxation only in those countries that provide strong enforcement of their environmental policies. We find that energy production from renewable sources has an uncertain effect on environmental taxation in all the groups probably because environmental taxation revenues are often utilised to subsidise alternative fonts of energy.

Governance indicators are taken into consideration through the quality of the regulator and through expenditure on environmental protection. The former indicator is proved to be an important determinant of environmental taxation in all groups of countries. The latter indicator is correlated with environmental taxes only for countries with mature industrial and service sectors and not for countries that present delayed development or former transition economies. This could be due to stagnant or still weakly enforced institutions that limit the application of environmental policies in these economies.

Our findings suggest that in order to apply environmental taxation policy, countries should take advantage of the interrelationship between economic growth and institutional enforcement; in other words, the connection between economic development and environmental awareness inevitably requires the application and enforcement of functional environmental policies.

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