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Working Paper

The political economy of environment-development relationships: A preliminary framework

Nota di Lavoro, No. 3. 2000

Provided in Cooperation with:

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Suggested Citation: Deacon, Robert T. (2000) : The political economy of environment-development relationships: A preliminary framework, Nota di Lavoro, No. 3. 2000, Fondazione Eni Enrico Mattei (FEEM), Milano

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**The Political Economy of
Environment-Development
Relationships:
A Preliminary Framework**
Robert T. Deacon*
NOTA DI LAVORO 3.2000

JANUARY 2000

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This paper was presented at the 3rd Toulouse Conference on Environment and Resource Economics, a FEEM, IDEI and INRA Conference sponsored by MATE on "Environment, Energy Uses and Climate Change", Toulouse, June 14-16, 1999. The research was supported by National Science Foundation Grant No. 9808696. Ed Balsdon provided valuable research assistance. Thanks are due to Jon Sonstelie and Perry Shapiro for comments on an earlier draft.

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Le opinioni espresse nel presente lavoro non rappresentano necessariamente
la posizione della Fondazione Eni Enrico Mattei

SUMMARY

The levels of public goods provided by government are determined in part by the form of political institutions in a country. Countries governed by democratic institutions arguably will provide public goods at different levels than countries ruled by autocrats or an elite group. To examine this proposition, the present paper develops a simple neoclassical theory of public good provision that allows for different political institutions. Differences in government form are based on a concept of inclusiveness. A government's structure of governance is inclusive if it takes into account the costs and benefits of the entire population when deciding public good levels. A less than inclusive government considers only the costs and benefits accruing to a subset of the population. Under plausible conditions the theory implies that public consumption goods, those that affect individual utilities directly rather than entering production functions as inputs, will be underprovided by less inclusive governments (similar to Mancur Olson and Martin McGuire.) This theory is tested with cross-country data on forms of government and provision of public goods. The provision of environmental public goods (the availability of safe water and sanitation facilities and regulations on the lead content of gasoline) is emphasised, though provision of public schooling and roads is also examined. The form of government is represented by combining data on the method of selecting government executives and representatives, the degree of power exercised by the legislature vs. the executive, the degree to which nominating processes are competitive, the practice of excluding political groups and parties, and other criteria. The empirical estimates are consistent with the theory, indicating that (after controlling for differences in income and other factors) the least democratic governments in the sample provide public goods at levels 30%-60% below the most democratic governments.

JEL: H4, Q2

NON TECHNICAL SUMMARY

Public goods are goods and services traditionally provided by government because private markets lack the needed incentives. Examples are environmental protection and national defense. The levels at which such goods are provided are determined by political processes, so the form of government and the nature of the politics in a country presumably affect public good levels. This paper examines this proposition by characterising differences in governments as differences in the degree of inclusiveness they practise in political decision-making. A government's structure of governance is inclusive if it takes into account the welfare of the entire populace when making public good decisions. A less than perfectly inclusive government considers only the welfare of an elite subset of the population when making these decisions. Under plausible conditions the theory implies that public consumption goods, i.e., those that affect the well-being of individual citizens directly, will be underprovided by governments that are less than perfectly inclusive. An implication is that less inclusive (less democratic) governments will provide less environmental protection than more inclusive governments. (For public goods that primarily benefit firms, however, by enhancing the productivity of production processes, the theory makes no definite prediction on under- or over-provision by less inclusive governments.) This model's prediction is tested with data on forms of government and provision of public goods for a large set of countries over several years. The provision of environmental public goods (the availability of safe water and sanitation facilities and regulations on the lead content of gasoline) is emphasised, though provision of public schooling and roads is also examined. The form of government is represented by combining data on the method of selecting government executives and representatives, the degree of power exercised by the legislature vs. the executive, the degree to which nominating processes are competitive, the practice of excluding political groups and parties, and other criteria. It is important to control for differences in income across countries, because less democratic governments tend to be systematically less wealthy than more democratic governments, and because income tends to influence the level at which a country provides public goods. Thus one must take care not to confound the two effects, political form versus income, on public goods provision. Overall, the empirical estimates obtained are broadly consistent with the theory.

After controlling for differences in income and other factors, the least democratic governments in the sample provide public goods at levels 30%-60% below the most democratic governments. With regard to environmental protection, this provides quantitative evidence for the often-noted phenomenon that less democratic governments are less successful at protecting the environment than more democratic governments. These results also indicate that fostering the development of more democratic government may indirectly enhance environmental protection.

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The Political Economy of Environment-Development Relationships: A Preliminary Framework

1 Introduction

A growing body of empirical research indicates that several types of pollution seem first to increase as per capita income increases and then to decline. The resulting inverted-U relationship between income and pollution has been christened the 'environmental Kuznets curve.'¹ Research on this topic has largely ignored the fact that pollution control is a public good, provided by government.² Empirical models typically regress a measure of pollution on income, income squared, and other variables, but omit the form of government as a determinant. As a consequence, the profession can offer no credible insights on the kinds of political reforms that would foster environmental protection in the developing world or on the likely environmental effects of recent trends toward democratization.

Omitting the form of government as an explanatory variable in cross country empirical models can lead to biased results and incorrect inferences on the effect of economic growth on the environment. As argued later, the form of government belongs in the model because non-democratic regimes are likely to under provide public goods such as pollution control relative to democracies. Also, the form of government is strongly correlated with income, as recent macro economic research has shown repeatedly.³ Omitting the form of government from empirical models of pollution generation and control is therefore a source of specification bias.

A mitigating factor is that most empirical studies have included fixed or random effects for countries or monitoring sites. There are several reasons why just including an additive country-specific constant does not remedy the problem, however. Most importantly, lumping the influence of government regime with other unexplained 'country effects' masks some of the potentially most

¹Thompson and Strohm (1996) question the inverted-U generalization

²Exceptions are Lopez and Mitra (1997) and Barrett and Graddy (1997).

³See Barro (1991), Levine and Renelt (1992), Easterly and Rebelo (1993.)

interesting and important results and policy insights this line of research has to offer. It certainly begs the question of how democratization in the third world might affect the environment. Second, political regimes vary over time within countries and fixed or random effects will not capture this. Third, as Lopez and Mitra (1997) argue, there are reasons why the environmental Kuznets curve's functional form and turning point should be different for different forms of government. Country-specific constants cannot capture this possibility.⁴

Agencies responsible for promoting international aid, lending, and trade have shown keen interest in the environmental Kuznets curve, particularly its downward sloping portion. Commenting on the environmental implications of growth, GATT (1992) notes that: "Concentrations of SO₂ have risen with income at low levels of per capita GDP, fallen with income at higher levels of per capita GDP, and eventually leveled off in the most advanced economies. The estimated turning point comes at about \$5,000. The conclusions for smoke pollution are much the same." The eventual decline is attributed to an income effect that operates through the policy process: "Countries near the top of the development ladder are likely to have different priorities from countries further down the ladder, and . . . as a result they are likely to have and enforce stricter environmental standards. This appears to be borne out quite well in practical experience." The conclusion seems straightforward: income growth, possibly due to expanded trade, will eventually bring environmental benefits if carried past the turning point.

The World Bank also drew a positive message from this research in its 1992 World Development Report. Commenting on how income growth affects environmental protection it reported that: "There are strong 'win-win' opportunities that remain unexploited. The most

⁴Further, because different pollutants are generated by different processes, the same set of independent variables, with second or third degree polynomial terms in income, will not generally be appropriate for explaining concentrations of all pollutants. For SO₂ emissions, which generally result from burning fossil fuels, the determinants would logically include attributes of a nation's non-traded fuels, e.g., the size and sulfur content of its coal reserves and its hydropower potential. Some of these pollutant-specific factors probably vary within countries, over time, and others presumably are fixed. Items that vary, such as fuel reserves, metal production, population density, and the composition of output, cannot be captured by fixed country effects. Even factors that probably are fixed within countries may have effects that cannot be represented adequately by an additive constant. There is no reason why SO₂ pollution in countries that use different energy sources, e.g., high sulfur coal versus hydro, will differ by a fixed constant at all income levels.

important of these relates to poverty reduction: not only is attacking poverty a moral imperative, but it is also essential for environmental stewardship.”

Whatever the factual merits of such reasoning may be, one possible consequence is a more relaxed attitude toward environmental protection in developing countries, particularly those that are growing rapidly. Policy makers might reason that the environmental protection problem eventually will take care of itself via an automatic policy response if growth proceeds far enough.⁵ This could blunt progress toward adoption of sensible environmental policies. Significantly, the environmental Kuznets curve literature has provided very little evidence of actual policy responses. Further, while the idea of an ‘inverted U’ relationship between pollution and income is entirely plausible, the crucial question for policy is the income level at which the turning point occurs. To date this term has not been estimated as accurately as the data will allow.

Finally, and perhaps most importantly, the received literature might cause policy makers to focus on the wrong policy instrument. If the observed correlation between income and pollution mainly reflects political differences, fostering political reform may emerge as the key instrument for environmental improvement. The empirical evidence now available to policy makers provides no information on this possibility and it arguably confounds the effect of economic growth on the environment with the effect of differing political institutions.

The next section of this paper offers a brief intuitive explanation of the effect omitting the form of government might have on the turning point in estimated environmental Kuznets curves. Relevant literature on this subject is then surveyed and a preliminary model of pollution control and public goods provision by non-democratic governments is developed. The model allows for interaction between economic growth, environmental protection, and the composition of output, and recognizes that the composition of output can be affected by growth and by environmental policy. Preliminary empirical analysis is presented last and is confined to examining one aspect of

⁵While most economists have drawn guarded conclusions from these results, some have been less cautious. See Salinas-Leon (1993, p. 10) and Beckerman (1992). Bartlett (1994) uses these empirical results to put a perverse twist on the possible effects of environmental policy, claiming that “existing environmental regulation, by reducing economic growth, may actually be reducing environmental quality.”

the overall model, the effect of government regime type on the provision of environmental public goods.

2 Why Politics Matters

The essential reason why omitting the form of government from the determinants of environmental quality might cause biased results can be shown intuitively. Suppose the pollution that would result from production if no effort were spent on abatement is a monotone function of a country's total output as in Figure 1. Spending resources on abatement results in a lower level of 'net pollution.' Abatement is generally accomplished by adopting regulations on waste treatment and production processes.⁶ Governments choose such regulations by balancing those environmental costs and benefits that are politically relevant, i.e., those that accrue to the group who controls the political process. In an ideal democracy the controlling group is the entire voting populace, and stylized models imply that the public good level equates marginal cost and marginal benefit to the median citizen.

Public choice theory has less to say about public goods provision by non-democratic governments. McGuire and Olson (1996) consider a model economy in which policies are controlled by an elite minority who can transfer funds from the public budget to themselves. Because public funds are fungible to the elite, the politically relevant opportunity cost of publicly produced goods is the full marginal cost of provision.⁷ That is, spending an extra government dollar on, say, public sanitation reduces the elite's income by one dollar. On the benefit side, while pollution control is often a non-exclusive public good, only the benefit accruing to the political elite is policy relevant. In a nondemocratic country this is only a fraction of the benefit the entire population can enjoy. Since policy is set by balancing politically relevant marginal benefits with

⁶The pollution generation curve is drawn to be concave, which is plausible if output shifts toward clean products as income grows. Figure 1 also shows net pollution to be monotonically increasing in income. These details are not essential.

⁷If pollution abatement takes place through regulations on production, its cost is felt in the prices of commodities. Here, the cost share borne by the elite should roughly equal their command of the nation's spendable income.

politically relevant marginal costs, the model implies that non-democratic governments will under provide public goods relative to democracies.

Figure 2 illustrates this simple message. It plots net pollution against output for three countries with different types of government: autocracy, A, democracy, D, and an intermediate type, Q, (quasi democracy) in which the elite group is relative large. Drawing the figure so that each regime abates a constant fraction of gross pollution makes the graph tidy, but is not essential. The figure reflects two crucial assumptions: (i) net pollution is greater under autocracy than democracy at each income level, as the argument in the preceding paragraph implies, and (ii) average income is lower under autocracy than democracy, i.e., $Y_A < Y_Q < Y_D$. The heavy line connecting income and pollution levels across the three countries now illustrates, in intentionally dramatic terms, a possible consequence of omitting the form of government in empirical studies of pollution and growth. Here, the heavy line plots out an inverted U relationship between pollution and income. The U shape is an artifact of the failure to control for the form of government, as pollution is assumed to be monotonically increasing with income for each form of government. More generally, omitting the form of government might bias the turning point either up or down.

This argument rests on two empirical propositions, that the form of government is systematically correlated with income and public good provision. Both propositions are examined empirically later in the paper.

3 Prior Research on the Growth-Environment Relationship

Most of the received research on the effect of economic growth on the environment is empirical. Shafik and Bandyopadhyay (1992) and Grossman and Krueger (1995) (SB and GK) both examined ambient concentrations of several air and water pollutants in a cross country panel of monitoring sites.⁸ Both specified pollution to be second or third order polynomials in per capita

⁸Shafik and Bandyopadhyay (1992) also examined access to clean water and sanitation, deforestation, and solid waste generation.

income, linear in other variables, and allowed for fixed or random effects.⁹ SB and GK both discuss structural factors, but neither postulates a structural framework. Both generally found inverted U relations for SO₂ and smoke in urban areas, with peaks in the range of \$4-6,000 in GK and \$3-4,000 in SB.¹⁰ Selden and Song (1994) used the same basic approach to examine country level *emissions* of several air pollutants. They also found inverted U patterns. Selden and Holtz-Eakin (1995) examined carbon dioxide emissions in the same way and found that per capita emissions rise with per capita income up to extremely high income levels. Panayotou (1993) and Cropper and Griffiths (1994) have estimated such relationships for deforestation and other environmental outcomes. Reviewing this work, Thompson and Strohm (1996) and Stern, *et al* (1996) find that the lack of a theoretical structure robs these studies of clear policy implications.

Hilton and Levinson (1997) took a step toward identifying structural factors for lead emissions from gasoline. They broke down total emissions into pollution intensity, measured as lead per gallon of gasoline, and total gasoline consumption. Pollution intensity (lead per gallon), which reflects a policy response, was found to decline with income as several have conjectured. Total gasoline consumption rises with income. The product, lead emissions, follows an inverted U pattern. These results indicate, at least for lead emissions, that it is a policy response that causes the pollution curve to bend down at higher incomes. Further, because lead emissions result from consumption rather than production, the eventual decline is not due to a 'pollution haven' effect, whereby rich countries import pollution intensive goods from poor countries.

Barrett and Graddy (1997) revisited the GK data, extending the model to include measures of political and civil freedom. They found support for the proposition that more freedom is associated with lower levels of several pollutants. Since democracy and civil/political freedom tend to go together, this agrees with our basic premise. They also found, however, that this relationship

⁹Other variables include investment shares of income, growth rates, trade intensity, debt, political rights and other variables in SB and population density plus climatic, topographical, and land use variables in GK.

¹⁰Results obtained for water pollutants and other environmental indicators are more varied, though single peaked curves for several forms of water pollution are obtained by GK. Another relevant empirical study is Lucas, Wheeler, and Hettige (1992) who examined changes in the industrial composition of output and implied changes in production of toxic materials across countries. Summarizing, their study found that production of toxics does decline at sufficiently high income levels, but that this is mainly due to shifts away from manufacturing at high incomes rather than to shifts within manufacturing toward less toxic outputs.

does not apply to all pollutants. This seems to indicate that the downward sloping portion of environmental Kuznets curves for some pollutants is caused by something other than an induced policy response. (Shifts in the composition of output seems an obvious possibility.)¹¹

In an important recent contribution Antweiler, Copeland, and Taylor (1997) (ACT) developed a rigorous structural framework. In their model countries set environmental policy endogenously by satisfying a Samuelson condition. Environmental policy, in turn, alters the relative prices of goods according to their pollution intensity. Countries trade, with comparative advantage determined both by environmental policy and factor abundance. A reduced form equation for pollution is then estimated with the same SO₂ data others have used, primarily to determine the environmental effects of trade liberalization.

Theoretical models of the growth-environment relationship are scarcer. Lopez (1994) models pollution as use of the environment as a productive input. He shows that an inverted U relationship is generally possible, though not if preferences are homothetic. He also shows that its form depends on the ease of substituting environmental and conventional factors. Lopez and Mitra (1997) extend this framework to examine the effect of government corruption. Corruption takes the form of payments from industry, the source of pollution, to government officials. Government officials are motivated by these payments and by the desire to retain office, which depends on the average citizen's welfare. They find that corrupt regimes may also follow an inverted U pattern, but with more pollution at each income level and a higher turning point than non corrupt regimes.

Overall, this review indicates the importance of basing empirical work on a structural framework to motivate policy inferences. It also describes suggestive evidence that the form of government is empirically related to pollution (Barrett and Graddy, 1997,)¹² and offers a set of relevant testable hypotheses (Lopez and Mitra, 1997.) Finally, ACT's structural framework seems adaptable to the present purpose, and a model sketched along these lines is presented next.

¹¹Congleton (1992) and Murdoch, Sandler, and Sargent (1997) correlated 'freedoms' measures with participation in international environmental agreements.

¹²GK and ACT both found pollution to be significantly higher in communist countries than other countries, and SB found a measure of 'political rights' to be significant in some regressions.

4 A Preliminary Framework

Consider of a small, open economy that consumes pollution, a public good, and two ordinary private goods. The analysis is static. Government policy concerning pollution control and public goods is endogenous, determined by income, the form of government, and other variables. The economy produces two private goods, X and Y, a public good Z, and a pollutant, W (waste.) Production of Y causes pollution, but production of X and Z does not. Thus pollution is partly determined by the composition of output. For simplicity, W is assumed proportional to Y

$$W = \alpha \cdot Y, \quad \alpha > 0. \quad (4.1)$$

W can be reduced by reducing Y or by spending resources to reduce α , its pollution intensity.

The economy is endowed with a fixed primary input, R, which may be a vector. The production function for private goods and pollution control is

$$f(X, Y, \alpha, R, T) = 0 \quad (4.2)$$

where T represents the production technology. $f(\cdot)$ is taken to be convex in X, Y, α , and R, increasing in X, Y, and α , and decreasing R. The private goods X and Y can either be consumed directly or used to produce the public good Z. Production of the public good is addressed shortly.

The country's economy is small and open, and trades both private goods at fixed world prices. Good X is numeraire and the price of Y is P. Production is competitive. The country's environmental policy takes the form of a tax on pollution, τ . Production of the public good is financed by a lump sum tax, Γ . Levels of both τ and Γ are determined later. The profit of a representative firm, net of the pollution tax and the tax to support public good production, is

$$P \cdot Y + X - c(X, Y, \alpha, R, T) - \tau \cdot \alpha \cdot Y - \Gamma, \quad (4.3)$$

where $c(\cdot)$ is the cost function for private goods. Profit maximizing output and pollution control choices are

$$Y = Y(P, \tau, R, T), \quad X = X(P, \tau, R, T), \quad \alpha = \alpha(P, \tau, R, T). \quad (4.4)$$

With an open economy, the composition of output is not affected by the income and preferences of domestic consumers except through environmental policy, as shown momentarily.¹³ After-tax maximized profit, which is effectively the rent generated by R, is given by

$$\pi = \pi(P, \tau, R, T) - \Gamma. \quad (4.5)$$

Production of the public good Z is assumed to require only the private outputs X and Y so

$$Z = Z(X, Y, T). \quad (4.6)$$

Public good production is assumed to take place at minimum cost. The resulting public good cost function, $g(Z, P, T)$, is convex and increasing in Z. Budget balance implies that

$$g(Z, P, T) = \Gamma. \quad (4.7)$$

The fixed number of individuals in the country is N. The country's government is controlled by an elite group numbering $E \leq N$. The limiting cases of pure democracy and pure dictatorship occur at $E=N$ and $E=1$, respectively. Taking the form of government as given, the number of elite in the country is fixed. The utility of an elite member, i , is

$$u = u(X_i, Y_i, Z, W), \text{ where} \quad (4.8)$$

X_i and Y_i are i 's consumption of the two private goods. Z and W are common to all individuals. u is assumed to be concave, increasing in X, Y, and Z, and decreasing in W.

Government policy regarding pollution control and public good provision are chosen by the elite to maximize their aggregate utility.¹⁴ As a first step toward examining these choices, consider the aggregate budget constraint for the elite group. Let σ denote the share of the economy's income that the elite controls, and assume this share depends on the country's form of government. It is useful to define a 'form of government' variable that captures the concept of inclusiveness--the degree to which government policy incorporates, or fails to incorporate, the interests of the entire population. The most natural choice is E/N , the size of the elite relative to the entire population. A higher value of E/N corresponds to a more inclusive government. With 'pure democracy' $E/N=1$, the elite is the entire population. More generally, assume $\sigma = \sigma(E/N)$.

¹³ This would of course be violated if some goods are not traded.

¹⁴ The elite's decision process could be characterized as maximizing the utility of the median elite member with little effect on the model.

As a working hypothesis, it seems reasonable to specify that $\sigma(E/N) \geq E/N$, with equality holding only for $E/N=1$. This means that the elite captures a disproportionately large share of income in non-democratic governments. In a pure democracy, the share necessarily equals unity. Further, it seems reasonable to specify that σ is strictly increasing and concave in E/N . For σ to be increasing means that increasing the size of the elite for a given N , i.e., moving toward democracy, increases the share of the economy's total income that the elite controls. This seems intuitively sensible. Concavity implies that $\sigma(E/N)/E$, the income share of an individual member of E , is decreasing in E . This means that an individual elite member's share of the economy's income is greater the smaller is the elite group, and is greatest under single ruler autocracy.

The economy's spendable income equals the rent generated by its resource endowment, $\pi(\cdot)$, plus the proceeds of the environmental tax, $\alpha \cdot \tau \cdot Y$, minus the cost of providing the public good, $g(\cdot)$. The elite captures the share σ of this. Let $e(P,W,Z,u)$ denote the expenditure function of a representative member of the elite. With this notation the elite group's budget constraint can be written

$$\sigma(E/N) \cdot [\pi(P,\tau,R,T) + \tau \cdot \alpha(P,\tau,R,T) \cdot Y(P,\tau,R,T) - g(P,Z,T)] = E \cdot e(P,W,Z,u). \quad (4.9)$$

The elite group controls government and makes policy to maximize their collective welfare. The formal problem is to maximize $E \cdot u(\cdot)$ subject to (4.9). Because E is fixed, this is no different than maximizing the utility of a typical elite member. The Lagrangian is

$$L = E \cdot u + \lambda \{ \sigma \cdot [\pi(P,\tau,R,T) + \tau \cdot \alpha(P,\tau,R,T) \cdot Y(P,\tau,R,T) - g(P,Z,T)] - E \cdot e(P,W,Z,u) \}. \quad (4.10)$$

The choice variables are u , τ , and Z and the first-order conditions are

$$\frac{\partial L}{\partial u} = E - \lambda \cdot E \frac{\partial e}{\partial u} = 0, \quad (4.11)$$

$$\frac{\partial L}{\partial \tau} = \lambda \left\{ \sigma \left[\frac{\partial \pi}{\partial \tau} + \alpha \cdot Y + \tau \cdot \alpha \frac{\partial Y}{\partial \tau} + \tau \cdot Y \frac{\partial \alpha}{\partial \tau} \right] - E \cdot \frac{\partial e}{\partial W} \left(\alpha \frac{\partial Y}{\partial \tau} + Y \frac{\partial \alpha}{\partial \tau} \right) \right\} = 0, \quad (4.12)$$

$$\frac{\partial L}{\partial Z} = -\lambda \left\{ \sigma \frac{\partial g}{\partial Z} + E \frac{\partial e}{\partial Z} \right\} = 0, \quad (4.13)$$

and the budget constraint (4.9). The solution is

$$\tau = \tau(P,R,E/\sigma,T), \quad Z = Z(P,R,E/\sigma,T), \quad u = u(P,R,E/\sigma,T). \quad (4.14)$$

The first-order conditions have natural interpretations. Equation (4.11) identifies $1/\lambda$ as the marginal cost of utility. In order to interpret (4.12), notice that the envelope theorem implies $\partial\pi/\partial\tau = -\alpha \cdot Y$ (see (4.3).) Using this and canceling common terms, (4.12) can be written

$$\tau = (E/\sigma) \cdot \frac{\partial e}{\partial W} \quad , \quad \text{or } \tau = \frac{E/N}{\sigma} \cdot \left[N \cdot \frac{\partial e}{\partial W} \right]. \quad (4.15)$$

Condition (4.13) can be written

$$\frac{\partial g}{\partial Z} = - (E/\sigma) \cdot \frac{\partial e}{\partial Z} \quad , \quad \text{or } \frac{\partial g}{\partial Z} = - \frac{E/N}{\sigma} \cdot \left[N \cdot \frac{\partial e}{\partial Z} \right]. \quad (4.16)$$

In (4.15) and (4.16) the terms $\partial e/\partial W$ and $-\partial e/\partial Z$ are an elite individual's marginal benefit of pollution control and the public good, respectively. Assume for a moment that all individuals in the country, elite and non-elite alike, have the same marginal benefit functions for pollution control and public good. In this case a Pareto efficient policy would equate the pollution tax to $N \cdot \frac{\partial e}{\partial W}$, the social marginal benefit of pollution control. In addition, it would equate the marginal cost of the public good to $-N \cdot \frac{\partial e}{\partial Z}$, the social marginal benefit of the public good. Recall that $(E/N)/\sigma$ is below unity for non-democratic governments. The model therefore implies that non-democratic governments will under-provide both pollution control and the public good, with the degree of under provision worse for less democratic regimes.

This formalizes a simple intuition. Because the elite captures a disproportionate share of the economy's net income, it will arguably bear a disproportionate share of the cost of any environmental regulation adopted or public good provided. If it captures all of the economy's rents, then it necessarily bears the entire cost. The elite captures only a proportionate share of the marginal benefit of pollution control and public good provision, however, because these goods are non-exclusive. Since the elite make the policy, public goods are under-provided relative to what is efficient.

This prediction must be amended if marginal pollution damages and marginal public good benefits increase with income. Members of the elite tend to be wealthier than the general population, so it is reasonable to expect each member's demand for public goods to be relatively

high when E/N is small. Strictly speaking, this implies that the effect of the form of government on public goods provision is indeterminate in this case.

Two practical considerations mitigate this income effect, however. First, less democratic governments tend to experience poor economic performance, so concentrating the control of government among a smaller elite should reduce the size of the pie each member shares. In other words, the income of an average elite member may not increase much as the degree of inclusiveness declines. Second, if E/N is small, members of the elite might find it advantageous to provide public goods, or substitutes for them, among themselves, even if the cost is high. An elite group may choose to live in a protected enclave, with their own systems for water, sanitation and education. They may even have clean air if enclaves are located away from urban centers. Dictators sometimes carry this to an extreme by maintaining villas in rich, pollution free, foreign countries. Such substitutes place a ceiling on the marginal damage the elite can suffer from general pollution and thus mitigate the income effect on publicly provided goods and pollution control.

It is instructive to consider the case of a public good, Z , that benefits industry rather than consumers, i.e., a public good input. A simple way to examine this is to drop pollution (W) from the model and to specify that Z enters the economy's profit function but not the elite's expenditure function. In this case the budget constraint (4.9) becomes

$$\sigma(E/N) \cdot [\pi(P,R,Z,T) - g(P,Z,T)] = E \cdot e(P,u). \quad (4.17)$$

Solving the elite's utility maximization problem now requires that Z be chosen to maximize the country's rent, the term in brackets on the left hand side of (4.17). Since E/N does not appear in this expression, the solution is independent of the form of government. That is, the model implies that all forms of government provide pure public inputs efficiently.

Finally, a simple intuitive argument indicates that plotting pollution against income may well result in an inverted U relationship for any form of government, but that the exact shape is likely to be different for different forms of government. In the context of the present model, increasing income is equivalent to increasing the economy's resource endowment, R . Increasing R allows the economy to produce more of both private goods (X and Y) which, ceteris paribus,

increases pollution. This tendency for pollution to increase as R increases should be independent of the form of government because it is a simple production effect. Increasing R also raises the demand for pollution control, however, resulting in a higher pollution tax. Raising the pollution tax lowers Y and its pollution intensity, α . The production and policy effects thus work in opposite directions, so the net effect on pollution is ambiguous. Intuitively, the pollution-income relationship is likely to have an inverted U-shape if the stringency of pollution control increases with the country's income at an increasing rate, so the policy effect tends to catch up to the production effect as income increases. From (4.15), however, the responsiveness of environmental policy to changes in total or percapita income tends to be small where σ/E is large, i.e., in non-democratic situations. Hence, if a turning point exists it should occur at a higher average income under non democratic government than democracy. This conclusion agrees with Lopez and Mitra (1997), though the reasoning is different.

5 The Form of Government and the Provision of Public Goods: Empirical Results

One political economy aspect of the environment-development relationship is examined empirically, the effect of political regimes on public goods provision. The model captures this effect in two ways, in the demand function for public goods and in the equilibrium environmental policy; see (4.14). Differences in political systems are captured by $E/\sigma(E/N)$, which can be written as a function of N and $(E/N)/\sigma(E/N)$. Recall that $(E/N)/\sigma(E/N)$ is higher in more democratic (more inclusive) regimes. The equilibrium public goods level is thus given by:

$$Z = Z(E/N, N, P, R, T).$$

Essentially the same effect is reflected in the pollution control tax, which is written:

$$\tau = \tau(E/N, N, P, R, T).$$

Given the duality between taxes and pollution control standards, $\tau(\cdot)$ can be considered a general measure of the stringency of a country's environmental policy.

Empirically, R represents the economy's capacity to produce, so GDP is an appropriate measure. P represents relative prices of goods with differing pollution intensities. In keeping with the open economy specification, the empirical approach assumes P is roughly the constant across countries and varies only over time. This is also assumed to be true for T , the technology variable. Variation in both can thus be captured by temporal dummy variables or time trends.¹⁵

Defining Political Regimes

The obvious difficulty for empirical work is to capture the form of government, interpreted as the degree of inclusiveness, in an empirically tractable way. We examine this problem from different perspectives to see if a single measure dominates and to see if robust results emerge. Political scientists have compiled extensive data sets on the political attributes of countries. Two of these sources are relied upon in what follows. The first is the Cross-National Time Series Data Archive first compiled by Arthur Banks (19**) and now maintained by ***. This source lists objectively observed attributes of the governmental systems of virtually all countries, as explained below. The second is the Polity III data base maintained by Keith Jagers and T. R. Gurr (1995) which gives information on the political systems of countries with populations greater than 500,000. Polity III reports some objective attributes plus subjective judgements on the degree to which different institutions of government are democratic, or responsible to the populace. Both data bases cover the period from the late 1990s back into the 19th century. These two sources were used in different ways to classify governments into groups with similar political attributes. Membership in individual groups is then represented with dummy variables.¹⁶

The first classification scheme relies on data from Banks (19**). Banks reports: the effectiveness (and existence or nonexistence) of a country's legislature, competitiveness of the

¹⁵ The population level, N , also appears in $Z(\cdot)$ and $\tau(\cdot)$. This is because the public good and pollution control are assumed to be pure public goods, so increasing population should cause the benefits of public good provision and pollution control to rise proportionately. In estimation it is assumed that Z is linearly homogeneous in N , which implies the use of percapita measures of public good provision. Regarding τ , it is assumed that both the benefits and costs of pollution control are proportional to N , so the standard is independent of population.

¹⁶ The widely used data base on political and civil freedoms sponsored by Freedom House and reported by Gastil was also considered, but was not used in part because of the common belief that it reflects a conservative bias.

legislature's nominating process, the presence or absence of political coalitions, the degree to which parties are excluded from political participation, whether the government is controlled by civilian or military components of the population, the method of selecting the chief executive (e.g., elective or nonelective,) the method of selecting the legislature (elective or nonelective,) and the responsiveness of a premier to the legislature in parliamentary systems.

Each attribute typically has several categories to which an observation (country and year) can be assigned. For example, for legislative effectiveness a legislature can be designated as nonexistent, ineffective, partially effective, or effective. A legislature is effective if it has significant autonomy, including the power to tax, spend, and override executive vetoes. A legislature is partially effective if the executive's power substantially dominates, but does not completely eclipse, it. For example, a partially effective legislature might not possess one or more of the powers needed to be an effective legislature. A noneffective legislature is defined as one that cannot implement legislation due to domestic turmoil, cannot meet because the executive prevents it, or is essentially a 'rubber stamp' body. And, of course, a nonexistent legislature is self explanatory. There clearly is an attempt to use objective criteria in assigning attributes.

None of these attributes can necessarily be considered decisive in indicating the degree of democracy or inclusiveness in a country's government. The presence of certain attributes does, however, generally indicate a presumptive absence of democracy. These are: ineffective or nonexistent legislature, noncompetitive nominating process for the legislature, no opposition to the party in power, significant exclusion of some political groups or parties, government controlled by military component of population, nonelective selection of the chief executive, nonelective selection of the legislature, and parliamentary government in which the premier is not responsible to the legislature. Any country that possesses none of these nondemocratic attributes was presumed to be a Democracy.

A similar procedure was used to identify countries that, based on the attributes observed, appear to be dictatorial. Here, the presumption is that a country is democratic if it has: an effective legislature (possessing substantial power to tax, spend, and override executive vetoes,) direct

popular election of the chief executive, or is a parliamentary government in which the premier is fully responsible to the legislature. Any country that possesses none of these democratic attributes is considered a presumptive Dictatorship. Observations not falling into either group are labeled Indeterminate.

To obtain a finer division the possible democracies and dictatorships were then subdivided according to other attributes. The Dictatorship group was split into two subgroups depending on whether or not a country has a popularly elected legislature. Those that do are placed in a group called Dictatorship 1, while those that do not are placed in Dictatorship 2. The Democracy group was also subdivided. An otherwise democratic country was placed in a group called Democracy 2 if it had a partially effective legislature (so its power is substantially outweighed by the executive,) or if some minor or extremist political parties are excluded from the political process. The remaining members of Democracy were placed in Democracy 1, which is arguably the most democratic group.

In the sample examined, this resulted in the following percentage breakdown of observations by political designation: Democracy 1 19%, Democracy 2 21%, Dictatorship 1 16%, and Dictatorship 2 16%, Indeterminate 28%. This ordering from Democracy 1 to Dictatorship 2 is expected to coincide roughly with the ordering of inclusiveness of government regimes. The inclusiveness of the Indeterminate group is unclear.

The second method for defining regimes also relies on Banks, but combines attributes in different ways. Three basic attributes are used: the method of selecting the chief executive, the type of chief executive, and the existence or effectiveness of the legislature. Figure 3 shows how government regimes are defined and gives sample frequencies. A country with an effective or partially effective legislature and an elected chief executive is defined to be a Parliamentary Democracy or Presidential Democracy, depending on whether its chief executive is a premier or a president.¹⁷ A regime with an elected chief executive (either president or premier) but an ineffective legislature or no legislature is called a Strong Executive system. When a country's chief executive

¹⁷Parliamentary democracy is distinguished from non-parliamentary democracy (presidential systems) because the legislature is arguably more powerful in the former.

is a nonelected member of the military, its regime is called a Military Dictatorship. When a country's chief executive is nonelected but not from the military, its regime is labeled Other. The Other group includes monarchies, protectorates, and countries in which no individual can be identified as wielding effective executive power, e.g., anarchies. The first two regimes appear most inclusive, followed by the strong executive and military dictatorships. Military dictatorships and strong executive systems seem more likely than presidential and parliamentary systems to cater to an exclusive minority. The inclusiveness of the Other category is unclear.

The third method for defining political regimes relies on the Polity III data base of Jaggers and Gurr (19**). Polity III reports a Democracy Score and Autocracy Score for each country and year. Each variable is a subjective assessment coded on a 0 to 10 point scale, with higher numbers corresponding to 'more' of the named attribute.¹⁸ These indexes were combined by subtracting 'Autocracy' from 'Democracy,' to obtain an overall democracy index that can take on 21 possible values, from -10 to 10, including 0. A country receiving a 0 on the Democracy scale and a top score on the Autocracy scale would receive an overall score of -10, while one with a top score on Democracy and 0 on Autocracy would score 10. Dummy variables were defined for country-year pairs falling into the different quintiles of this range. These regime variables are labelled Q1-Q5, ordered from most democratic to most autocratic.

Environmental and Public Goods Data and Empirical Specifications

Cross country data were collected for several measures of public goods provision, with emphasis on environmental public goods, and one measure of environmental policy. Two environmental public goods are examined, the percent of the rural population having access to sanitation facilities and safe drinking water. These data are collected by the World Health Organization and are reported in the World Resources Institute database. Empirical analysis is based on data from a cross section of 118 countries for the year 19**. Since there is no time variation, temporal

¹⁸Polity III also reports data on procedures for transferring executive power, the degree of competition in the electoral process, the openness of executive recruitment, the institutional independence of the chief executive, the openness of political expression, the general openness of competition for government office, and the degree of centralization of state authority.

dummies are unnecessary. The only variables included on the right hand side are therefore percapita income and the political dummies. Each dependent variable has a natural truncation at 100%. When plotted against income, therefore, it should be increasing, roughly concave, and truncated at 100%. To capture this the dependent variable is expressed in levels in the two models, income is entered in logs, and tobit estimation is used.

The model does not just apply to environmental public goods, so it is of interest to examine other public goods for which data are available. Two are examined here, roads and public education. Data on the extent of paved and unpaved roads, available sporadically for about 120 countries over the period 1965-1995, were taken from the International Road Federation. To examine the hypothesized relationship, road density (kilometers of road per square kilometer of land) is specified to be a log-log function of population density, per capita income, and dummy variables for the form of government. A time variable was included to capture changes in technology and prices. This model was estimated with fixed effects for continents to allow for broad regional differences in climate and topography.¹⁹

To examine provision of public education, data on secondary school enrollments for approximately 120 countries over the period 1960-1995 were taken from Banks. The dependent variable is secondary school enrollment, divided by the population under age 15 to control for population age structure. Attention is focused on secondary public education because primary education is nearly ubiquitous across a large number of countries and hence does not exhibit much cross sectional variation. The independent variables are per capita income, population, time, and the political regime dummies. As with roads, the functional form is log-log and fixed effects for continents are included.

The environmental policy measure considered is the lead content of gasoline as reported by Octel Corp. This variable was examined for even years between 1972 and 1992 for a sample of 48 countries. Lead is a cheap source of octane in gasoline. When burned it collects in areas near roads and can eventually be ingested by humans. Lead ingestion leads to well known health problems,

¹⁹ Fixed effects for countries would largely absorb the effects of political variation since regimes exhibit relatively minor variation within countries over time.

and the most common way to control its emission is to legislate an upper limit on lead concentrations in gasoline. By examining the actual lead concentration, rather than the legislated maximum, it is implicitly assumed that gasoline producers are effectively constrained by lead content regulations. Many countries have banned its use, imposing an effective zero limit on concentrations.

The empirical model for lead concentrations includes income and the political regime dummies as regressors. It also includes two additional variables. The first is a time trend. It reflects the fact that worldwide lead use in gasoline has been declining monotonically over the sample period, which may reflect increased knowledge of the health effects of lead in humans and development of technology for raising octane without using lead. Yearly dummies and a time trend yielded nearly identical results for other parameters and for overall fit. The linear trend specification is reported because it is simpler. The second new independent variable is the percent population living in urban areas. It is included to capture cross country differences in the human exposure and related health effects of emitting a given amount of lead into the environment. Intuitively, if a country's population is entirely rural then gasoline consumption and lead emissions will be dispersed, leading to low concentrations per unit land area in the environment. In a largely rural country the population is also dispersed, so exposure is relatively light. By contrast, in urban areas both gasoline consumption and human habitation are concentrated in the same areas. Lead concentrations are naturally truncated at zero. Accordingly, the relationship with income is necessarily nonlinear. This was taken into account by expressing lead concentrations in levels, entering income in logs, and using tobit estimation.

Results

Table 1 presents mean income and public good levels, by political regime, for the three different methods of defining regimes. Incomes are clearly higher in democracies than in autocracies and the effect is roughly monotonic. There are a few fairly minor anomalies, e.g., Q5 in the Polity III regime set. This may be due to the influence of major oil producing countries, some of which are

autocratic and happen to be wealthy due to their natural resource base. A plausible reason why incomes are lower in less democratic regimes is weak property rights due to a poorly established rule of law. This should depress investment incentives and economic growth. A related explanation is that such regimes often suffer from corruption that can drain away both the economic surplus and incentives that a private economy would otherwise yield. The observation that regimes and income are highly correlated confirms an earlier claim, that failing to control for differences in political systems will tend to bias the estimated relationship between a country's income and its level of environmental quality or public good provision.

While there are exceptions, road provision, public schooling, and access to safe water and sanitation generally decline as democracy declines, while lead concentrations in gasoline generally increase. This is consistent with the story told earlier, that autocracies do not include the benefits accruing to all citizens when deciding the levels at which such goods should be provided. The pattern is most consistent for the two regime definitions that use the Banks data. Of course, the observed correlation between income and politics means that this public goods ordering could also be due to differences in incomes.

Table 2 presents regression results for the four public goods and lead concentrations using the first method for defining political regimes. Income is highly significant and of expected sign in all cases, and as shown shortly this is also true for results using other regime definitions. All equations fit the data well. Dictatorships (Dictatorship 1 and 2) under-provide the four public goods relative to the two more democratic regimes in all but one comparison. Dictatorships also 'over-provide' lead. The pattern is closest to that predicted a priori for the cases of roads and schooling. In the case of safe water and sanitation the three less democratic regimes (Democracy 2 and Dictatorship 1 and 2) are indistinguishable from one another, but all under-provide relatively to the most democratic regime.

Results for the second Banks measure, in Table 3, show that the most democratic regime, which is the default, consistently provides greater public goods levels and lower lead levels than

the two regimes expected to be the least democratic (strong executive and military dictatorship). The effect is significant in the large majority of possible comparisons.

Results using the Polity III data to define political regimes appear in Table 4. The ordering of political effects is not quite as consistent as with the other two measures, but still generally follows the expected pattern. The two least democratic regimes, Q4 and Q5, almost always provide greater public good levels and less lead than the two most democratic regimes, Q1 and Q2.

Comparing results across tables for different public goods, the differences between regimes are most distinct for roads, school enrollment, and lead levels. The pattern is typically less distinct for safe water and sanitation. For these two cases the most democratic regime generally has significantly higher provision than the others, but little variation is evident among the four less democratic regimes.

All three methods of defining political regimes give approximately the same fit to the data. There is one exception: the second method using the Banks data, shown in Table 3, does a poor job of fitting lead concentrations. The reason for this is not clear.

Most importantly, political regimes clearly matter for the provision of public goods and environmental protection, even after controlling for differences in income. Overall, the differences generally run in the expected direction. The differences between the most democratic regime and each of the other regimes is statistically significant in the vast majority of cases (56 out of 65) and all of the significant differences are of the expected sign. Differences among the less democratic regimes are less often significant, however. Generally, the differences between less democratic regimes are more likely to be significant for school enrollments and lead concentrations than for roads, safe water, and sanitation, though this is not a strong pattern.

The political regime effect on public good provision is generally large. Table 5 reports percent differences between public good and environmental policy levels under the most democratic regime and the 'worst,' of the two less democratic regimes. In most cases the worst regime is also the least democratic *a priori*, though there are a few exceptions. The estimated degrees of under-provision by less democratic governments are highly consistent across regime

definitions for schools (30-36%), safe water (29-33%), and sanitation (43-59%). The spread of estimates is broader for roads (33-66%) and for lead in gasoline (41-106%). Clearly, however, even the smallest effects are quantitatively large.

6 Conclusions

These results, though preliminary, do serve to demonstrate that such questions are empirically researchable. The general finding that the pattern of correlations generally supports the maintained hypothesis about the effect of governance on the provision of public goods is encouraging. In addition, unreported results indicate differences in the income elasticities of public goods provision under different systems of governance. This implies that incorporating fixed effects for countries cannot capture the effects of differences in political systems, even when political systems tend to be relatively constant within countries.

Refining the model of political outcomes in nondemocratic governments is a logical next step. The model developed here relies entirely on the concept of inclusiveness to differentiate political systems. It is highly stylized and overlooks some of the more interesting attributes that autocracies seem to display, such as an apparent tendency to spend heavily on military and police functions, possibly to defend their favored position. Another obvious question to address is why countries end up with the political systems they have, i.e., what process leads to differences in political regimes? Even if the model developed here is not amended, a more careful empirical analysis may reveal a better way to use the data on political attributes to represent variations in inclusiveness. A straightforward extension would be to examine political effects on other public goods and environmental quality indicators for which data are available.

It seems likely that public good levels respond to changes in political conditions gradually. Roads are capital improvements and can sensibly be augmented and depreciated only slowly. Provision of safe water, sanitation, and schools all require some capital investment, and hence are subject to the same effect. Intuitively, investigating a lag structure for the effects of political

conditions may yield a clearer understanding of the effects of politics. A thorough investigation of the dynamics of public goods provision and political change may also shed light on whether or not the correlations observed here can be viewed as causal. Establishing a causal link from politics to public good and environmental outcomes would be an important accomplishment. It would confirm the importance of political reform as a policy instrument for those who seek to improve environmental outcomes and living conditions in some of the world's poorest and most troubled nations.

References

- Banks, A.S., 1989. *A Cross-national Time Series Data Archive*. SUNY Binghamton: Center for Social Analysis.
- Barro, Robert, 1991. "Economic Growth in a Cross Section of Countries." *Quarterly Journal of Economics*, Vol. 61 (May 1991) 407-44.
- Bartlett, Bruce, 1994. "The high cost of turning green." *The Wall Street Journal*, September 14.
- Bennett, B. G., J. G. Kretzschmar, G. G. Akland, and H. W. deKoning, 1985. "Urban Air Pollution Worldwide." *Environmental Science and Technology*, 12(4) 298-304.
- Barrett, Scott, and Kathryn Graddy, 1997. "Freedom, Growth, and the Environment." London Business School, September 1997.
- Beckerman, W., 1992. "Economic Growth and the Environment: Whose Growth? Whose Environment?" *World Development* 20 481-496.
- Congleton, Roger D., 1992. "Political Institutions and Pollution Control." *Review of Economics and Statistics*, 74(3) 412-21.
- Cropper, Maureen, and Charles Griffiths, 1994. "The Interaction of Population Growth and Environmental Quality." *American Economic Review* 84 (2) 250-254.
- Deininger, Klaus, and L. Squire, 1996. "A New Data Set Measuring Income Inequality." *World Bank Economic Review* 10(3) 565-91.
- Easterly, William, and Sergio Rebelo. 1993. "Fiscal Policy and Economic Growth," *Journal of Monetary Economics* 32, 417-458.
- Finer, S.E., 1997. *The History of Government From the Earliest Times*. New York: Oxford University Press.
- General Agreement on Tariffs and Trade, 1992. *International Trade 1990-1991*. Volume 1. Geneva.
- Greene, William H., 1997. *Econometric Analysis*. Prentice Hall.
- Grossman, Gene M., and Alan B. Krueger, 1995. "Economic Growth and the Environment." *Quarterly Journal of Economics* 112 (2) 353-378.
- Hettige, H., R. E. B. Lucas, and D. Wheeler, 1992. "The Toxic Intensity of Industrial Production: Global Patterns, Trends, and Trade Policy." *American Economic Review*. 82 (2) 478-481.
- Hilton, F. G. Hank, and Arik Levinson, 1997. "Factoring the Environmental Kuznets Curve: Evidence from Automotive Lead Emissions." Working Paper, Department of Economics, University of Wisconsin-Madison.
- Holtz-Eakin, D. and T. M. Selden, 1995. "Stoking the Fires? CO₂ Emissions and Economic Growth." *Journal of Public Economics* 57(1) 85-101.

- Levine, Ross and David Levine, 1992. "A Sensitivity Analysis of Cross-Country Growth Regressions." *American Economic Review*, Vol. 82, No. 4, 942-64.
- Lopez, Ramon, 1994. "The Environment as a Factor of Production: The Effects of Economic Growth and Trade Liberalization." *Journal of Environmental Economics and Management*, 27 163-184.
- Lopez, Ramon, and Siddhartha Mitra, 1997. "Corruption, Pollution, and the Kuznets Environment Curve." Department of Economics, University of Maryland at College Park.
- Lucas, R. E. B., David Wheeler, and H. Hettige, 1992. *Economic Development, Environmental Regulation, and the International Migration of Toxic Industrial Pollution: 1960-1988*. Policy Research Paper WPS 1062, Washington D.C.: The World Bank.
- McGuire, Martin C., and Mancur Olson, 1996. "The Economics of Autocracy and Majority Rule: The Invisible Hand and the Use of Force." *Journal of Economic Literature* 34 (1) 72-96.
- Murdoch, J. C., T. Sandler, and K. Sargent, 1997. "A Tale of Two Collectives: Sulphur versus Nitrogen Oxides Emissions Reduction in Europe." *Economica*, May 1997, 281-301.
- Panayotou, Theodore, 1993. "Empirical Tests and Policy Analysis of Environmental Degradation at Different Stages of Economic Development." Working Paper, Technology and Employment Programme, Geneva: International Labor Office.
- Salinas-Leon, R., 1993. "Green herrings." *Regulation: The Cato Review of Business and Government*. 16 29-34.
- Selden, T. M. and D. Song, 1994. "Environmental Quality and Development: Is There a Kuznets Curve for Air Pollution?" *Journal of Environmental Economics and Management*, 27 (2) 147-162.
- Shafik, N. and S. Bandyopadhyay, 1992. "Economic Growth and Environmental Quality: Time Series and Cross-Country Evidence." Policy Research Working Paper No. WPS 904, Washington, D.C.: The World Bank.
- Singer, J. G., ed., *Combustion: Fossil Power Systems*, (Appendix A) Combustion Engineering Inc., Windsor, CT 1981.
- Stern, David I., Michael S. Common, and Edward B. Barbier, 1996. "Economic Growth and Environmental Degradation: The Environmental Kuznets Curve and Sustainable Development." *World Development*, 24 (7) 1151-1160.
- Summers, Robert and Alan Heston, 1995. "The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950-1988." (updated to 1995) *Quarterly Journal of Economics* 106 (1990)327-368.
- Thompson, Peter, and Laura A. Strohm, 1996. "Trade and Environmental Quality: A Review of the Evidence." *Journal of Environment and Development*, 5 (4) 363-389.
- United Nations, *National Accounts Statistics: Main Aggregates and Detailed Tables*, (various years), Rome.

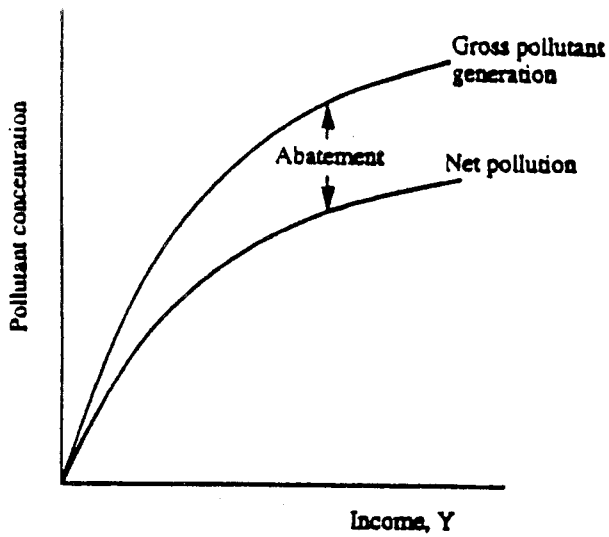


Figure 1.

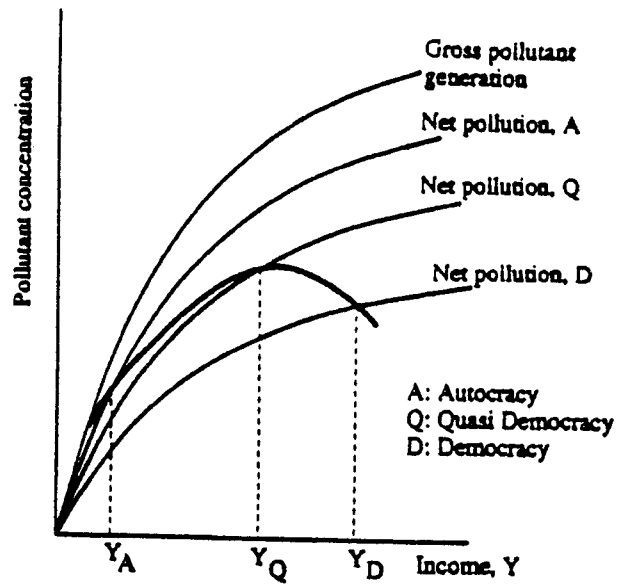


Figure 2.

Selection and type of executive:

Effectiveness of legislature:	Elected		Nonelected	
	Premier	Nonprem.	Military	Other
Effective or partially effective	R1 31.3%	R2 17.6%	R4 8.7%	R5 16.6%
Ineffective or nonexistent	R3 25.5%			

R1. Parliamentary democracy
 R2. Nonparliamentary democracy
 R3. Strong executive
 R4. Military dictatorship
 R5. Other

Figure 3. Definitions of Regimes

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- (xxxii) This paper was presented at the Conference on "Colloquia on Economic Research", AIDEI (International Association of Italian Economists), IGIER (Innocenzo Gasparini Institute for Economic Research) and Fondazione Eni Enrico Mattei with the contribution of Banca Monte dei Paschi di Siena and CNR (Consiglio Nazionale di Ricerca), Milan, June 18-19, 1998
- (xxxiii) This paper was presented at the 1998 World Congress of Environmental and Resource Economists, organised by the Association of Environmental and Resource Economists, European Association of Environmental and Resource Economists and Fondazione Eni Enrico Mattei, Venice, June 25-27, 1998
- (xxxiv) This paper was presented at the International Symposium on Technological, Energy and Environmental Topics in Transport, "Externalities in the Urban Transport: Assessing and Reducing the Impacts" organised by Fondazione Eni Enrico Mattei and Scuola Superiore Enrico Mattei, Milan, October 27-29, 1998
- (xxxv) This paper was presented at the "European Corporate Governance Network Conference", Fondazione Eni Enrico Mattei and Directorate General for Industry of the Commission of the European Communities, Milan, November 6-8, 1998
- (xxxvi) This paper was presented at the Second EFIEA Policy Workshop on "Integrating Climate Policies in the European Environment. Costs and Opportunities", organised by the Fondazione Eni Enrico Mattei on behalf of the European Forum on Integrated Environmental Assessment, Milan, March 4-6, 1999
- (xxxvii) This paper was presented at the Fourth Meeting of the Coalition Theory Network organised by the Fondazione Eni Enrico Mattei, CORE of Louvain-la-Neuve and GREQAM of Marseille, Aix-en-Provence, January 8-9, 1999
- (xxxviii) This paper was presented at the International Conference on "Trade and Competition in the WTO and Beyond" organised by the Fondazione Eni Enrico Mattei and the Department of International Studies of the University of Padua, Venice, December 4-5, 1998
- (xxxix) This paper was presented at the 3rd Toulouse Conference on Environment and Resource Economics, organised by Fondazione Eni Enrico Mattei, IDEI and INRA and sponsored by MATE on "Environment, Energy Uses and Climate Change", Toulouse, June 14-16, 1999
- (xl) This paper was presented at the conference on "Distributional and Behavioral Effects of Environmental Policy" jointly organised by the National Bureau of Economic Research and Fondazione Eni Enrico Mattei, Milan, June 11-12, 1999

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