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The Political Economy of Green Taxation in OECD Countries

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Abstract

This paper addresses the role of politics in environmental policymaking in OECD countries. The public interest theory of regulation assumes that politicians pursue the public good and employ economically efficient instruments such as Pigouvian taxes to discourage polluting activities. Alternative theories of regulation, however, explain more realistically the environmental policymaking process. The theory developed in this paper argues that the goals of raising revenue and industry competitiveness overwhelm the goal of improving environmental quality when politicians set green taxes. This theory is empirically tested with a political economy model using data on OECD countries. The results suggest that policymakers do not set taxes with a specific concern for the environment, but to generate revenues. The model also demonstrates the concavity of the revenue function with respect to emissions; taxes are raised up to an optimal point beyond which raising them would discourage emissions, and thus revenues. Harmful behavior is not discouraged through the imposition of the taxes, since less healthy populations are taxed less. Emissions generated by industries that are exempted from taxation are offset by the industries that are taxed. When polluting products constitute a high share of the exported products, revenues from environmentally related taxes drop. These results help explaining the lack of environmental orientation of green taxes in the OECD countries.

Keywords: taxation, environmental policy, public choice, public finance

JEL Classification: D78, H23, K323, L51, Q20

OECD member countries face a daunting set of environmental challenges that include improving air quality, maintaining adequate water quality, managing solid waste, protecting the ozone layer, and guarding against biodiversity losses. Member countries have addressed these challenges through the use of a number of regulatory instruments that include technology-based command-and-control regulation, performance standards, river basin associations, and the use of taxes and other economic incentives. Over the last decade, instruments based on economic incentives have played a large and growing role in environmental policies of OECD countries.[1] All countries have introduced environmental taxes and an increasing number of countries are implementing comprehensive green-tax reforms, while others are contemplating doing so (OECD, 2001).

The mere mention of environmental taxation brings immediately to mind one of the notable contributions of Arthur Cecil Pigou (1920).[2] The Pigouvian theory of taxation, which emerges in a discussion of spillover effects that impose costs on non-transacting parties,

stipulates that appropriately designed taxes can limit polluting behavior while minimizing social cost. However, as Professor Pigou explained, what seems to be good in theory does not work well in practice (Pigou, 1938, p. 331; 1960, p. 99). Indeed, as he pointed out, environmental taxes will not likely be set on the basis of environmental logic (Barnett and Yandle, forthcoming).

As Pigou predicted, it is difficult, if not impossible, to find taxes that might come close to following a pure Pigouvian prescription (Yandle, 1998, pp. 130–132). Though difficult to construct in the first place, given that to achieve their acclaimed efficiency status, such taxes are to reflect marginal damages on an industry-by-industry, or even better on a plant-by-plant basis, the process by which environmental taxes are actually set is complicated by industry competitiveness and revenue raising concerns.[3] Because of the political economy struggle, what may on the surface look like an environmental tax, and even be called an environmental tax, can actually be just another way to raise revenues.[4] Put differently, environmental pleadings can serve as a useful disguise in the politician's never-ending search for revenues for redistributional purposes. The extent to which the pursuit of revenue goals may in fact overwhelm or even accompany the effort to achieve environmental goals is an empirical question, which we address in this article. We do so by developing a theory and then presenting empirical results that reject the simple Pigouvian hypothesis. Political revenue seeking seems to be the better explanation of green taxes.

The article is organized as follows. The second section reviews the main theories of regulation found in the social science literature. This section also briefly surveys some of the principal OECD environmental taxes and explains how, on the surface, the taxes charged do not square with the ideal Pigouvian criterion of minimizing social cost. In the third section, a political economy theory and a statistical model are developed to explain the variance in the level of environmental taxes collected across OECD countries. The fourth section describes the data used to estimate the model and reports the findings. The last section offers some final thoughts on the research.

1. Theories of environmental regulation

In its most highly stylized form, the neoclassical theory of regulation justifies the intervention of government in the economy to correct for externalities generated by market failure. When the costs of pollution are not reflected in prices, and the cost of intervening is less than the gains from doing so, market inefficiencies result. Stated in terms of property rights, where there are no clearly defined and enforced property rights or rules of liability, economic agents use scarce resources with less concern for the impact that their decisions might have on other parties, including future generations.

Although clearly not embraced by proponents of property rights, rules of liability, and the Coasian solution, Pigouvian taxes are well accepted in theory as economically efficient and environmentally effective instruments (Fullerton, 2001; Stavins, 1998a, 1998b; Yandle, 1998). In their ideal form, environmental taxes are a flexible policy instrument that can minimize control costs for achieving a given pollution target. While reducing polluting actions, they simultaneously provide incentives for technological innovation and encourage further reductions in polluting emissions. In theory, the internalization of the external costs

is done through a system of taxes on polluting activities that are set equal to marginal social damage. Even in a less than ideal form, green taxes may be deemed more efficient and effective than other costly regulatory instruments, such as command-and-control regulation.

But this is the normative theory of environmental regulation. It is an exercise of maximizing social welfare subject to constraint. Although never stated, the theory is consistent with a publicly-interested regulatory authority, one that designs and implements environmental policies with one overarching objective: to serve the public interest. Accordingly, politicians choose the instruments that maximize efficiency. Unswayed by special interest pleadings, the publicly-interested politicians with definiteness of purpose single-mindedly pursue long-term goals that maximize social welfare. These politicians calculate carefully and intervene up to the point where the incremental costs of intervention just offset the associated incremental benefits (Stavins, 1998b; Becker, 1985). This, of course, is a highly stylized version of the public interest theory.

The dissatisfaction with finding strong evidence to support this normative theory has led many social scientists to look for alternative theories and models that would explain the environmental policymaking process.[5] Three major theories are the most developed.

The *capture theory*, which is generally attributed to the economic historian Gabriel Kolko (1963), states that politicians are sincerely willing to respond to the needs of the electorate, but that they lack essential information on how to do so. Therefore, they may have to rely on information and guidance provided by those who have much of it to offer—the industry to be regulated or the special interests that plead for industry regulation. Although industry representatives have the most information on production, products, prices, and export and import markets, they are not generally seen as being driven to serve the broad public interest. Instead, they more often are seen as being led by an invisible hand that, when appropriate institutional conditions hold, may result in the public interest being served. However, when defined in particular ways, many regulatory variables, such as which standard to adopt, which products to tax, and at what rate, how to treat products destined for export versus those headed to domestic markets, and the whole matter of exemptions can serve *de facto* as barriers to entry.[6] Because of information asymmetry and relative transaction costs, special interest groups, according to capture theory, are likely to manipulate politicians toward their own interest.

The *special interest theory* takes capture theory a step further to explain which one of a number of competing special interests will be successful in gaining influence. According to this theory, politicians can be thought of as brokers who auction their services to the highest bidder (Stigler, 1971; Peltzman, 1976; Posner, 1974).[7] Taking into account organizing and other transaction costs, the theory holds that the group that can bid the most is the group that has the most to gain or lose when the politician acts.

The *Bootleggers and Baptists theory* developed by Yandle (1989a) states that both environmental groups (the Baptists) and industry (the Bootleggers), may advocate the pursuit of the same environmental goal, with different motivations behind their actions, however. The Bootleggers wear the clothing of a special concern toward environmental protection, although the unstated goals behind their actions are more related to protecting their market share and competitiveness. To illustrate, the Clean Air Act Amendments of 1970 in the United States is said to have resulted from pressures from industry for federal

command-and-control standards as a means for inhibiting states from setting even more stringent, and nonuniform, standards (Elliott, Ackerman, and Millian, 1985).

Along the same lines, in their positive theory of environmental regulation, Buchanan and Tullock (1975) explained how emission standards would be preferred to effluent taxes by firms where these measures take a form that limits entry into the industry sector. In such a setting, environmental regulation generates opportunities for existing firms to earn profits in a cartel-like manner. Environmental measures that prescribe more stringent standards for new rather than for existing firms, as in the U.S. case, become icing on a regulatory profits cake that is welcomed as a regulator-enforced barrier to entry.

Considerable evidence of the political economy of particular environmental programs exists in the literature. Ackerman and Hassler (1981), for instance, provide an interesting account of the evolution of one major part of the Clean Air Act in the United States, that being requirements for scrubbers on electricity producers, with particular attention to the crucial role played by coal interests.[8] More recently, Leveque (1996) has assembled a series of case studies in Europe that describe different aspects of the environmental policymaking in the emerging European Union (EU). And Yandle and Buck (2002) provide numerous examples of European and American Bootlegger/Baptist struggles in their account of the struggle over the ratification of the Kyoto Protocol.

Cahn (1995) argues that federal clean air policies in the U.S. serve as symbolic palliative to a public concerned about environmental issues. Behind the stated goal of protecting the environment, the environmental regulation serves a specific political and economic function—namely, to rationalize air pollution regulations to the benefit of business interests.[9] The symbolic nature of environmental regulatory policies is also reflected in their lax enforcement. Therefore, whether by design or chance, the public is given the symbolism of environmental regulation, while the business community is provided with tangible public policies (Gonzalez, 2001). In this way, the environmental concerns of the public are managed, and the relationship between corporate firms and the environment is only minimally changed.

Several organizations were active in the 1990 Clean Air Act policymaking process in the United States. There were traditional trade organizations: the American Petroleum Institute, the Motor Vehicle Manufacturers Association, the Edison Electric Institute, the Chemical Manufacturers Association, and the National Coal Association (Gonzalez, 2001). Furthermore, the Business Roundtable, an organization composed of the chief executive officers of the largest two hundred firms in the United States, was also active in the policymaking process of the 1990 Clean Air Act. All these can serve as a means for the business community to develop a consensus on public policy and then have their resources directed at the implementation of such policy.

In addition, the corporate community also created the Clean Air Working Group (CAWG) to deal specifically with air pollution policy. The CAWG is an umbrella organization encompassing all those industrial sectors that would presumably be affected directly affected by proposed clean air legislation.[10] Also, the key provisions of the 1990 Clean Air Act were formulated in the House of Representatives—specifically, in the House Energy and Commerce Committee (Gonzalez, 2001). The chairperson of this committee was Democrat John Dingell of Michigan, who is widely considered a close ally of the automobile industry. Dingell sponsored the administration bill in the House.

Although different researchers tend to favor different theories of the political economy of taxation, a comprehensive theory of political economy of taxation that could be applied to all situations does not exist; nor is it realistic. The complexity of the policymaking process and the nature of the environment protection problem only allow for a mixture of elements, concepts and hypotheses. In practice, a combination of theories helps explain how the environmental policymaking process develops. For instance, Heclo (1998) argues that the public interest theory meets the business interest theory in the "democratically configured" issue network surrounding the 1990 Clean Air Act. In other words, while the clean air issue network contained powerful business interests, it was also composed of groups and individuals believed to be concerned largely with the public interest.

The extent to which all OECD member states are subject to political pressures of the sort experienced in the United States and Europe when setting environmental policy, is, of course, an empirical question. But there is ample indirect evidence that various interest groups successfully gain exemptions and special treatment in the design of OECD country environmental taxes. For example, even though green taxes are sometimes labeled "carbon taxes," they hardly reflect the carbon content of the diverse fuels. A number of OECD countries, Austria, Belgium, Denmark, Finland, Germany, Italy, Japan and Sweden, apply taxes on electricity consumption, and not, for example, on the carbon content of the primary fuels used to generate the electricity.

Coal and coke taxation contributes little to the total tax revenue from environmentally related taxes even though these fuels are heavily polluting and the most carbon intensive. Actually, only Denmark, Finland, the Netherlands, Norway and Sweden levy taxes on coal and coke use at all, and there are very important exemptions on the taxes they levy.[11]

In most countries, the tax rate that applies to unleaded petrol is significantly higher than the rate applied to diesel, with the exception of Australia, Switzerland, U.K. and the U.S. From an environmental point of view, this is somewhat curious, as the use of diesel is more polluting, on a per engine basis, than the use of petrol, in terms of emissions of NOx and VOCs particles.

The tax rates on light fuel oil used for heating purposes are normally much lower than the tax rates on diesel, even if the products—technically speaking—are almost identical. In some countries, Canada, New Zealand, the U.K. and the U.S., there are no taxes on heating oils at all.

Energy used in the generation and distribution of electricity is normally exempt from taxation; so is energy used in commercial fishing. The revenue share accounted for by other environmentally related taxes (e.g. pesticides, detergents) is negligible. But while this casual survey may offer support of the special interest and capture theories of regulation, a more systematic examination of data may prove otherwise. In the interest of making a more general inquiry, we now turn to the development of an empirically testable theory of green taxation.

2. A political economy theory of green taxation

We offer the following theory-based model to explain green tax revenues. In the process of choosing and implementing a policy instrument, we assume that policymakers are balancing

two major goals: revenue-generating opportunities and industry competitiveness. We also assume that they pay little attention to environmental effectiveness.

The political economy model developed here purports to determine the relative importance that policymakers give to these goals and to identify the variables that will explain the variance observed in green tax revenues across OECD countries. In our statistical model, the dependent variable is total revenue from environmentally related taxes, $R_{i,}$, with adjustments made for fuel taxes to be explained later. The pool of explanatory variables is composed of three vectors: the revenue generating potential of a certain country, G_i (measured by the Gross Domestic Product); the environmental quality vector, E_i (measured by the quality of health,[12] H_i, the total quantity of carbon emissions in a given year C_i and its squared form C_i^2); the vector of industry pressure X_i (measured by the total goods exported in a given year, Exp_i, and the number of exemptions and rebates awarded to energy-intensive sectors, ExReb_i).
Thus,

$$R_i = R_i(G_{i,} E_{i,} X_i), \quad i = 1, \ldots, n \text{ (OECD country index)} \tag{1}$$

Or, more specifically,

$$R_i = \alpha + \beta_1 \text{GDP}_i + \beta_2 H_i + \beta_3 C_i + \beta_4 C_i^2 + \beta_5 \text{Exp}_i + \beta_6 \text{ ExReb}_i + \varepsilon_i, \tag{2}$$

where ε_i represents the error term, which is assumed normally distributed.

The revenue function is a composite function of carbon emissions (c) and taxes ($t(c)$): $R(c) = c^* t(c)$, where the tax function $t(c)$ is increasing with respect to emissions: $dt/dc > 0$. The revenue function is assumed increasing and concave with respect to emissions. If emissions are constant, it results that the tax function is also concave (Simon and Blume, 1994). That is, $d^2t/dc^2 < 0$. The concavity of the tax function has important implications. It means that taxes generate revenue only up to an optimal point t^*, which corresponds to an optimal emissions point c^* (See Appendix). Beyond this point, raising taxes has a discouraging effect upon emissions that continues but, at the same time, decreases revenues. Since the main goal is to raise revenue, it only pays to increase taxes up to the optimal point c^*.

The fact that green taxes generate government revenues is common knowledge (Stavins, 1998a, 1998b; Fullerton, 2001; Barde, 1996). Recent research (Kahn, 2002) has demonstrated that people with higher education and higher income are more pro-green than people with lower education levels and incomes. A recent survey of more than 20 empirical studies that estimated Environmental Kuznets Curves indirectly confirms this relationship (Yandle, Vijayaraghavan, and Bhattarai, 2002). We argue, therefore, that green taxes are more politically acceptable in higher-income countries than in lower income countries even though, to our knowledge, the point has not be tested empirically.

As explained in the previous sections, the interests of powerful and well-organized industry organizations are unavoidably taken into consideration when designing public policy. According to the typology developed by Schneider and Ingram (1997), these groups fit the description of "advantaged target populations," characterized by positive social constructions and high power.[13] Policy design is biased toward these groups because they are

strong and well regarded in society. They offer important electoral benefits to the politicians. Advantaged groups have sufficient power to generate support to a viable opponent in subsequent elections; but perhaps even more important, these groups often have sufficient power not to comply with the legislation at all and to challenge it at every step in its implementation. Supporting these groups arouses little opposition, especially since costs are not so visible and legislators are able to mask policies from the public view, an action that contributes to the general public's tendency to be rationally ignorant.

Environmentally related taxes raise the marginal costs of production for polluting firms. If firms do not decide to relocate, the most polluting firms will lose market share to the least polluting firms. To prevent relocation, avoid the loss in profitability of polluting firms, provide political favors, and perhaps to maximize constrained tax revenues, tax exemptions and rebates are offered.[14]

Industry influence is also reflected in the choice of a policy instrument.[15] In comparison with taxes, firms subject to alternative environmental policy instruments, for example grandfathered emission permits, negotiated agreements, and regulations, only pay abatement costs; they avoid the cost of taxes on uncontrolled emissions. These ongoing tax payments put firms at a comparative disadvantage and induce them to seek exemptions from regulators relative to the imposition of these taxes (Stavins, 1998a). However, to the extent that polluting firms enjoy specialized location benefits, it is possible for the state to discriminate across firms in providing tax forgiveness.

Concerning the health variable, there are two sets of considerations. First, research in health economics indicates that there is a positive correlation between the quality of health and concern for the quality of environment (Kahn, 2002). Health-conscious people are likely to have higher incomes and therefore to be more concerned about the air they breathe than those who are less aware, and perhaps less healthy. Personal and socio-environmental factors cluster together in areas of low income and high mortality (van Doorslaer et al., 1997; Kaplan, 1996). Given that the level of health quality in a certain country is high, green taxes would enjoy a higher acceptability; there are more opportunities to raise revenues when people are healthier.

Second, the quality of health in a certain country gives a rough approximation of the quality of environment. All else equal, more carbon emissions would imply a lower level of health quality. All else equal, a true Pigouvian tax would discourage such harmful emissions by imposing a higher burden on polluters located among less healthy population. An opposite finding would suggest that green taxes are not set with a specific concern for the environmental wellbeing of human communities.

In a Pigouvian theory, where social costs rise exponentially with emissions, the revenue function would be an increasing and convex function with respect to emissions. Our revenue theory, however, assumes that it is increasing and concave. The introduction of the carbon emissions variable in the model, in the squared form, intends to reveal the sign of the second derivative of the revenue function. As stated above, politicians are interested in raising taxes up to an optimal point t^*. Beyond t^*, taxes would have a discouraging effect upon emissions and revenues would drop.

The effect of the special industry influence upon the policymaking process is embedded in the number of exemptions and rebates awarded to the sectors affected by regulation. The

"exported goods" variable also reveals the intention to minimize the impact upon industry competitiveness. If revenues drop because of more products being exported, it means that a high volume of polluting production is not taxed domestically. Alternatively, it could mean that industry receives rebates for export.

Certainly, we would expect that the GDP and health[16] variable are positively correlated with the revenues from green taxes. Since revenues are a composite function of emissions and taxes (revenues = emissions ∗ taxes), a positive sign is expected to the carbon emissions variable. That is, revenues should increase when emissions increase. To prove the concavity of the revenue function with respect to emissions, and thus, the lack of concern for environmental effectiveness, a negative sign is expected to the carbon emissions in a squared form. If the goal of industry competitiveness is pursued, we expect to see a positive sign to the exemptions and rebates variable and a negative one to the export variable. If many exemptions and rebates are offered, revenues from industries that are taxed should offset the loss in revenues from industries that are exempted.

3. Empirical analysis

3.1. Data collection

Data regarding tax revenues, GDP, carbon emissions, exemptions and rebates, were obtained from the OECD database on environmentally related taxation. Data regarding health quality and exported goods were collected from the World Development Indicators reports of the World Bank.

Revenues from environmentally related taxes are expressed in U.S. million dollars.[17] According to OECD definition of terms, an environmentally related tax is characterized as "any compulsory, unrequited[18] payment to general government levied on tax-bases that are deemed to be of particular environmentally relevance" (OECD, 2001, p. 15).

Taxes on the purchase or use of motor vehicle and fuels, including taxes on petrol and diesel, generate most of the revenues from environmentally related taxes (more than 90%).[19] Very small revenues are raised on tax-bases such as heavy fuel oil, coal and coke, which typically are used in heavy industries. The remainder of total environmentally related tax revenues came from such items as natural gas, waste, packaging materials, etc. Since the tax-base mostly affects the environment by generating carbon emissions, only this indicator of air quality was included in the pool of independent variables.

Because of their presence long before the environmental movement occurred, we removed revenues from taxes on petroleum-related products in European countries from the green tax revenue variable. Taxes on petroleum were imposed in the European countries as a method to limit consumption. However, revenues from taxes on petroleum products in other countries were included in the calculation of total revenues.

GDP data are based on purchasing power parity adjusted 2000 U.S. dollars.[20] The health variable is measured as the infant mortality rate (number of infants who die before reaching one year of age, per 1,000 births in 1998).[21] Infant mortality rate captures the quality of health, since it reveals the effects of malnutrition and the quality of natural environment in a certain country.

Emissions of carbon dioxide are expressed in million short tons (1998).[22] Carbon dioxide (CO_2) emissions, largely a by-product of energy production and use, account for the largest share of greenhouse gases, which are associated with global warming.[23] The Carbon Dioxide Information Analysis Center (CDIAC), sponsored by the U.S. Department of Energy, calculates annual anthropogenic emissions of CO_2. These calculations are derived from data on fossil fuel consumption, based on the World Energy Data Set maintained by the United Nations Statistics Division, and from data on world cement manufacturing, based on the Cement Manufacturing Data Set maintained by the U.S. Bureau of Mines. Emissions of CO_2 are calculated and reported in terms of their content of elemental carbon.

Exports are expressed in 1999 million US dollars.[24] This variable represents the value of all goods and market services provided to the rest of the world. It includes the value of merchandise, freight, insurance, transport, travel, royalties, license fees, transport, and other services. The variable excludes labor and property income as well as transfer payments.

There are many special provisions and rebates that apply to green taxes. Denmark rebates taxes to registered business depending on the energy intensity of production. In Finland, fuels used in industrial production as a raw material or auxiliary material or consumed as immediate inputs in manufacturing of goods are exempt. In the Netherlands, refunds can be given when energy sources are not used as fuels. In Norway, coal and coke used as a reduction agent in industrial processes or used in the production of cement are exempt from taxation. These exemptions represent around 99% of all exemptions from coal and coke use in Norway. In Sweden, fuels used for the production of heat in a combined heat and power plant receives a 50% reduction in the energy tax rate. Fuels that are used for other purposes than as motor fuels or for heating are outside the scope of the tax, and thus exempted (OECD, 2001).

3.2. Findings

Data were processed with the help of the statistical package Limdep version 7.0 using the linear OLS regression. Our results are reported in Table 1.

Since the initial specification suffered from heteroskedasticity, the covariance matrix was corrected using to the Breusch-Pagan (1979) method. We note that the F-test indicates that the null hypothesis of joint insignificance of coefficients is rejected in the favor of the alternative. Therefore, the pool of variables taken together has explanatory power with respect to the dependent variable revenues.

We note that all coefficients are significant at 1% level and have the expected signs.

The positive and significant coefficient of the GDP variable is consistent with our expectations. It indicates that taxes are set in harmony with the revenue-generating potential of countries. A more general interpretation of this relationship merely supports the notion that the countries in the sample are economies where the demand for environmental quality is income elastic. This is generally in accord with findings for Environmental Kuznets Curve estimates of OECD and other countries (Grossman and Krueger, 1995; Selden and Song, 1994; Shafik, 1994). In our model, GDP increases, which generates demand for environmental quality. Green taxation follows.

Table 1. The OLS regression of revenues from green taxes upon revenue generating, air quality and industry influence variables.

Variables	Coefficients (standard error)
Constant	0.3412 (1.5493)
GDP	0.0182** (0.0043)
Health (infant mortality per 1,000 births)	−0.210** (0.0696)
Carbon	0.044** (0.0131)
Carbon squared	−0.0000084** (0.00000132)
Export	−0.00083** (0.000136)
ExReb (exemptions and rebates)	0.075** (0.022)

Standard errors are reported in parentheses. The model is corrected for heteroskedasticity using Breusch-Pagan (1979) specification. $R^2 = 0.9647$, F-test $(6,17) = 77.47$, $N = 24$ cases.[25]
**Significant at 1% level.

The health coefficient, which is measured as infant mortality per 1,000 births, is negative and significant. This finding suggests that the revenues from environmentally related taxes are positively related to the quality of health in OECD countries. Two inferences can be drawn from this result. As shown in the previous section, healthy people have higher socio-economic status and are more pro-green. Therefore, the positive correlation of revenues with health suggests that taxes are there to generate revenue. The second implication is that taxes do not exhibit a direct Pigouvian relationship. If they did, the link between revenues and the quality of health would be negative: lower health, and thus, lower environmental quality, would be taxed more, all else equal. We recognize that there could be a lagged relationship here; poor health leading to higher taxes and improved environment and then better health. We were unsuccessful in obtaining lagged healthcare data.[26]

The coefficient of the carbon variable is positive and significant. The fact that it is positive merely confirms the relationship of emissions with revenues. The revenue function is the product of taxes and the quantity of emissions ($R(c) = t(c) * c$); thus, when emissions increase, revenues should increase as well. The coefficient of the squared carbon variable is more interesting, however. Its negative sign indicates the concavity of the revenue function (and therefore, of the tax function) with respect to emissions. This result yields supporting evidence, again, that the tax does not wear the clothing of Pigou.

The coefficient on the export variable is negative and significant at 1% level. The negative sign implies that lower green tax revenues are associated with higher export activity, which means that, holding revenues constant, producers for domestic consumption bear a heavier

green tax burden. The result suggests that export industries may be more powerful politically than other industries.

The coefficient on the exemptions and rebates variable is positive and significant at 1% level. According to our expectations, this indicates that revenues from environmentally related taxes are higher when the number of exemptions and rebates are higher, a result that is consistent with the green taxation for revenue theory. The appearance of higher total revenues with exemptions and rebates also suggests that the taxing authority engages in the taxation version of price discrimination. In other words, the exemptions and rebates are extended as a way to obtain as much revenue as possible.

4. Conclusions

This paper addressed the role of politics in environmental policymaking in OECD countries. Based on previous research, a theory of political economy of green taxation is developed. It is hypothesized that policymakers set taxes with a special concern for generating revenues. They are also vulnerable to economic pressures from the politically powerful elite, which attempt to preserve their competitive position by escaping the cost of emissions taxation. Carbon emissions are also taken into consideration when setting the appropriate level of taxes, but exclusively for the purpose of determining the optimal level c^* beyond which raising taxes is no longer optimal, from a revenue-generating standpoint.

A model of political economy of policymaking was constructed and tested using data on OECD countries. The revenues from environmentally related taxes were regressed upon a matrix of explanatory variables chosen in consistence with our theory. The results indicate that taxes are not set with a specific concern for the environment; their purpose is, largely, to generate revenue. The concavity of the tax function with respect to emissions is supported by the empirical results. The results also show that taxes are set with a concern for industry competitiveness through the use of exemptions and rebates. It is interesting to observe that the goals of industry competitiveness and revenue generating are conflicting. To offset this conflict, policymakers set taxes so that industries that are taxed compensate for the preferential treatment offered to industries exempted. These results help explain why taxes in OECD countries may lack environmental effectiveness.

The political dominance of the economic elite has both normative and practical implications. This dominance violates broadly held, but perhaps naïve, democratic notions of equal representation and participation (Dryzek, 1996). Moreover, the political dominance of the economic elite, coupled with its class interests, places substantial constraints on society's ability to confront serious environmental problems through political means. The implications suggest that private law and property rights enforcement may become an attractive alternative to political environmentalism.

What does this mean for the public health and the health of the environment? The results suggest that these concerns will be relegated to the secondary status below the operation of the market and the interests of politically powerful special interest groups. Furthermore, most attempts by environmental groups to replace the logic of the market with social or environmental values will have limited success.

Now, at last, one remaining question remains to be addressed. Is there hope that a true Pigouvian tax will ever be adopted? In Kingdon's (1995) terms, a coupling of problem, environmental pollution, with the solution, green taxes, clearly exists. Is there hope that this coupling will be linked with the political stream? Barde (1996) argues that a green tax reform is needed to revolutionize the environmental policymaking in the OECD countries. The task is immense, however. The green tax reform would need to reconcile the conflicting goals of environmental effectiveness, revenue generating and industry competitiveness. In our opinion, it is impossible to completely reconcile these competing forces. Which is to say, Professor Pigou was correct. It is unlikely that human communities will ever observe in operation a perfect example of one of his taxes.

Appendix: Technical analysis

The concavity of the carbon tax

The concavity of the tax function with respect to emissions is derived from the concavity of the revenues function with respect to emissions (Figure 1).

The tax function, $t = t(c)$, where c-carbon emissions. We assume that the tax function is an increasing function with respect to emissions, that is, $dt/dc > 0$. The revenue function, $R(c) = t(c) * c$.

The second derivative of revenues with respect to emissions yields:

$$d^2R/dc^2 = (d^2t/dc^2) * c + 2(dt/dc).$$

If the revenues function is a concave function with respect to emissions, its second derivative should be negative. That is, $d^2R/dc^2 < 0$. Therefore,

$$(d^2t/dc^2) * c + 2(dt/dc) < 0, \quad \text{which yields, } d^2t/dc^2 < -(2/c) * (dt/dc).$$

The expression on the right hand side is a negative number (since $dt/dc > 0$). Therefore, $d^2t/dc^2 < 0$. The negative sign of the second derivative of the tax function with

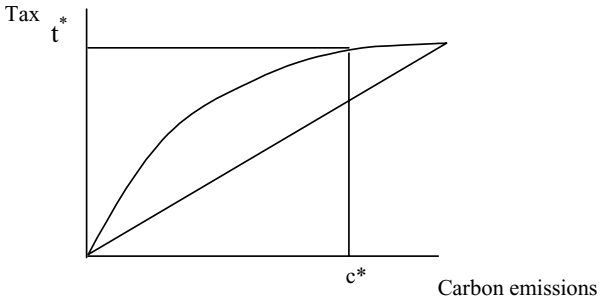

Figure 1. The shape of the tax function with respect to emissions. Taxes increase at a decreasing rate with respect to emissions.

respect to emissions indicates that the tax function is a concave function with respect to emissions.

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Notes

1. OECD member countries are: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States.
2. Pigou is generally credited for the analysis of taxation as an economically efficient instrument that discourages harmful behavior (A. C. Pigou, *Economics of Welfare*, London: Macmillan, 1920).
3. Among environmental instruments, it is generally acknowledged that taxes are more transparent than regulation, for instance, and thus less susceptible to special interest capture. However, capture may still occur. In addition, the net tax burden of firms may not be particularly transparent, given the amount of exemptions and deductions allowed in the general tax system. We note that the details of tax codes are generally well known to the specific groups that pay taxes, but are not so well understood by the typical citizen. Rational ignorance prevails again.
4. U.S. taxes on certain chemical feed stocks and crude oil paid by industrial firms into the "Superfund" under the 1980 Comprehensive Environmental Response, Compensation, and Liability Act, which incidentally cost more to collect than they yield in revenue, are an example of this (Probst et al., 1995, pp. 61–62; Yandle, 1989b). In this case, the tax rate is the same for all firms, irrespective of their environmental record, and have nothing to do with marginal damages.
5. This summary statement reflects the vast public choice literature, which includes the seminal median-voter model, developed by Downs (1957) and Bergstrom (1979) as well as interest group politics theory, in which competition among interest groups for political influence can have important efficiency-enhancing properties (Becker, 1983; Aidt, 1998). For a survey of public choice research that is focused directly on environmental policy, see Yandle (1999).
6. Not all parts of the industry may get fair representation during the consultation process: importers and smaller firms may be not as successful at making their concerns known as bigger, larger players. Not only may representatives of the domestic industry ignore the interests of foreign firms, but they may also advocate measures serving as hidden import barriers (De Clercq, 1994).
7. The theory of rent-seeking behavior that addresses motivation and strategies pursued by special interest groups is relevant here. On this, see (Tollison, 1992, 1997; Tullock, 1993; Wittman, 1989).
8. But see Joskow and Schmalensee (1998) for a political economy analysis of the acid deposition element in 1990 Clean Air Amendments. They suggest how government-issued "allowances" to emit SO_2 were allocated as side payments to interest groups in states that lost coal markets due to the legislation.
9. A similar point is made in Yandle (1997) but for a more explicit reason. Industrial polluters and environmentalists wanted to escape environmental remedies that were costly for industry and ineffective in achieving political goals for environmentalists.
10. The industries represented in the CAWG were: agriculture, aluminum, automotive, chemicals, coal, construction equipment, containers, contractors, drugs, utilities, farm equipment, fiberglass, food products, forest products, glass, heavy mobile equipment, mining, paper, petroleum, railroads, realtors, rubber, service industries, steel, wholesalers and a variety of manufacturing companies (Clean Air Working Group, 1981).
11. For instance, coal and coke used in the production of cement are either completely exempt or large tax rebates are being given. Very few taxes are levied on heavy fuels used by industry.
12. The 'health' variable, however, could be included in the revenue-generating potential vector, as well. Previous research indicates that higher health is associated with higher education and higher income, since people in

the upper classes spend more on disease prevention, which increases health quality. Therefore, the variable has revenue-generating potential, as well.

13. The poor population, labeled 'dependents' in Schneider and Ingram's (1997) typology, does not exert much influence upon environmental policymaking. Although they are positively constructed, they have low power. Their constructions usually emphasize their helplessness and neediness. However, equity concerns are sometimes taken into consideration when designing environmentally related taxes. Some environmentally related taxes are income regressive. Dependents are the recipients of beneficial policies, but less so than one would expect, given the magnitude of their problems.
14. Since the bulk of carbon taxes are composed of energy and transport taxes, the impact of such taxation will vary between different sectors according to their energy intensity. Energy-intensive sectors would bear the burden of increased energy taxation. In OECD countries, energy-intensive industries account for about 25% of GDP, on average (OECD, 2001).
15. In this paper, we only focus on testing for industry influence in shaping environmental taxation. We don't purport to show the strength of diverse interests or motivations behind their actions. This would require a more detailed analysis.
16. Since the health variable is expressed as infant mortality, which has inverse implications with the actual health of the population, a negative sign to the actual coefficient is expected.
17. Source: http://www.oecd.org/oecd/pages/home/displaygeneral/0,3380,EN-document-471-14-no-1-3016-0,FF.html#title5.
18. Taxes are unrequited in the sense that benefits provided by government to taxpayers are not normally in proportion to their payments.
19. Revenues from environmentally related taxes amount to, on average, 2% of GDP and 6% of total tax revenues. Although there are differences between countries, the revenues from these taxes are significant in all the OECD member countries. Denmark is the country where the revenues from these taxes constitute the largest share of GDP, while Korea, Greece, Portugal and Turkey are the countries with the largest shares in total tax revenue (OECD, 2001). Between 1994 and 1998, revenues from environmentally related taxation increased considerably in Austria, Denmark, Finland, Hungary, Korea, the Netherlands and Turkey. This has been due mainly to the broadening of the application of existing taxes to new tax-bases, increases in tax rates and the introduction of a number of new environmentally related taxes. For France, Luxembourg and the United States, the figures indicate a decrease in importance of these revenues (OECD, 2001).
20. PPPs are price relatives, which show the ratio of the prices in national currencies of the same product in different countries. The rationale behind using PPPs for calculating GDP is to obtain rates of currency conversion that eliminate the differences between countries and so permit volume comparisons. Source: National Accounts of OECD countries, Main aggregates, Volume 1. Web site: http://www.oecd.org/pdf/M00018000/M00018518.pdf.
21. Data are obtained from the World Bank at http://www.worldbank.org/data/wdi2000/pdfs/tab2_18.pdf.
22. Source: OECD Environmental data compendium. http://www.oecd.org/pdf/M00019000/M00019556.pdf.
23. Anthropogenic CO_2 emissions result primarily from fossil fuel combustion and cement manufacturing. In combustion, different fossil fuels release different amounts of CO_2 for the same level of energy use. Burning oil releases about 50 percent more CO_2 than burning natural gas, and burning coal releases about twice as much. Cement manufacturing releases about half a metric ton of CO_2 for each ton of cement produced.
24. Data are collected from the website: http://www.worldbank.org/data/wdi2001/pdfs/tab4_9.pdf.
25. Six countries were excluded from the sample due to missing data: Iceland, Korea, Luxembourg, Poland, Slovakia and Turkey.
26. In additional estimates focusing on the health variable, we used private healthcare expenditures, then, public healthcare expenditures, and then the sum of private and public healthcare expenditures in place of infant mortality. Generally speaking, the coefficients and signs of most other variables were unchanged. Of the three specifications, public health expenditures proved to be the most interesting. Public healthcare expenditures was highly significant and the coefficient was negatively signed. More expenditures, lower taxes. However, the coefficient on carbon emissions squared lost significance, being significant at the 12% level. The interaction between public health expenditures and carbon emissions suggests a positive relationship. However, the next step—to increase emission tax revenues—appears to be missing. Neither of the other two healthcare expenditure variables was significant at conventional levels.

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