Rule of law and its implications for the environmental taxation-income path across European Countries

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Abstract

Recent research has clearly demonstrated that economic development is closely related to environmental quality. In last two decades this relationship has been described by the Environmental Kuznets Curves that postulates an inverted U-shaped relationship between pollution and income. However, while theoretical and empirical research has focused on the polluting effects of economic development, few have identified the policy instruments which can be introduced to counteract such negative effects. This paper concentrates on one of these instruments and examines how environmental taxation is related to economic development. The introduction of environmental taxes usually requires strong regulation capabilities such as effective monitoring and enforcement. We assume that these capabilities reflect the integrity of the institution of rule of law and examine how the strength of rule of law affects the environmental taxation-income path. Data from 28 European countries analysed confirm the existence of an inverse U-shaped relationship between environmental taxation and per capita income. The empirical results clearly demonstrate that the environmental taxation-income relationship is strongly influenced by the rule of law which, when strong, ensures that environmental policies are implemented effectively. A strong rule of law thus contributes to achieving a turning point at lower levels of per capita income. Our analysis also made it possible to identify differences in environmental taxation-income paths among European countries, showing that post-transition economies may have not yet reached the turning point of the curve due to the presence of a weaker rule of law.

Keywords: Environmental taxation, Environmental Kuznets Curve, Rule of law

JEL Classification: H23, O43, O44, P28, Q58

1. Introduction

Extensive theoretical and empirical research suggests that improvements in environmental quality with the rise of per capita income, could reflect how successfully environmental policies are implemented. In this paper we analyse the relationship between income and taxation, one of the most important marked-based instruments for environmental protection. To the best of our knowledge the economic literature does not provide a clear picture concerning the relationship between environmental taxation and economic activity, as represented by per capita income. The idea that environmental taxation may first increase with rising income before it starts to decline with even higher income is a hypothesis that we denominate as Environmental Taxation Kuznets Curve (ETKC). This relationship, being the result of successfully implemented environmental protection policies, is proved to be strongly influenced by the institutional context.

The relationship between economic development and environmental quality has been widely discussed. This relationship is usually measured by the Environmental Kuznets Curve (EKC) that defines the links between economic growth and environmental degradation. Models that investigate the existence of EKC propose an inverse U-shaped curve whereby, starting from lower levels of per capita income, pollution increases gradually to reach a peak before decreasing at a turning point at higher levels of per capita income. The evidence of the classical EKC is usually based on various theories relating how socioeconomic progress relates to environmental protection (Galeotti et al., 2006). One of these theories considers environmental quality as a socially preferred good. This theory suggests that, as economic

growth and social well-being increase, stronger institutions call for environmental awareness, thus opting for environmental protection as active policy and not simply as the consequence of economic development. This theory, therefore, points towards compatibility between economic growth and a clean environment that can be achieved through application of effective environmental policies. The introduction and application of these policies, in turn, depend to a great extent on the stringency of the institutional context. In fact, the quality of institutions is proved to strongly affect the functioning of environmental policies (Bhattarai and Hammig, 2004; Dasgupta et al., 2001; Leitão, 2010; Magnani 2000).

Numerous studies confirm the importance of market-based policy instruments, such as environmental taxes, for pollution reduction (for example, Ekins, 1999; Ekins and Barker 2001; EEA, 2005; Scrimgeour et al., 2005). The use of environmental taxation is found to produce a double dividend by achieving not only environmental but also economic improvements (Bosquet 2000). It is argued that tax extraction from polluting factors instead of production factors leads to the rise in economic growth (Bovenberg and de Mooij, 1997).

While the results of environmental protection are well documented in empirical studies, the factors that contribute to its implementation are left in the shade. Some studies make an effort to analyse environmental protection and evidence factors crucial for its efficacy (Barker 2001; Ekins and Barker, 2001; Bovenberg and de Mooij, 1997). One of these factors should be institutional enforcement. Among others, institutions such as the protection of property rights, legal origins, democracy and governance have been shown to have an important impact on the quality of the environment (Cole, 2007; Leitão, 2010; Weisbuch, 2000). However, among the institutions studied from an environmental perspective, that of rule of law has not yet received attention its deserves. Given that implementation of environmental policies and particularly of environmental taxation, rarely occurs without state intervention, the strength of the rule of law, which is an institution of governance, is expected to have a decisive impact. We hypothesize that the rule of law plays a double role in environmental taxation implementation. The first is a direct mechanism that refers to the impact that the rule of law has on environmental taxation, since strong rule of law has a positive impact on the enforcement of the taxation system. In turn, there is an indirect impact that works through the positive contribution that the rule of law gives to economic growth. Since taxation is commonly related to per capita income, which is assumed as ability to pay, the rule of law, through its contribution to economic growth, indirectly affects environmental taxation.

In this paper, therefore we advance two hypotheses. The first evaluates the existence of the Environmental Taxation Kuznets Curve, i.e. an environmental taxation–income path. In particular, we show that the relationship between environmental taxation and per capita income results in an inverse U-shaped curve. The second hypothesis tests whether the turning point of ETKC is influenced by the stringency of the rule of law. We demonstrate that enforcement of the rule of law shifts the turning point to lower levels of per capita income, accelerating the improvement of environmental quality.

2. Background

An increasing body of empirical research (for reviews see Dasgupta et al., 2002; Dinda, 2004; Stern, 2004), has confirmed the existence of the EKC for various polluters in different countries, including European countries (Bimonte, 2002; Markandya et al., 2006; Dutt, 2009; Lipford and Yandle, 2010). The presence of this curve indicates the progress achieved in environmental protection policies. Various studies put forward a wide range of factors that contribute to this progress, such as an increase in welfare and economic openness, shift to

green technologies, switch in preferences *verso* clean products, among others. Not surprisingly, environmental policy plays a decisive role in determining how these factors influence environmental protection.

In turn, some studies have demonstrated that the successful implementation of environmental policies is determined by the institutional context. For example, corruption has been shown, at theoretical and empirical level, to have a negative effect on the environment, undermining the effectiveness of such policies (Cole, 2007; Damania et al., 2003; Leitão, 2010, Lopez and Mitra, 2000, Welsch, 2004). In contrast, strong institutions in the form of political liberties, civil rights and democracy have been shown to positively contribute to environmental issues (Bhattarai and Hammig, 2001; Frankel and Rose, 2002; Torras and Boyce, 1998) as have secure property rights (Culas, 2007) and legal protection (Di Vita, 2009).

Rule of law is one of the most important institutions that determines the successful implementation of policies (Galeotti, 2007). Kaufmann et al. (2010) define the rule of law as the "perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence". Environmental policies are therefore dependent on the quality of this institution as it determines the functionality and applicability of these policies. Although the link between the quality of the rule of law and effective environmental policies is not surprising, very few empirical studies have shown that a reinforced rule of law improves environmental quality (Panayotou, 1997; Bhattarai and Hammig, 2001, Castiglione et al. 2012).

Inter alia, environmental taxation is one of the instruments that policy makers introduce to compel private users of environmental resources to take account of the social costs of their actions. As argued in the early literature (Pigou, 1932 and Baumol 1972), environmental taxation would improve social welfare since this tax is imposed to neutralise a negative externality. Today it is demonstrated that the double dividend produced by environmental taxation through environmental improvements and gains in economic performance greatly enhances environmental effectiveness (Bosquet 2000, Bovenberg and de Mooij, 1997, and Scrimgeour et al., 2005). At the same time, it needs to be still understood which the factors are responsible for the effectiveness of this policy.

Here, we evaluate the extent to which the European environmental taxation is determined by the strength of the rule of law and how its enforcement contributes to reversing the gradual increase in pollution. Most policies aimed at environmental improvement and preservation were introduced in Europe at the end of eighties and beginning of nineties. The emergence of these policies was initially instigated by increasing public awareness of environmental damage and the widespread realisation of its detrimental effect to the long-term goals of economic development (EEA, 1995).

Since then, the taxation system in European countries has passed through complex evolution processes that witnessed the introduction of different forms of taxes designed to perform different functions. A large part of these environmental taxes has been proven to be effective (EEA, 2005). Some notable examples are Germany's introduction of taxation on leaded petrol which led to the rapid substitution of this polluting fuel with an environmentally less damaging one; the decrease in the amount of waste delivered to landfill sites in Denmark after the introduction of a tax on waste treatment; the reduction of traffic in urban centres after a traffic congestion charge was introduced in various European cities (Ekins, 1999).

These are a few of the many examples that demonstrate that when environmental taxes successfully reduce polluting factors, less taxation is subsequently required. Therefore, in conditions where the rule of law is strong and policies are properly reinforced, the volume of environmental taxation may actually first increase and then decrease as a consequence of the

effectiveness of environmental policies. Some European countries, the so called "eco-leaders" such as Denmark, Netherlands, Norway and Sweden have achieved much progress in application of environmental taxation policy (Scrimgeour et al., 2005). These countries have successively reduced emission levels, and this has led to the decrease of environmental taxation inflow. Even though, the revenue generation through tax extraction, was not the primary aim of environmental policy, most of these countries recycle the revenue obtained from taxation back into economy by reducing income tax and increasing investments, which significantly enforces the economic performance. The success in introduction such environmental taxes has induced the European Environmental Agency to prefigure a reform of the tax system, denominated Environmental Tax Reform (ETR). According to EEA (2005), the ETR is a change in the national tax system that shifts the burden "from economic function, sometimes called 'goods', such as labour (personal income tax), capital (corporate income tax) and consumption (VAT and other indirect taxes), to activities that lead to environmental pressures and natural resources use, sometimes called 'bads' (EEA, 2005: 83)". The main aim of this taxation policy shift in European countries is to reconcile economic growth and the environment (Ekins, 2011).

In the light of progress achieved in environmental policies we advance the hypothesis that the relationship between environmental taxation and income per capita should exhibit an inverse U-shaped profile, strongly influenced by the stringency of the rule of law. Therefore, we evaluated the existence of what we term an Environmental Taxation Kuznets Curve (ETKC), The increasing slope of the curve is found in conditions where income and institutions are growing, and environmental taxes are introduced. When these taxes achieve major efficacy, the ETKC curve reaches a turning point with the pollution levels that stop increasing and start declining. This turning point reflects a moment when relatively high level of income per capita is achieved and institutional quality is improved. At this point, no further increase in taxation is needed since the existing one is able to promote pollution abatement. The decrease of emission levels implies a diminishing taxation burden. The relationship between environmental taxation and income would, therefore, result in an inverse U-shaped curve, where emissions would increase with more intense environmental protection measures and decrease with less intensive measures, supported by the stringency of the rule of law.

In providing our analysis we assume that heterogeneity should exist in environmental taxation-income path in different countries. In fact, the theory of opportunity costs states that, in pollution abatement, wealthy countries have lower opportunity costs with respect to less developed countries (Khanna and Plassmann, 2004). Therefore, given that the demand for environmental quality is income-elastic (Bimonte, 2002; Khanna and Plassmann, 2004; Magnani, 2000), higher income per capita and a strong institutional context are both associated with lower exposure to pollution. In fact, despite the fact that less developed countries with weak institutions work towards pollution abatement (Galeotti, 2007; Magnani, 2000), in many cases their environmental progress is undermined by unenforced regulations. This explains how the environmental protection, income and institutions are related. Under the strong rule of law the turning point of the ETKC would shift leftward, towards lower income point. This is because a strong institutional context facilitates environmental policies and provides more effective environmental protection even at lower income levels. Therefore, we argue that countries with different institutional enforcement would demonstrate heterogeneous environmental taxation-income paths.

3. Model

To verify the existence of an inverse U-shaped curve of the environmental taxation-income

relationship and the influence of the rule of law on the behaviour of this curve, we start by considering direct and indirect effect the rule of law has on environmental taxation. In addition to the direct effect that the rule of law has on environmental taxation, there is an indirect effect on taxation through the influence of the rule of law on per capita income.

Our analysis is based on the alternative specification of the inverse U-shaped curve proposed by Bradford et al. (2005). This approach provides has the advantage of a more robust estimation as it avoids the use of nonlinear transformations of nonstationary regressors, a problem that occurs in quadratic and cubic regression functions[1]. This specification also allows us to better capture the direct and indirect effects.

The indirect effect is evaluated with the following growth equation:

$$Y_{it} = \mu_i + \chi_t + \beta_1 R_{it} + \beta_2 X_{it} + \varepsilon_{it} \quad (1)$$

where real GDP per capita (Y_{it}) is a function of the rule of law (R_{it}) and other regressors (X_{it}). The matrix (X_{it}) consists of classical variables of the growth model, such as capital stock level of education and share of trade in GDP, while μ_i and χ_t correspond to unobserved specific effects of country and year respectively.

To capture the direct effect we set the change of environmental taxation (ET) as a function of the growth rate of GDP (g) and of the distance of income (y) from the turning point (y^*):

$$\frac{\partial ET_t}{\partial t} = \gamma (y - y^*) g \quad (2)$$

Therefore, ET increases until the turning point y^* is reached and decreases after this when the coefficient γ is negative, and g is positive. A negative sign of γ reflects the inverse U-shaped relationship between environmental taxation and GDP per capita.

To incorporate the indirect effect in the direct one we follow the approach proposed by Leitão (2010), and establish the turning point y^* as a function of the rule of law (RoL):

$$y^* = \phi_1 + \phi_2 Rol \quad (3)$$

We assume that $\varphi_2 < 0$ so that the stronger rule of law implies lower levels of GDP per capita at the turning point y^*. Taking together and integrating with respect to time equations (2) and (3), while keeping income, average growth rate and average degree of the rule of law constant, we obtain:

$$ET_t = \lambda + \gamma (y - (\phi_1 + \phi_2 RoL)) gt \quad (4)$$

where λ is a constant of integration.

To estimate equation (4) we use the following reduced form, transforming environmental taxation into logarithms:

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[1] The estimation of the pollution-income relationship based on these functions were found to suffer from severe econometric misspecifications (for a review see Stern 2004).

$$\ln ET_{it} = \lambda_i + \alpha_0(y_i g_i t) + \alpha_1(g_i t) + \alpha_2(RoL_i g_i t) + \alpha_3 Z_{it} + \mu_{it} \quad (5)$$

where the countries are indexed by i and time by t. ET is the environmental tax per capita, y_i is the average real per capita GDP, g_i is the average real per capita GDP growth and RoL_i is the average of the degree of the rule of law, all measured over the sampled period. Additional explicative variables are defined by matrix Z_{it}. These variables are expected to influence the level of environmental taxation: the level of corruption, the quality of regulation, index of economic freedom, tax revenue in GDP and the share of exports and imports in GDP.

To obtain y_i and g_i we refer to the indirect effect of the rule of law on environmental taxation and calculate the fitted values of Y_{it} by estimating equation (1). By computing the average value of per capita GDP of the first (Y_i^1) and the last (Y_i^2) four year period of the total of GDP series for each country, we obtain the average of per capita GDP and its growth rate in the following way:

$$Y_i^2 = Y_i^1 \exp(10 g_i) \quad (6)$$

$$y_i = Y_i^1 \exp(5 g_i) \quad (7)$$

where y_i and g_i are interpolated values at a sample mid–point.

On the basis of the estimation of equation (5) we evaluate the existence of the EKTC and the influence of the rule of law on the position of the curve.

4. Data, variables and descriptive statistics

To estimate environmental taxation-income relationship, we used the environmental taxation data provided by Eurostat Environmental Accounts (2011). Environmental taxation is measured in millions of euros divided by millions of ECU. Among the explicative variables we introduce the rule of law index (Kaufmann et al., 2010). Data on this index, from 1996 to 2002, is available every two years, while data from 2003 to 2008 is given yearly. The missing data for the year 1997, 1999, 2001, is imputed as the average value between two years.

Other independent variables used are: the quality of regulation, index of economic freedom, level of corruption, tax revenue in GDP and shares of exports and imports in GDP. The first three variables reflect the quality of institutional environment, which influences the process of tax collection. Strong regulator quality, transparent economic systems and low corruption limit tax evasion, increasing budget tax revenues. The measures of the quality of regulation and level of corruption are also provided by Kaufmann et al. (2010). The index of economic freedom is taken from the Heritage Foundation and Wall Street Journal (2010). The variable on tax revenue in GDP reflects the volume of various taxes collected and indicates the capacity of regulator to collect taxes. Finally, economic openness expressed in imports and exports reflects the level of economic activity, influencing pollution, and therefore, the amount of environmental tax revenues. Data on both variables were taken from World Development Indicators (World Bank 2010). We expect all explicative variables to have a positive relationship with environmental taxation.

Data used in this analysis was obtained from a panel of 28 European countries and spans the timeframe from 1996 to 2008 for a total of 392 observations. Table 1 reports the

description of variables and source of data, while Table 2 presents a summary of the sample statistics.

To obtain interpolated values of average income per capita (y_i) and its growth rate (g_i) and estimate the indirect effect of the rule of law on the environmental taxation–income relation we utilize classical variables of economic growth models (equation 1). These variables are real per capita GDP, capital per worker, education and share of export and import in GDP, all obtained from World Development Indicators (World Bank 2010). For the purpose of better capturing the indirect effect, we divided countries according to their stage of economic development. This division was necessary in the light of criticisms put forth by Vincent (1997) and Galeotti (2007) on probable overlapping of country data series. This must be considered in our model since we have high-income observations from market-economy countries and low-income observations from post-transition countries. Moreover, this division is useful to capture how different economic production and institutional conditions affect income and, therefore, environmental taxation. The first group (G1) includes European countries characterized by mature industrial and/or service sectors, such as Austria, Belgium, Denmark, Finland, France, Germany, Luxemburg, Netherlands, Norway, Sweden and the United Kingdom. Countries that, according to the European Union regional policies, present delayed development in industrial and/or a growing service sectors at either national or regional level constitute the second group (G2): Cyprus, Greece, Ireland, Italy, Malta, Portugal and Spain. Former transition countries with shrinking agricultural sector and developing industrial and service sectors were assigned to the third group (G3): Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

5. Estimations and discussion

One of the problems when estimating a growth model (equation 1) is the possible endogeneity between the rule of law and income. In fact, countries tend to enter virtuous circles of institutional and economic development. To address the problem of endogeneity, the rule of law was instrumented by considering (i) the fraction of population that speaks English as a mother tongue; (ii) the fraction of population that speaks one of the five primary Western European languages, including English as a mother tongue and (iii) the index of economic freedom. First-stage regression indicates the validity of the instrumental variables used here. Moreover, the validity of the first two instruments has been confirmed by Cole (2007), Hall and Jones (1999) and Leitão (2010).[2] The endogeneity of the rule of law was also tested with the Durbin-Wu-Hausman test, the results of which (not reported in the table) led to rejection of the null hypothesis that the rule of law is exogenous.

The growth model (equation 1) is estimated for the three groups of countries: *G1, G2, G3*. Given the presence of fitted values of y_i and g_i we do not express variables in natural logarithms (Leitão, 2010), and instrument the rule of law by using 2SLS (Table 3). As suspected, rule of law (R_{it}) does not have the same influence on income across the three groups of countries. In the *G1* group the rule of law has a positive and significant impact on income, while in the *G2* group the rule of law has a negative but a significant impact. This unexpected sign can be due to the fact that institutional performance in these countries aggravated in the presence of increasing per capita income. It seems that the worsening effects

[2] Other variables, such as country's distance from the equator, a dummy for legal origin were added as instruments in the regression but they did not prove to be valid.

of the rule of law on growth were strongly counterbalanced by other economic factors. As expected, in former-transition countries (*G3*), which present the lower average value of the rule of law index, there is no statistically significant relationship between income and the rule of law. Other variables such as capital stock, level of education and economic openness, expressed through exports and imports, all have a significant positive effect on income, with the exception of *Edu* in the G2 group.

Dealing with panel data, we considered the difference between fixed and random effect models (Cameron and Trivedi, 2009). To estimate equation 1 we preferred the random effects model since introducing time invariant instruments prevented the potential correlation between country–specific effects and the explanatory variables. In estimating the direct effect of the rule of law on environmental taxation (equation 5), it is very likely that a country's unobservable characteristics can be correlated with income, thus making it more appropriate to consider estimates derived from fixed effects. Moreover, given the significance of Hausman test statistics, the random effects model was rejected in favour of the fixed effects model.

The ETKC model (equation 5, table 4) was first estimated considering only *ygt*, *gt* and *RoLgt* (specification 1). These variables were all significant with expected signs. As discussed in Section 2, the negative sign of the coefficient on *ygt* indicates the presence of the inverse U-shaped environmental taxation - income relationship in European countries. These results confirm our first hypothesis: with the growth of income, environmental taxation first increases to counteract damaging pollution effects and then decreases, once pollution starts to decline as a consequence of successfully applied environmental taxation policy. It is worth noting, that the coefficient on *RoLgt* is positive, demonstrating the expected positive relationship between the strength of the rule of law and environmental taxation.

Our findings also confirm the second hypothesis on the importance of the rule of law for the position of the environmental taxation – income path. As demonstrates the estimated value of ϕ_2 which is negative and statistically significant (Table 4), the strong rule of law determines the turning point of the EKTC at a lower level of income per capita. Under the strong rule of law, the turning point of environmental taxation – income path shifts to the left, meaning a major efficiency of environmental taxation policy, where pollution abatement is enhanced even at lower income levels.

Successively, other explanatory variables were added (specification 2): control of corruption (*CCorr*), regulation quality (*RegQual*), index of economic freedom (*Ecfree*), tax revenue in GDP (*TaxRev*) and share of exports and imports in GDP (*XIMint*). As expected, all the variables carry positive signs and are statistically significant. Control of corruption and regulation quality have a greater effect on environmental taxation with respect to index of economic freedom and economic openness, while the effect of taxation revenue is very small.

The final hypothesis we test is that of the presence of heterogeneity in the environmental taxation-income path between different economies. We believe that market-economy countries (*mark*) with strong rule of law have already reached a turning point in the ETKC, while post-transition countries (*ptrans*) with lower levels of income and a weaker rule of law have just started the declining trend or have not yet reached a turning point. Heterogeneity in the environmental taxation-income relationship is introduced by relaxing the assumption that these two groups of countries have the same turning point, which is influenced by the state of the rule of law. Following Leitão (2010) we investigate this heterogeneity allowing for different income slopes across countries.

The descriptive analysis of the data confirms this hypothesis. For the purpose of illustration, Figure 1 shows the environmental taxation-income path for three market-

economies and three post-transition countries. As is evident, market-economy countries have already achieved their turning point and have reduced environmental taxation, while post-transition countries are still characterized by an upward slope which can be due to their weak rule of law enforcement.

To test for heterogeneity, we add two additional variables, $y_i g_i t * ptrans$ and $(RoL_i g_i t * ptrans)$, which incorporate the effect of rule of law in post-transition economies in equation 5 to obtain:

$$\ln ET_{it} = \mu_i + \alpha_{01}(y_i g_i t) + \alpha_{02}(y_i g_i t * ptrans) + \alpha_1(g_i t) + \alpha_{21}(RoL_i g_i t) + \alpha_{22}(RoL_i g_i t * ptrans) + \alpha_3 Z_{it} + \mu_{it} \quad (8)$$

Estimation results obtained from equation 8 are presented in Table 4. Specification 1a contains basic variables, while specification 2a includes the control variables. Given that all the variables are statistically significant in all estimations, the heterogeneity assumption can be rejected.

To determine if the inverse U-shape curve characterizes the environmental taxation–income relation, we test the hypothesis of $\alpha_{01} < 0$ and $\alpha_{01} + \alpha_{02} < 0$ for the market-economy and post-transition countries respectively. By testing the hypothesis $\frac{\alpha_{21}}{\alpha_{01}} < 0$ and $\frac{\alpha_{21} + \alpha_{22}}{\alpha_{01} + \alpha_{02}} < 0$ for market-economy and post-transition countries, we evaluate whether a relationship exists between the rule of law and per capita income at the turning point. The results show (Table 5) that market-economy countries are characterized by the inverse U-shape environmental taxation-income path, where the enforced rule of law leads to a turning point which occurs at a lower level of per capita income. As for post-transition economies, in the basic specification of the model (1a) there is no evidence for the EKTC path and no impact from the rule of law. The evidence of the curve and the rule of law influence appears only when other control variables are considered (2a). This is probably due to the fact that post-transition economies have not yet achieved much progress in applying environmental policies and should pay more attention to the enforcement of the rule of law.

6. Conclusions

In this paper we focus on the links between environmental protection policy and economic growth, assessing how this relationship is influenced by the quality of institutions in European countries. In particular, we advance the hypothesis that the relationship between environmental taxation and per capita income is an inverse U-shaped curve, which is based on the presumable success achieved by European countries in pollution abatement. We argue that the rule of law plays a decisive role in the environmental taxation-income relationship by increasing the effectiveness of environmental policies. Our analysis also explains the differences in the progress achieved in the application of environmental policies in market-economy and post-transition countries.

The analysis covered 28 European countries and utilized data from between 1996 and 2008. To check for the existence of the inverse U-shaped relationship between environmental taxation and per capita income, we apply an innovative Bradford et al. (2005) approach that avoids estimation of nonlinear regression and increases its robustness. While existing literature, such as Leitão 2010, extends Bradford et al. (2005) model to check for corruption effects for pollution – income relation, we take another direction and study how the

relationship between environmental protection and income is influenced by the rule of law. Nonetheless, our work can be also considered as a robustness test for the methodology presented by the above mentioned authors.

To investigate the role of the rule of law in the relationship between environmental taxation and per capita income we firstly address the indirect effect of the rule of law on environmental taxation through its impact on income per capita. Our results confirm the widely held opinion in economic literature opinion that the rule of law is positively related to per capita income in market-economy countries. At the same time, the direct effect of rule of law on environmental taxation demonstrates that enforcement of the rule of law has a positive impact on environmental policy application. In fact, we confirm the presence of an inverse U-shaped curve of environmental taxation – income relation for the entire panel where the rule of law has a negative impact on per capita income at the turning point of the curve. Therefore, countries with enforced rule of law achieve greater progress in environmental policies at a lower per capita income level and have thus already reduced environmental taxation levels.

We also control for the heterogeneity in the environmental taxation – income path between market-economy and post-transition countries. The results show that post-transition economies have not yet reached the turning point of the environmental taxation - income curve and this probably reflects weaker enforcement of the rule of law which thus hinders the proper implementation of environmental policies.

As for policy implications, our analysis suggests that the effective implementation of environmental protection policies can be the result enforcement of the rule of law which deserves close attention in designing functional environmental policies to favor economic development.

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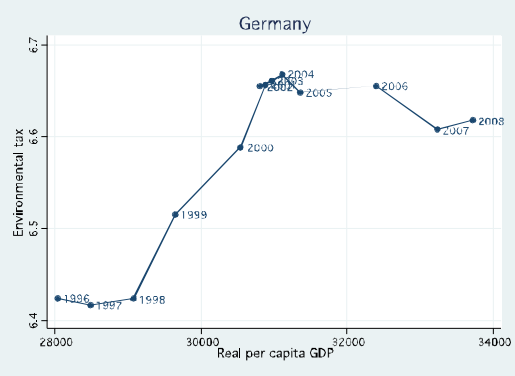
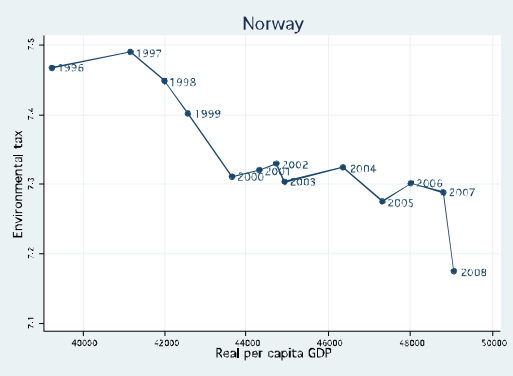
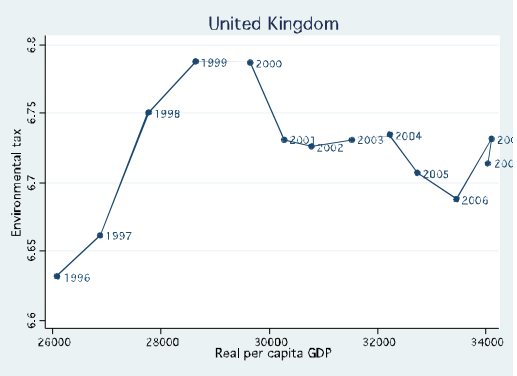
Figure 1: Trends in per capita environmental tax revenue and per capita income

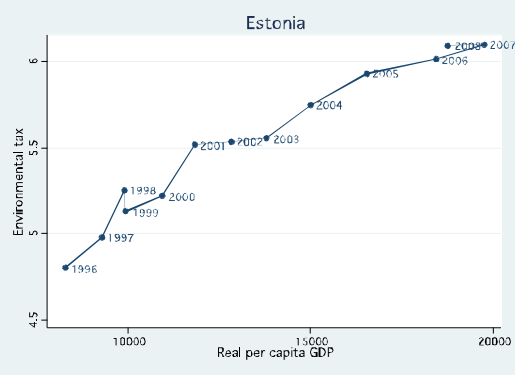
A) market-economy European countries

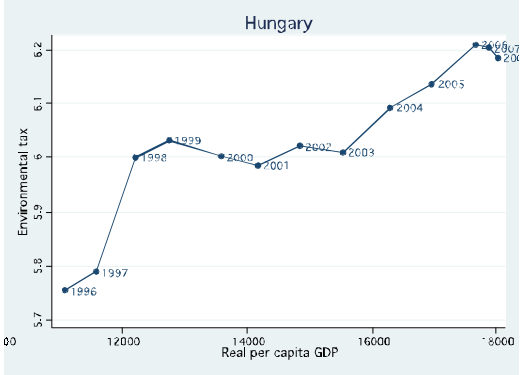






B) post-transition European countries





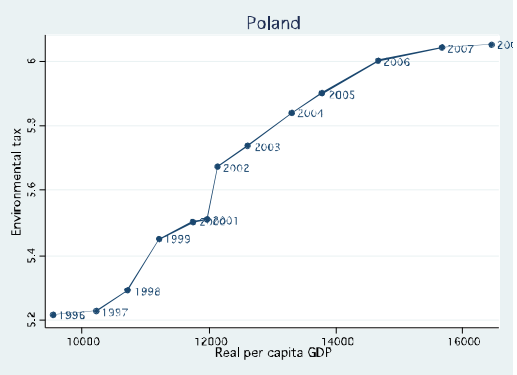


Table 1: Data information

Variable	Definition	Source
Y	Real per capita GDP	WDI (2010)
Kpw	Capital Stock per worker	WDI (2010)
R	Rule of Law	Kaufmann (2010)
CCorr	Control of Corruption	Kaufmann (2010)
EcFree	Index of Economic Freedom	Heritage Formation and Wall Street Journal (2010)
EDU	School enrolment, tertiary (% gross)	WDI (2010)
Engfrac	Fraction of a country's population that speaks English as a mother tongue	Hall and Jones (1999)
Envtax	Environmental tax	Eurostat (2010)
Eurfrac	Fraction of a country population that speaks one of the five primary Western European languages, including English as a mother tongue	Hall and Jones (1999)
RegQual	Regulation Quality	Kaufmann (2010)
TaxRevenueGDP	Tax Revenue (% of GDP)	WDI (2010)
XIMint	Share of exports + imports in GDP	WDI (2010)

Table 2: Sample summary statistics

	Mean	Std. Dev.	Min	Max	Obs
Y	24723.22	11987.3	5921.674	74421.63	363
Kpw	8459.583	5676.116	374.5925	32710.88	352
R	1.148901	0.580172	-0.193140	1.964045	364
CCorr	1.156859	0.794892	-1.021719	2.47	364
EcFree	66.15247	7.229807	45.7	82.6	364
EDU	53.12494	18.25695	9.626324	94.88895	321
Engfrac	0.061286	0.223440	0	0.974	364
Envtax	6.391923	0.637011	4.68375	7.654727	363
Eurfrac	0.244464	0.394537	0	1.004	364
RegQual	1.162789	0.423399	-0.234753	2.012003	364
TaxRevenueGDP	20816.41	4955.785	10700	32700	256
XIMint	105.6177	50.04793	44.15393	318.2252	362

Table 3: Estimation results for growth equation (1)

	G1	G2	G3
R	9,252.85	-6,659.37	993.273
	(4,661.173)*	(2,121.705)***	(1762.512)
Kpw	1.404	1.557	2.013
	(0.137)***	(0.167)***	(0.234)***
Edu	34.469	34.651	52.179
	(20.879)*	(25.81)	(8.016)***
XIMsh	52.481	43.318	36.532
	(11.664)***	(11.905)***	(7.301)***
Constant	-6,787.14	13,409.26	-106.849
	(7379.95)	(2,288.912)***	(1346.251)
Obs	119	70	122
N. of id	11	7	10
R–squared	0.776	0.828	0.844
Wald χ^2	577.25	222.7	2242.27
Prob.	(0.000)	(0.000)	(0.000)

Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4: Estimation results based on interpolated values (Equation 4)

	1	2	1a	2a
ygt	-0.91	-1.298	-0.53	-1.072
	(0.201)***	(0.238)***	(0.246)**	(0.306)***
*ygt*ptrans*			0.218	0.15
			(0.053)***	(0.061)**
gt	9.118	12.021	3.912	8.978
	(1.744)***	(2.063)***	(2.332)*	(2.935)***
RoLgt	0.632	1.154	1.424	1.782
	(0.215)***	(0.255)***	(0.343)***	(0.352)***
*RoLgt*ptrans*			-1.185	-1.192
			(0.372)***	(0.449)***
CCorr		0.116		0.103
		(0.043)***		(0.042)**
RegQual		0.131		0.134
		(0.048)***		(0.048)***
EcFree		0.007		0.005
		(0.002)***		(0.002)**
TaxRevenueGDP		0.00003		0.00003
		(0.000)***		(0.000)**
XIMint		0.002		0.001
		(0.001)**		(0.001)*
Constant	-44.618	-25.587	-44.749	-31.438
	(3.256)***	(4.808)***	(3.240)***	(5.235)***
^{2}	-0.649	-0.889		
p-value	(0.000)	(0.000)		
Observations	338	241	338	241
Number of id	26	26	26	26
R-squared	0.59	0.72	0.61	0.73
F-test	145.99	66.94	95.49	55.58
p-value	(0.000)	(0.000)	(0.000)	(0.000)
Hausman	444.29	91.16	483.00	135.80
p-value	(0.000)	(0.000)	(0.000)	(0.000)

Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5: Estimation results for heterogeneity model (equation 8)

	(Y1a)	(Y2a)
Market-economy European countries		
α_{01}	-0.91	-1.298
	(0.032)**	(0.000)***
$\frac{\alpha_{21}}{\alpha_{01}}$	-2.687	-1.662
	(0.015)**	(0.000)***
Post-transition European countries		
$\alpha_{01}+\alpha_{02}$	-0.312	-0.922
	0.107	(0.003)***
$\frac{\alpha_{21}+\alpha_{22}}{\alpha_{01}+\alpha_{02}}$	-0.766	-0.64
	0.1678	(0.007)***

p-value in parentheses
Statistically significant: * at 10%; ** at 5%; *** at 1%