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DECENTRALIZATION AND THE ENVIRONMENT

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Decentralization and the Environment

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Abstract

A part of the literature on fiscal federalism over the years has dealt with environmental policy as a particular case of the supply of public goods. The central issue is the identification of criteria on how to allocate powers and functions over environmental management at different levels of government. The main stream of literature focuses on the conditions needed to establish whether pollution standards and regulatory programs should be set and designed by central or rather by local governments. This paper provides a review of the debate and explores a few potential limits of the prevailing line of enquiry.

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Keywords: environmental federalism, decentralization, environmental policy, environmental regulation, environmental governance.

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1. Introduction

The issue of how to allocate powers over environmental policies at different levels of government has received attention, so far, mainly within the framework of the literature on fiscal federalism. The grounds for arguing in favour of the decentralization of public sector responsibilities include the fact that most public goods are local, that their production does not exhibit important economies of scale, that there is a possibility of tailoring the supply of public goods to citizen preferences that are heterogeneous across jurisdictions, and of avoiding the inefficiency of imposing a uniform national standard in the face of locally different marginal costs of provision. These grounds are applicable directly to the regulation of activities that affect the environment. However, there has been little interchange between these studies and the considerable body of literature dealing specifically with the interactions between economic activities and environmental resources. This paper focuses largely on the issues relating to pollution and the abatement of pollution, as an illustration of a set of issues with more general applicability.

In conventional environmental economics (as in the welfare economics literature from which it descends), governments are depicted as carrying the responsibility for much of the desired environmental protection. That literature tends to ignore that fact that environmental policy-making does not emanate from a single unitary authority but is the outcome of a multi-layered structure designed to deal with the large number of different and conflicting demands that citizens place on their governments. Decentralization is a way of dealing effectively with a large number of objectives, increasing flexibility in policy-making, and permitting the use of a broader range of policy instruments.

In addition, the complexity of ecological systems implies that economic decisions concerning a specific natural resource generally affect more than one ecological component, although the impact is often lagged and difficult to predict. In multi-level governmental systems, the interdependence between environmental impacts caused by economic activities that take place at different points in space and time poses problems that have a bearing on the assignment of environmental powers.

A knowledge of the specificity of environmental policy within the more general problem of public goods provision, an adequate scientific specification of environmental issues, and a correct understanding of the decentralization of governmental systems, are all essential and possibly inseparable components for the

design of environmental policies. There is in this field an important need for integration between different strands of economic and scientific enquiry.

2 Environmental federalism: who should do what?

A considerable share of the literature on environmental federalism is linked to the work of Wallace Oates. The basic idea that runs through his several contributions to the subject (in particular Oates and Schwab 1996; Oates 1998b, 2002a, 2002b, Oates and Portney 2001) is the general one that the responsibility of decision-making over a particular environmental issue should be given to the smallest jurisdiction that spatially encompasses all (or nearly all) the benefits and costs associated with it. Following this rule, the provision of environmental protection can be tailored to the preferences of citizens, the costs of production and other local conditions, and this would allow the attainment of a higher social welfare compared to the provision of a uniform standard of environmental protection across all jurisdictions.

2.1 Setting pollution standards

Environmental policy in this literature refers exclusively to pollution control. The fundamental responsibility of environmental decision making is therefore, in that framework, setting pollution standards. Oates (2002a) identifies three benchmark cases: a first in which environmental quality is a pure public good, a second in which it is a local public good, and a third in which there are local spillover effects.

Case 1. Pure public good. Environmental protection can be thought of as a pure public good within a given country in those cases when environmental quality (Q), although varying across different locations, still is a function of the aggregate level of emissions (P): $Q=f(P)$. This case corresponds to that of global (or uniformly mixing) pollutants such as greenhouse gases¹ and ozone-depleting substances²: the impact citizens may suffer from climate change or from a reduced ozone layer, for example, may vary across regions but depends on the aggregate, not on the local, emissions. The location of the emission source is irrelevant as far as the vector of damages in the different jurisdictions is concerned.

1 Such as carbon dioxide, methane, water vapour, and nitrous oxide.

2 Chlorofluorocarbons (CFCs), halons, and other chlorine- or bromine-containing compounds used mainly as industrial chemicals, solvents, and fire extinguishing agents.

This is the only case in which the environmental federalism literature univocally recognizes a need for the central government to set standards, since decentralized decision makers have no control over the level of environmental quality within their jurisdiction. In fact, policies aimed at dealing with global environmental issues probably require a standard setting authority at a tier higher than central governments: the international coordination required to allocate the abatement effort efficiently and limit free-riding in many cases has been shown to require supranational institutions.

The efficient level of pollution would have to be established by equalizing marginal benefits of emission reductions, summed over all citizens, to marginal abatement cost. A cost-effective implementation would then require use of economic instruments (such as emission taxes or tradeable permits) capable of equalizing marginal abatement costs across all sources.

Case 2. Local public good. Environmental protection is a local public good when environmental quality in each jurisdiction is a function only of the quantity of pollution emitted in that jurisdiction: $Q_j=f(p_j)$. This is the case for local, or non-uniformly mixing pollutants such as particulate emissions from diesel engines, trace metal emissions, ozone accumulation in the lower atmosphere, and some cases of water and ground pollution.

It is in this case that the argument for decentralized standard setting is strongest: the efficient level of environmental protection should equalize marginal benefits summed over the residents of the jurisdiction with marginal abatement costs. If either abatement costs or preferences vary across jurisdictions, then decentralized choices will be superior to a uniform policy designed at the central level: the magnitude of the gains from decentralization will depend on the differences in costs across jurisdictions and on the price elasticity of demand for environmental protection (Oates 1997).

Schoenbrod (1996) adds democratic accountability to the benefits of decentralized standard setting: the massive job of controlling the nation's environment from the center would induce the central government to delegate its decision making responsibilities to experts and bureaucrats in functional agencies (such as the US Environmental Protection Agency (EPA)) established at the national level but away from officials who are directly responsible to voters. The argument has not gained much following, however. The same US EPA, rather than a monolithic structure operating through uniform regulations, is a reasonably decentralized organization articulated into ten regional offices working in close connections with the states.

Case 3. Local spillovers. Most types of pollution cause damages that do depend on the location of the source of emissions, and their impact is felt both locally and in neighboring jurisdictions. The level of environmental quality in each jurisdiction would then depend on the particular pattern of emissions in each of the others: $Q_i = f(p_1, p_2, \dots, p_n)$. This category comprises regional, non-uniformly mixing pollutants such as sulfur oxides from power stations and industrial plants, unburned hydrocarbons and nitrogenous air pollutants from vehicle exhausts, but also agricultural emissions of nitrogen species, such as nitric oxide, ammonia, pesticides and their derivatives which can be both airborne and waterborne for long distances across the border of jurisdictions.

When environmental impacts are felt in different political units from those where the emissions occur, so that also the benefits of pollution control accrue to people in jurisdictions other than those in which the control is exercised, environmental protection will be usually under-provided. Inter-jurisdictional externalities, in a setting of a decentralized allocation of powers, will lead to an inefficiently low level of control. Some authors here highlight the conditions under which Coasian bargaining may bring about efficient solutions; others recommend differentiated taxes or subsidies designed by the central level so as to induce local governments to internalize the damage caused by pollution spillovers.

In summary, the message of the fiscal federalism literature is pretty straightforward: those forms of environmental protection that tend to generate benefits contained within the boundaries of local jurisdictions would present a strong case for decentralized environmental management, whereas environmental issues that tend to spill over such boundaries – and all the more global environmental problems – would require some form of central government intervention.

Straightforwardness notwithstanding, environmental economists have substantially ignored inter-jurisdictional externalities as a motive behind the assignment of powers over the environment. One reason may be that the impact of most environmental policies has a limited geographical span, so that it is relatively rare that significant benefits of pollution control actually accrue to people in other jurisdictions (Scott 2000). Another explanation is that many inter-jurisdictional externalities can be dealt with by coordination – a theme which has received attention in the literature on decentralization for example by Breton and Scott (1978) and Inman and Rubinfeld (1997). Integrated management of multi-jurisdictional river basins offers many examples of coordination in federal countries as well as across

national boundaries.³ More generally, international environmental agreements coordinating national policies on sulphur, CFCs, CO₂ emissions and a number of other issues, are all attempts (a few of which reasonably successful) to internalize trans-boundary externalities in the absence of a centralized authority.

Furthermore, underlying the fiscal federalism literature there seems to be a sharp dichotomy between the centralized and the decentralized mode of organizing environmental governance. Oates's decentralization theorem, for instance, equates the allocation of environmental powers to higher level governments with the setting of uniform standards.⁴ On the other hand, it places decentralized decisions that will be tailored to the local circumstances. It assumes, in other words, a rigid constraint on the capacity of the central government to respond to local differences in costs and preferences. Reality is probably less clear-cut. Some standardization of services provided by central governments does seem to be observed in practice (Walsh 1992). In the case of environmental governance, however, in several countries a tendency has been observed for the policies of the central government not to be imposed by a command system but to be implemented unevenly and flexibly through a process of negotiation (Breton and Salmon 2004}). The *modus operandi* of EU directives to the European member states, again, is not one of top-down imposition of uniform standards, but a complex decision making system where member states influence the Union's policy formation in the Council (the official institution where they can defend their interests) as well as at many other levels in the policy process. When mechanisms of this sort are at work, they probably create wide margins for central policies to reflect local variations across jurisdictions. The institutional devices by which a governance system can build up the capacity of higher levels of government to tailor their policies to suit local heterogeneity are a subject that deserves further attention.⁵

3 In Germany, the Länder passed agreements among themselves to unify their regulations for the water of their common rivers. The most important institution of co-operation between regions is the LAWA (Länder Arbeitsgemeinschaft Wasser), which brings together all the Ministers of the Environment of the various Länder. See for example French Académie de l'Eau (2002) for worldwide case studies of joint water management in federal countries as well between countries.

4 See for example Oates (1972), p. 11, 36.

5 See Breton and Salmon (2004) for a detailed discussion of a few such institutional devices (e.g. *cumul des mandats* whereby political actors at the centre also have important responsibilities at the subcentral level) at work in the French political system.

2.2 Policy design and implementation

The task of ensuring the implementation of rules or norms established on a national level is normally allocated to sub-central authorities.

The allocation of powers over implementation can take quite different forms. To simplify, one could identify a structured and an adaptive approach as benchmark cases, with real world situations fitting along the continuum between the two extremes. In structured implementation (e.g. USA's Clean Air Act, most of the German environmental law, many EU directives) legislation from the center regulates the behaviour of local authorities in detail, for example through the establishment of binding standards, deadlines and procedures. This is most frequently observed in federal systems. In adaptive implementation (e.g., the Danish systems), national legislation establishes just the framework for the activities of local authorities, leaving the latter with the responsibility for filling in the details according to local conditions (Andersen 2004; Berman 1980).

In general, the economic literature on environmental federalism does not devote as much attention as it should to the issues of implementation and enforcement.⁶ For instance, establishing the objectives is not a question completely disjoint from the level at which policy design and implementation – the actual provision of the environmental public good – then takes place. The conventional condition for an efficient provision of public goods says, in fact, that an efficient standard should be set where the sum of all individuals' willingness to pay for increases in environmental quality (the marginal rate of substitution between private and public good, X and Q respectively) equals the cost of providing Q . If we add a term to recognize the eventual welfare losses due to distortionary effects of the taxes needed to finance environmental policies (often referred to as marginal cost of public funds, $MCPF$), we get

$$\sum_i MRS_{XQ}^i = MRT_{XQ} + MCPF \quad (1)$$

The costs of provision (the properties of the MRT term), however, are in all likelihood influenced by the level at which implementation occurs – with factors such as technology, economies of scale, and size of the jurisdiction sometimes playing a

⁶ More is to be found in the political science literature on policy analysis and environmental governance; see for example Ingram and Mann (1980).

relevant role. Ease or efficiency in collecting the required taxes (which would impact the *MCPF* term) may also vary at different levels of government.⁷

Whereas a few of these factors – economies of scale and heterogeneity *across jurisdictions* in the costs of provision or in preferences (the *MRS* term) – have been often considered as elements that can determine the desirable degree of decentralization, the comparative advantages *across levels of government* that these and other factors may determine in implementing environmental policies still require further study, both in empirical and the theoretical terms.

2.3 Generating and diffusing scientific information

Beside standard setting, the environmental federalism literature frequently cites the generation and diffusion of information on environmental problems as a task that is generally assigned, in theory as in the real world, to the central level of government. Research and collection of data are activities that benefit everyone and that tend to be subject to important economies of scale. In most countries these tasks are assigned to environmental protection agencies that function at the federal or national level.

The environment is a policy area that relies heavily on scientific and technical information. A problem of scale may act as a constraint on the extent of feasible decentralization: below a given size of a jurisdiction there may be a capacity problem on the part of local authorities even to process the existing information and data for use in the ongoing administration of national legislation. The capacity problem is a function of the resources and specializations of the local environmental administrations' personnel (Andersen 2004).

Decentralization of the standard setting authority may therefore require an active central environmental agency that, in addition to do research on the environment, offers guidance in the form of recommended standards and best available technology, so as to lay out the menu of choices at the local governments' disposal (Oates and Portney 2001).

⁷ If a tax is a pure benefit tax – such as a user charge – the marginal cost of public funds is zero. If the tax is greater or smaller than the marginal utility citizens derive from the supplied good, then the benefit tax is imperfect. The size of the *MCPF* term is therefore also affected by citizens' preferences over environmental quality: the more citizens have a real demand for *Q* and derive utility from it, the smaller the *MCPF*. On the relationship between environmental policy, public consumption and the marginal cost of public funds see also van der Ploeg and Bovenberg (1994).

3 Environmental policy and interjurisdictional competition

Even in the strongest case for decentralized decision making over environmental standards, the one of local pollutants, a large body of literature has argued that assigning the power at the local level may result in suboptimal outcomes. One reason relates to the potential trade distortions that may arise from locally differentiated environmental standards. A second, linked, reason arises if local governments lowered their environmental standards in order to hold down the costs of compliance for existing and prospective firms. The resulting dynamic instability, in the absence of countervailing forces, could set in motion a competitive “race to the bottom” leading to inefficiently high levels of pollution.

3.1 Trade distortions

The harmonization of safety, health and environmental standards with the objective to prevent or eliminate distortions of competition in international trade has been, in the real world, a strong motive behind the centralization of environmental standard setting, particularly in the European Union.⁸

From the point of view of economic theory, however, it is not obvious that differences in environmental regulation across countries should induce a distortion of competition, defined as any measure that reduces the efficiency of international trade. The environment, in its function as a sink for emissions, is one of the scarce inputs of which different countries have different initial allocations. Environmental regulations create an artificial price for such input, depending on its relative abundance and on national preferences. Common markets are created to ensure the welfare gains of international specialization based on competitive advantage; uniform environmental standards across member states, besides overwriting local preferences, could hinder efficiency by reducing the scope for such gains (Oates 1998a).

In actual policy making (particularly in the European Union) as well in the economic literature, the harmonization of environmental standards finds nonetheless many supporters. The case for international coordination rests on three main arguments. The first and most obvious are transboundary spillovers, which require

⁸ In the case of the EU, article 100 of the EEC Treaty (now article 94 of the Amsterdam Treaty), on the approximation of laws for the internal market, has been used to harmonize emission norms from stationary sources across member states.

agreements and negotiations on reciprocal reductions of emissions in order to contain inefficiency. International coordination, however, does not necessarily mean harmonization to a uniform standard.

The second is the possibility that countries will make a strategic use of national environmental policies to improve their position on the international markets. One way this can be done is by using environmental regulation as a substitute for tariffs and quotas, e.g., using domestic standards to influence the international price of a product. A lax standard would work as an import subsidy, whereas a strict standard as an export tax – and countries could increase their welfare by choosing the most favourable policy depending on whether they are a net importer of a net exporter of that good. This can happen when the industry at home is perfectly competitive (firms are price-takers) but the domestic industry has a large enough share of the world market to influence the international price (Ulph 1997, Van Der Laan and Nentjes 2001).

Another way of making strategic use of national environmental policy, depending on the degree and kind of competition in the international market, is setting lax standards in order to keep one's export industries competitive. A number of studies (Barrett 1004, and Ulph 1998, among others) have shown, usually assuming Cournot oligopolies and either standards or emission taxes as policy instruments, that in theory at least this can generate a race towards inefficiently low environmental protection – the race to the bottom discussed in more detail in the next subsection.

The third argument for harmonization is that locally differentiated environmental regulations in some cases may translate themselves in differences in product standards and in a consequent fragmentation of the market, which interferes with specialization and competition (Nentjes 1993).

According to Van Der Laan and Nentjes (2001) the concept of 'distortion of competition' has sometime received a slightly different interpretation, focussing on considerations of fairness rather than on the efficiency of results. That interpretation would have played some role for example in EU decisions regarding harmonization versus subsidiarity in environmental legislation. The use of uniform standards in that case would serve the purpose to guarantee a level playing field to producers in the common market, on grounds analogous to those behind uniform national legislations on health, safety, and labour conditions.

3.2 Race to the bottom

The issue of a race to the bottom in environmental standards in a context of interjurisdictional competition has received a wide attention. Wilson (1996) provides a detailed survey of this literature up to the mid-nineties. Oates and Portney (2001) include also some more recent works.

One stream of literature develops a set of models describing a world in which competition among governments for mobile firms leads to efficient choices also in terms of levels of local environmental protection. With local governments free to set their own environmental standards, intergovernmental competition would not only not generate a race to the bottom but be even welfare enhancing (Oates and Schwab 1988, 1996).

These models, however, are based on fairly restrictive necessary conditions: governments must be price takers on the capital market and not engage in strategic behaviour in response to policies of other competing governments; they must be in conditions to avail themselves of the best suited among expenditure, tax, and environmental policy instruments; and their policies should have no external effects on other jurisdictions.

In more realistic settings, the efficiency properties of these models may no longer hold. If, for instance, the financial weight of government choices may impact on the price of capital, interjurisdictional competition may result in allocative distortions. The same can happen as a result of capacity or institutional constraints on the part of governments in the choice of policy instruments (e.g., restrictions on the allowable revenue raising mechanisms for local governments), or of strategic considerations in the design of policies (e.g., public agencies responding also to objectives of budget maximization). Both may result in an inefficiently low level of provision of environmental protection if tight environmental measures have a potentially negative impact on the local tax base (Zodrow and Mieszkowski 1986, Wilson 1986, Oates and Schwab 1988, Wildasin 1989).

Kanbur, Keen, and van Wijnbergen (1995) take into account the dimension of the country and show that small countries will reduce their environmental standards to be able to attract foreign investors. Marsiliani, Renström and Withagen (2003) present a model of environmental tax competition where saving behaviour is taken into account, since one cannot consider the capital stock being invariant with respect to the fiscal regimes. Uncoordinated policy making (tax competition) will induce a lower capital tax than coordinated policy making. Individuals will therefore save more

(if savings respond positively to the after-tax return), and the uncoordinated regime will have larger capital stocks. If environment is a normal good, a larger capital stock makes a country choose larger environmental consumption (i.e., a more stringent standard). On the other hand, in the uncoordinated regime, countries do not internalize international spillovers. This implies that if the international externalities are small the uncoordinated equilibrium would result in higher environmental quality, whereas if they are large the opposite would hold.

A number of studies looking for evidence of a race to the bottom in environmental matters appear to conclude that, at least at the intergovernmental level, it is not a phenomenon of significant empirical importance (among others, Revesz 1996, List and Gerking 2000, Dinan et al. 1999).⁹ Scott (2000) argues that the feared downward instability is rare because, first, industrialization also implies costs for a jurisdiction in terms of infrastructure, health services and so on, that can set fairly high limits to the competitive cut in standards; and second, abatement costs may not be a major element in many firms' location decision – location in a clean environment may have a positive value for firms and their workers as well.

The evidence, in other words, remains mixed, as argued by Wilson (1996) in his survey of the various analytical models which have dealt with the theoretical case of a race to the bottom in environmental standards in a world with free trade and capital mobility. The race to the bottom may arise when there are domestic distortions and constraints on tax and subsidy instruments that leave governments with the option of lowering standards as a last resort (Lal 1998). Outside the world of first best outcomes, it is the case by case magnitude of the distortions that would allow us to say more on how best allocating powers over environmental regulation.

⁹ A different issue is that pertaining to international races to the bottom in environmental regulation due to the competition for the allocation of globally mobile capital. The role played by the need to attract foreign investment in locking industrializing countries into lax environmental measures – a 'trap in the bottom' – still requires serious investigation. Whereas there seems to be little empirical evidence of environmental races to the bottom among countries with already high standards and strong institutions, or between the industrialized and the developing part of the world (Porter 1999, Wheeler 1999, Ahlering 2004), it is between countries with low standards and weak institutions that competition for market shares and foreign investments appear to produce a downward pressure on standards. This could lead to a polarization of international environmental conditions with third world countries specializing in pollution intensive productions (Tannenwald 1997, Muradian and Martinez-Alier 2001).

4 Heterogeneous preferences over environmental policy

A central point in the argument in favour of decentralized standard setting to maximize social welfare is that heterogeneous preferences across jurisdictions over environmental and health standards must be respected.

When the U.S. EPA, in 2001, issued a new standard for the permissible level of arsenic (a contaminant with certain carcinogenic risks) in drinking water, reducing allowable concentrations by 80 percent from 50 to 10 parts per billion, it was argued that the new rule would violate efficiency conditions (see e.g. Oates 2002a). Treatment of drinking water is an activity that exhibits large economies of scale, so that the standard was to be most expensive for small districts. Differences in marginal costs alone could provide the case for some form of government transfer aimed at allowing residents in small districts to benefit of the same reduction in health risk as the rest of the country. However, it was argued that a uniform, national standard would also fail to consider the differences in preferences across various communities, and that subsidies would even amplify the resulting inefficiency.

But are preferences over the environment really subject to significant variability across jurisdictions? The issue deserves, in my opinion, further attention. Whereas the argument probably holds for a number of publicly provided public goods, the same may not necessarily be true for environmental standards – particularly those involving high risks and/or effects on human health. It would make intuitive sense, in particular, that in matters of risk over human health most of the variation in choices were determined more by the ability of individuals to pay for the relevant policies – their budget constraints and consequent trade-offs – than by a difference in preferences. It is obviously an empirical matter. Elliot et al. (1997) for example, find that both socio-demographic and economic factors have a significant impact on individual support on environmental spending in the USA. Kahn and Matsusaka (1997), in an empirical study of California, find that most of the variation in voting on environmental policies is explained by individual income and the price of the environmental good.

Looking for a theoretical explanation, Marsiliani and Renström (2000, 2002) find that non-inferiority of consumption goods and of the environmental good are sufficient conditions in a wide class of models (from static to overlapping generations models) to obtain a negative relationship between income inequality and the stringency of environmental policy. Since environmental regulations come at the

expense of production possibilities, poorer individuals (with a higher marginal utility of consumption and, if the environment is a normal good, a lower marginal rate of substitution between environmental quality and private consumption) will prefer lower pollution taxes or laxer standards: the endowment of the decisive individual in relation to the average influences her preferences with respect to the stringency of environmental policies.

Much more investigation is needed to reach conclusions on the matter, but in the meantime it is not defensible to argue in favour of decentralizing choices in matter of environmental standards with health implications only on the ground of differences in preferences across jurisdictions.

5 Ecological constraints to the decentralization problem

The environmental federalism literature aims at providing normative prescriptions to deal with the general problem of assigning responsibilities over environmental policy at different levels of government. It is however possible to identify some limitations that affect the generality of some of its most widely accepted results.

As discussed in section 2.1, regional and global spillovers – spatial interconnection in the consequences of emissions from economic activities – have generally been recognized as a potential limit to environmental decentralization. Even some of the literature that more cogently makes the case for maximum decentralization and for market solutions to most environmental issues (e.g., Anderson and Hill 1996; Butler and Macey 1996) recognizes the existence of environmental limits to the extent of sustainable devolution in this regard. The guiding principle is that to minimize the costs of monitoring regulatory agencies, authority should be devolved to the lowest level of government that also allows for control of pollution or other spillover effects.

The environment, however, is not just a sink which passively receives pollution, as it may appear from the economic literature dealing with environmental federalism. The discharge of waste, particularly at the scale implied by modern industrial economies, sets in motion feedbacks and indirect effects. Besides the assimilation of emissions, the impacted environmental resources supply a multiplicity of other services that are essential to the ecosystem and to human activities: the fixation of

solar energy into biomass, regulation of the gas composition of the atmosphere, regulation of local, regional and global climate (including the redistribution of humidity), soil formation and stabilization, fixation of nitrogen, decomposition and recycling of organic waste, biological control of organisms that can be deleterious to agriculture and other economic activities, biological control of human and animal disease, pollination, regulation of the water cycle and so on. The biological resources that provide these services are integral parts of ecosystems characterized by complex interrelationships of many species with each other and with the environment in which they live.

The complexity of ecological systems implies that policy decisions concerning, for example, the regulation of a specific kind of pollution in a given jurisdiction generally indirectly affects more than one ecological component, although the impact is sometimes lagged and difficult to predict. The functions performed by environmental resources inhabit different hierarchical levels within an ecosystem as well as different spatial domains. Nature may therefore act as a limit to the extent of decentralization that can retain the capacity to design and implement environmental policies capable of encompassing these multiple and overlapping spatial dimensions.

On the other hand, economic efficiency conditions for the use of environmental resources are based on a view of an environment made of unconnected components, so that only the direct (and often only the local) impacts are considered: the assimilative capacity of pesticides or nutrients by a watershed, or of CO₂ by the atmosphere, the ozone layer, fisheries and so on as fragments whose management and regulation can be considered serially and in isolation.

This is partly a consequence of the fact that efficiency conditions for the use of all environmental resources have been developed as extensions of theoretical constructs originally concerned with non-renewable resources – oil, gas, and other mineral deposits – whose depletion has indeed had little impact on the stock of other resources and on the rest of the ecosystems. The capacity of the environment to assimilate waste and pollution – one among the fundamental services provided by the environment – is a renewable resource. As for all renewable resources, a rate of use in excess of its natural regenerative rate can lead to collapse of the assimilative capacity of a given medium.

A further limitation in conventional models of environmental federalism lies in a set of assumptions on both individual preferences and on the processes associated with the supply of environmental policies. The typical prescriptions in terms of

desirable decentralization, implicitly assume separability of the level of provision of the public good 'environmental quality' from the taxation used to finance environmental policies. But changes in environmental quality Q are generally attained through regulation of private economic activities; we should therefore expect environmental regulation to induce modifications in the behaviour of firms producing the private goods X , and hence in the MRT term in equation (1). Smith, Schwabe and Mansfield (1999) examine in detail the implications of such assumption. In partial equilibrium terms, the change in the MRT term would reflect changes in the marginal cost of both Q and of other private goods whose production is responsible for deterioration in Q . These effects in turn have general equilibrium consequences: the level of Q will also depend on natural services impacted by the production of other commodities. The effect of regulation on Q will therefore depend on the interconnections within both the environmental and the economic system. The net benefit of pollution control for the citizens in one jurisdiction will generally depend on regulatory and private production activities both within and outside the jurisdiction: the general equilibrium effects will impact both the distribution of benefits and the nature of the costs. Similarly, the services provided by protected and wilderness areas are affected by the external activities taking place in zones of influence around these reserves: again the two sides of equation (1) are not separable.

The point that the spatial dimension of the environmental media linking economic activities and environmental quality matters is not a new one: it was already developed in detail in the work of Kneese and Haefele (1974), Kneese and Bower (1979) and others who advocated issue-specific environmental agencies with authority over regions defined on the ground of the spatial dimension of the environmental resource to be managed rather than on political jurisdictions. More recently, this point has been taken into account in empirical analyses of the social cost of environmental regulation (see for example Hazilla and Kopp, 1990). With the exception of some works on functional overlapping jurisdictions (Casella and Frey, 1992, Frey and Eichenberger, 1999), this it is mostly ignored in the literature on environmental federalism. Relaxing the separability restrictions, however, implies losing the generality of the simplified normative judgements expressed in that literature.

In addition to a spatial component, the ecological and economic values of environmental resources also possess a temporal dimension. Ecological functions have different temporal cycles: for some the cycle is seasonal; for others, it may be of longer duration. When ecological functions are disrupted or variability suppressed

through, let us say, regional policies and programs, some of the damage may consequently be manifest with a lag of a season, of years, perhaps of decades. Furthermore, the damage resulting from subjecting a particular cycle to duress may inflict damage to the ecological productivity of other functions that have temporal cycles of varying lengths.

The existence of a positive discount rate implies that damage that is more distant in time will be imputed a lower present value than those that are less distant. If governments at different levels use different intertemporal discount rates, this would have to be taken into account. Should there be evidence, for example, that higher level governments use lower discount rates in making their decisions; the decentralized solutions would lead to an allocation nearer to efficiency for environmental resources whose ecological functions have shorter temporal cycles, and vice versa. This too is largely an empirical matter and further enquiry is needed, but the intertemporal dimension of many environmental policies may well impose further constraints to the extent of desirable decentralization.

An additional aspect that may influence the judgement on desirable degree of decentralization concerns the demand side of environmental policy. The dominant logic, following Oates' work, has been to evaluate the welfare gains or losses from allocating powers at a given level on the grounds of the heterogeneity in individual preferences across jurisdictions, and of the price elasticity of their demands. This approach, as Smith et al. (1997) note, implicitly assumes that the environmental goods can be reproduced at different locations, so that all citizens will access the same goods within their own jurisdictions. If this hold for several dimensions of environmental quality, such as clean air and water, it may not hold for other dimensions such as biodiversity, wilderness areas, national parks and other natural assets, which may be intrinsically available only in some jurisdictions and not be reproduceable elsewhere. In these cases, the question of who should be counted in the sum of the *MRS* in the left hand side of equation (1) is not a trivial one, and may crucially affect the amount of environmental public good to be provided. If people outside the decision making jurisdictional unit also have a stake but are not counted, then decentralization would lead to welfare losses.

Most of the arguments above appear to point to constraints to the desirable extent of environmental decentralization. Environmental interdependences, for instance, would seem to dictate the necessity of a highly centralized regulatory structure for the protection of the different interconnected components. More than

reversing the conventional results, however, this section is aimed at pointing out a few aspects generally overlooked in the mainstream literature and that deserve further analysis. A normative prescription in favour of centralization, for example, would hold only in the presence of extremely high costs of coordination between governments located at different jurisdictional levels. If coordination costs allow, decentralization can bring about potential benefits such as a more direct access to local information, as well as initiative and creativity on the part of the citizenry and of more junior governments. Moreover decentralization, by fostering competition among units of governmental systems, allows these to adjust automatically, to a degree at least, to exogenous changes. This capacity to adjust is particularly important for decision-making structures dealing with environmental issues, where there is a need to be adaptive and flexible to be able to cope with high levels of uncertainty and respond to a continuing flow of new evidence and scientific information.

6 Future research directions

Several issues, in this field, remain open for further research, and a few are outlined below.

The existing literature mainly deals with the allocation of the standard setting authority or, in a few cases, with the power of implementing policies. An interesting subject for further enquiry is that of the monitoring and enforcement of environmental policies. Do the same limits to decentralizing the powers discussed in the previous section apply also to decentralizing tasks such as monitoring and enforcement? Intuition suggests that they probably do not and that there may be efficiency gains from allocating such tasks to levels of government different from those that make the decisions. A number of issues would however have to be considered. Setting the standards at the central level and allocating monitoring and enforcement to local authorities, as is generally the case in the real world, may open up a large discretionary power for local government in deciding the level of implementation.

A further issue is that of regulatory capture. Coordination between levels of government, both in setting the standards and in defining the details of implementation, would allow for more decentralization than could otherwise take place. This however opens up the risk of capture of the regulatory authorities by

lobbies that may exercise a stronger influence at the local level. Precisely in the attempt to avoid capture, in the USA's Clean Air Act, Congress has described the legislation in minute detail and in fact prohibited the EPA from negotiating with interested parties.

The existing research work on the division of powers that pertain to environmental issues in decentralized governance structures is set in a framework that takes for granted that the relevant governance structure is federal. Two points must be made about this research strategy. The first is that there may be mechanisms at work in federal states that are absent in decentralized unitary states; if so, then there would be a gap in the literature regarding environmental policy-making in the latter. The second is that there may be supra-national structures such as the EU, which are neither federal nor unitary. This case also would benefit from further analysis rather than being subject to a mechanical application of the existing models dealing with environmental policy-making in federal countries.

A few important recent developments in the theory of decentralized governmental systems have not, as yet, been integrated in the theoretical and policy discussions of how policy-making regarding the environment should be assigned to different levels of government. A number of models have been constructed, considering the benefits and costs of decentralization, to arrive at some notion of an equilibrium assignment. Breton (1987, 1986) argued that intergovernmental competition could serve to articulate a mechanism that could execute an initial assignment and that would change an assignment should it no longer be appropriate. There is now a considerable body of research available (see, for example, Breton and Salmon, 2001, Breton and Fraschini, 2003, Oates, 1999 and Bird, 2000) supporting the idea that an automatic mechanism based on intergovernmental competition operates to determine equilibrium decentralized assignments in federal and in some unitary states (again, the case of structures like the EU has not been investigated). On the part of the legal-political institutions that preside over assignments and re-assignments, failing to take into account intergovernmental competition would probably mean failing to minimize the costs of adjustments. These developments too could possibly provide useful insights if incorporated in the study of environmental governance.

References

- Ahlering, Beth (2004), "The impact of regulatory stringency on the foreign direct investment of global pharmaceutical firms". Working paper, ESRC Centre for Business Research.
- Andersen, Michael Skou (2004), "The Danish communes: capacities and constraints in environmental policy implementation", Paper presented at the Symposium on Environmental Policies in Decentralized Governmental Systems, Alghero, Italy, March 2004.
- Anderson, Terry L. and Peter J. Hill (1996), "Environmental federalism: Thinking smaller", PERC Policy Series PS-8, Bozeman MT: Political Economy Research Center, December, <http://www.perc.org/publications/policyseries>
- Barrett, Scott (1994), "Strategic environmental policy and international trade". *Journal of Public Economics*, 54, 325-338.
- Berman, Paul (1980), "Thinking about programmed and adaptive implementation". In Ingram, Helen M. and Dean E. Mann (eds) (1980), *Why Policies Succeed or Fail*, Beverly Hills, California: Sage Publications.
- Bird, Richard M. (2000), "Fiscal Decentralization and Competitive Governments", in Galeotti, Gianluigi, Pierre Salmon, And Ronald Wintrobe (eds)(2000), *Competition and Structure: Essays in Honor of Albert Breton*, New York: Cambridge University Press, pp. 129-149.
- Breton, Albert (1987), "Towards an economic theory of competitive federalism", *European Journal of Political Economy*, 3(1-2), 263-329.
- Breton, Albert (1996), *Competitive Governments. An Economic Theory of Politics and Public Finance*, New York, NY: Cambridge University Press.
- Breton, Albert and Angela Frascini (2003), "Vertical competition in unitary states: The case of Italy", *Public Choice*, 114(1-2), 57-77.
- Breton, Albert and Pierre Salmon (2001), "External effects of domestic regulations: comparing internal and international barriers to trade", *International Review of Law and Economics*, 21, 135—155.
- Breton, Albert and Pierre Salmon (2004), "Environmental governance in France: Forces shaping centralization and decentralization, Paper presented at the Symposium on Environmental Policies in Decentralized Governmental Systems, Alghero, Italy, March 2004.

- Breton, Albert and Anthony Scott (1978), *The Economic Constitution of Federal States*, Toronto, ON: University of Toronto Press.
- Butler, Henry N. and Jonathan R. Macey (1996), *Using Federalism to Improve Environmental Policy*, Washington D.C.: AEI Press.
- Casella, Alessandra and Bruno Frey (1992), "Federalism and clubs: Towards an economic theory of overlapping political jurisdictions." *European Economic Review*, 36(2-3), 639-646.
- Dinan, Terry, Maureen Cropper and Paul Portney (1999), "Environmental federalism: Welfare losses from uniform national drinking water standards", in Panagariya A., P. Portney and R. M. Schwab (eds) (1999), *Environmental and Public Economics: Essays in Honor of Wallace E. Oates*, Cheltenham, U.K.: E. Elgar, 13-31.
- Elliott, E. and B. J. Seldon and J. L. Regens (1997), "Political and economic determinants of individuals' support for environmental spending." *Journal of Environmental Management*, 51(1), 15—27.
- French Académie de l'Eau (2002), "Proposal for a strategic guide to assist in the constitution of international inter-state commissions for shared water resources." Technical report, <http://www.inbo-news.org/ag2002/GuideStrategiqueAcademieGb.PDF>.
- Frey, Bruno and Reiner Eichenberger (1999), *The new Democratic Federalism for Europe: Functional Overlapping and Competing Jurisdictions*, Cheltenham, U.K.: E. Elgar.
- Hazilla, Michael and Raymond J. Kopp (1990), "Social cost of environmental quality regulations: A general equilibrium analysis." *Journal of Political Economy*, 98, 853-73.
- Inman, Robert P. and Daniel L. Rubinfeld (1997), "The political economy of federalism", in Mueller, Dennis C. (ed.) (1997), *Perspectives on Public Choice, A Handbook*, New York, NY: Cambridge University Press, 73-105.
- Kahn, M. E. and J. G. Matsusaka (1997), "Demand for environmental goods: Evidence from voting patterns on California initiatives", *Journal of Law and Economics*, 40(1), 137-73.
- Kanbur R., M. Keen, and S. van Winjnbergen (1995), "Industrial competitiveness, environmental regulation and direct foreign investment", in Goldin, Ian and L. Alan Winters (eds.) (1995), *The Economics of Sustainable Development*, New York, NY: Cambridge University Press, 289-302.
- Kneese, Allen V. and Blair T. Bower (1979), *Environmental Quality and Residual Management*, Baltimore, MD: Johns Hopkins University Press.

- Kneese, Allen V. and Edwin T. Haefele (1974), "Environmental quality and the optimal jurisdiction", in Allen V. Kneese (ed.) (1995), *Natural Resource Economics: Selected Papers of Allen V. Kneese*, Aldershot, U.K.: E. Elgar, 94-113.
- Lal, Deepak (1998), "Social standards and social dumping", in Giersch, Herbert (1998) (ed.), *Merits and limits of markets*, Heidelberg and New York: Springer, 255-74.
- List, John A. and S. Gerking (2000), "Regulatory federalism and U.S. Environmental Policies." *Journal of Regional Science*, 40, 453-71.
- Marsiliani, Laura and Thomas I. Renström (2000), "Inequality, environmental protection and growth." CentER Discussion Paper 34/2000.
- Marsiliani, Laura and Thomas I. Renström (2002), "On income inequality and green preferences", Working Paper No. 30, October, W. Allen Wallis Institute of Political Economy, University of Rochester.
- Marsiliani, Laura, Thomas I. Renström and Cees Withagen (2004), "Environmental policy and interjurisdictional competition in a second-best world." *B.E. Journals in Macroeconomics*, forthcoming.
- Muradian, Roldan and Joan Martinez-Alier (2001), "Trade and the environment: from a 'Southern' perspective", *Ecological Economics*, 36(2), 281-297.
- Oates, Wallace E. (1972), *Fiscal Federalism*, New York NY: Harcourt Brace.
- Oates, Wallace E. (1997), "On the welfare gains from fiscal decentralization." *Journal of Public Finance and Public Choice*, 2(3), 83-92.
- Oates, Wallace E. (1998a), "Environmental policy in the European Community: Harmonization or national standards?." *Empirica*, 25, 1-13.
- Oates, Wallace E. (1998b), "Thinking about environmental federalism." *Resources*, 130, 14-16.
- Oates, Wallace E. (1999), "An essay on fiscal federalism." *Journal of Economic Literature*, 37(3), 1120-49.
- Oates, Wallace E. (2002a), "The arsenic rule: A case for decentralized standard setting?" *Resources*, 147, 16-18.
- Oates, Wallace E. (2002b), "A reconsideration of environmental federalism", in List, John A. and Aart de Zeeuw (eds.) (2002), *Recent Advances in Environmental Economics*, Cheltenham, UK: E. Elgar, 1-32.
- Oates, Wallace E. and Paul R. Portney (2001), "The political economy of environmental policy." Discussion Paper 01-55, November, Resources for the Future, <http://www.rff.org>.

- Oates, Wallace E. and Robert M. Schwab (1998), "Economic competition among jurisdictions: Efficiency enhancing or distortion inducing?", *Journal of Public Economics*, 35, 333-54.
- Oates, Wallace E. and Robert M. Schwab (1996), "The theory of regulatory federalism: the case of environmental management", in Oates, Wallace E. (1996) (ed.), *The Economics of Environmental Regulation*, Cheltenham, UK: E. Elgar, 319-31.
- Porter, Gareth (1999), "Trade Competition and Pollution Standards: "Race to the Bottom" or "Stuck at the Bottom"? *Journal of Environment and Development*, 8(2), 133-151.
- Portney, Paul R. and Robert M. Schwab (eds) (1999), *Essays in Honor of Wallace E. Oates*, Cheltenham, UK: E. Elgar.
- Revesz, Richard L. (1886), "Federalism and interstate environmental externalities." *University of Pennsylvania Law Review*, 144(6), 2341-1416.
- Schoenbrod, David (1996), "Why states, not EPA, should set pollution standards." *Regulation*, 19(4), 18-26.
- Scott, Anthony D. (2000), "Assigning powers over the Canadian environment", in Galeotti, Gianluigi, Pierre Salmon, and Ronald Wintrobe (eds)(2000), *Competition and Structure: Essays in Honor of Albert Breton*, New York: Cambridge University Press, 174-219.
- Smith, V. Kerry and Kurt A. Schwabe and Carol Mansfield (1999), "Does nature limit environmental federalism?", in Portney, Paul R. and Robert M. Schwab (eds) (1999), *Essays in Honor of Wallace E. Oates*, Cheltenham, UK: E. Elgar, 126-148.
- Tannenwald, Robert (1997), "State regulatory policy and economic development." *New England Economic Review*, March/April, 83-103.
- Ulph, Alistair (1997), "International trade and the environment; A survey of recent economic analysis", in Folmer, Henk and Tom Tietenberg (eds) (1997), *The International Yearbook of Environmental and Resource Economics 1997/1998*, Cheltenham, U.K.: E. Elgar, 205-242.
- Ulph, Alistair (1998), "Political institutions and the design of environmental policy in a federal system with asymmetric information." *European Economic Review*, 42, 583-92.
- Van Der Laan, Rob and Andries Nentjes (2001), "Competitive distortions in EU environmental legislation: Inefficiency versus inequity." *European Journal of Law and Economics*, 11(2), 131-52.

- van der Ploeg, Frederick and A. Lans Bovenberg (1994), "Environmental Policy, public goods and the marginal cost of public funds." *Economic Journal*, 104(423), 444-454.
- Walsh, Cliff (1992), "Fiscal Federalism. An overview of issues and a discussion of their relevance to the European Community." Discussion Paper 12, February, Federalism Research Centre, Australian National University.
- Wheeler, David (1999), "Racing to the bottom? Foreign investment and air pollution in developing countries." Policy Research Working Paper Series 2524, World Bank, Washington DC.
- Wildasin, David (1989), "Interjurisdictional capital mobility: Fiscal externality and a corrective subsidy." *Journal of Urban Economics*, 25, 192-212.
- Wilson, John Douglas (1996), "Capital mobility and environmental standards: Is there a theoretical basis for a race to the bottom?", in Bhagwati J. and R. Hudec (eds) (1996), *Fair Trade and Harmonization: Prerequisites for Free Trade?*, Cambridge, MA: MIT Press, 393-427.
- Zodrow, George R. and Peter Mieszkowski (1986), "Pigou, Tiebout, property taxation, and the underprovision of public goods." *Journal of Urban Economics*, 19, 356-70.