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Environment and Development

a Law and Economics Approach

Anna Rita Germani

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Environment and Development: A Law and Economics Approach

Anna Rita Germani¹

ABSTRACT

This paper gives an overall look to the debate over growth and environment by analyzing their possible relationships throughout the concept of sustainable development. The main literature on the two main strands of debate about economic development is discussed: the first one, in particular, on reducing income inequality as well as reducing absolute poverty, the second one underlying that real development must consider the environmental contest together with economic, social and cultural values. Then, the main methodological aspects of law and economic theory are given, in order to provide some insights in order to better analyze the various interactions between the different decision-makers (governments, firms, regulators, etc.) involved in the process. In fact, by combining the economic and legal concepts under a unique theoretical framework could result more productive in an integrated perspective made of growth, environment and sustainable development.

1. ENVIRONMENT AND ORIGINS OF THE CONCEPT OF SUSTAINABLE DEVELOPMENT²

The various issues analyzed in the present work aim to give a clear-cut outline of some of the aspects of the economic analysis of law relevant for studying the environment. The purpose is mainly to offer the general and preliminary aspects of the methodology proper to law and economics applied to the environmental economic theory, by dedicating particular attention to the control of environmental risk and to the concepts of civil liability.

In order to evaluate the different instruments for controlling pollution in a comparative perspective, it is necessary, first of all, to tackle the possible interactions between the economic development and the environmental dynamics

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² This paper is based on a seminar given to Ph.D. students in *Ricerca applicata nelle scienze sociali (RASS)* at Dipartimento Innovazione e Società (DIeS) of the «Sapienza» Università di Roma in the spring 2007. I am particularly grateful to Guglielmo Chiodi and to Cesare Imbriani for their valuable comments and to an anonymous referee for constructive criticism.

underlying the actual debate on sustainability. The concept of sustainable development started with the work of Malthus on population and growth in the late 1700s, but it appears to really emerge during the fervid debates in the early 1970s focusing in particular on economic development and on the relationships between environment and development objectives. Some notable examples include: 1) *How to Be a Survivor: A Plan to Save Spaceship Earth* [Ehrlich, 1971]; 2) *The Limits to Growth* by the Club of Rome [Meadows, Meadows, Randers and Behrens, 1972]; 3) *A Blueprint for Survival* [The Ecologist, 1972]; 4) *Only One Earth* [Ward and Dubos, 1972].

In fact, in order to better study the consequences of growth in population, resource use, pollution and so on, in 1972 a team of systems scientists and computer modelers (Donella Meadows, Dennis Meadows, Jorgen Randers, and William Behrens), commissioned by the Club of Rome, attempted to study the interactions between the Earth's and human systems. In their book, *The Limits to Growth*³, the conclusions were stunning; they sustain that by the year 2100 the world might be caught in a catastrophe if the growth in resources use, industrial output, and population expansion continued on their then current course; the only scenarios which indicated human welfare could be sustained were ones in which growth was reduced.

Since the world economy depicted in *The Limits to Growth* didn't convince many other scientists, first Herman Kahn, William Brown, and Leon Martel [1976] and then Julian Simon [1981] presented alternative models characterized by a more optimistic view, based mainly on the idea that the continuing evolution of technological progress could eliminate the natural limits until they are no longer limiting⁴.

³ The most recent updated version goes under the name *Limits to Growth: The 30-Year Update* and was published in 2004 [Meadows, Meadows and Randers, 2004]; a previous version, named *Beyond the Limits*, was published in 1992 as a 20 year update on the original work [Meadows, Meadows and Randers, 1992].

⁴ Herman Kahn, William Brown, and Leon Martel, published their book in 1976. Julian Simon, in his book believes in the beneficial nature of population growth and argues that population is the solution to resource scarcities and environmental problems,

However, the first actual attempt to define sustainable development appears to be the following statement from the World Conservation Strategy [IUCN /UNEP/WWF, 1980]: «for development to be sustainable, it must take account of social and ecological factors, as well as economic ones; of the living and non-living resource base; and of the long-term as well as the short-term advantages and disadvantages of alternative action»; but the World Conservation Strategy was often criticized for being concerned mainly with environmental sustainability rather than sustainable development.

It is known, therefore, that the most universally quoted definition of sustainable development is that produced in 1987 by the World Commission on Environment and Development (WCED), otherwise known as the Brundtland Commission⁵. In *Our Common Future* report, the sustainable development has been identified as the one that «satisfies the present needs without risking that future generations cannot satisfy their own needs». And again, «in the past we have been concerned about the impacts of economic growth upon the environment; we are now forced to concern ourselves with the impacts of ecological stress upon our economic prospects». Just because environmental and natural resources degradation cannot be evaluated from the market, and since the sustainable development theorists become always more skeptical towards the self-corrective mechanisms of the economic system, it is extremely necessary to acquire awareness on the different possible regulatory policies that could be adopted to achieve the optimal level of prevention for environmental risks.

Following the publication of the Brundtland report there were many others alternative definitions of sustainable development [see for example, Pezzey, 1989; Pearce, Barbier, and Markandya, 1989; Rees, 1989]. Mitlin [1992] notes that, in general, the several definitions involve two components: the meaning of development (what are the main goals of development: economic growth, basic needs, etc.) and the presuppositions necessary for sustainability.

Despite the widespread acceptance on the definition of sustainable devel-

since people and markets innovate. For a similar and more recent work of this thesis, see Bjørn Lomborg, *The Skeptical Environmentalist* [2001].

⁵ After its Chairperson, Gro Harlem Brundtland, Prime Minister of Norway.

opment provided by the Brundtland Commission, there is not strong scientific consensus in supporting it. As it has been observed by Banuri [1999] the disagreement resides mainly on how to put the idea of sustainable development into operation (for example, on how to set up sustainability policies) and on how to implement sustainable development.

More recently, sustainable development has been defined as encompassing environmental, economic, and equity issues [Bartelmus, 1994]. The 1995 World Summit on Social Development further defined this term as «the framework for our efforts to achieve a higher quality of life for all people», in which «economic development, social development and environmental protection are interdependent and mutually reinforcing components». The 2002 World Summit on Sustainable Development expanded this definition identifying the "three overarching objectives of sustainable development" to be (1) eradicating poverty, (2) protecting natural resources, and (3) changing unsustainable production and consumption patterns. The 2005 World Summit Outcome Document refers to the "interdependent and mutually reinforcing pillars" of sustainable development as economic development, social development, and environmental protection.

As a matter of fact, the term sustainability has been widely used to refer, not only to the maintenance of environmental and natural resources, but also, and mostly, to economic and social spheres; this broad application, thus, demonstrates that sustainable development is, by its nature, an interdisciplinary concept, drawing on economic and social sciences, as well as law, management and politics. That is why, I am strongly convinced that the field of environmental law and economics is an important floor that is well suited to face such issues; in the next paragraphs, it is shown how the economic analysis of law could be conveniently employed in order to 1) search for solutions suitable for controlling environmental risk and to 2) provide some specific guidelines.

2. THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND DEVELOPMENT

The useful distinction made by H. Daly, J. Cobb and C. Cobb [1989] between growth (quantitative increase in production of goods and services) and development (qualitative improvement in design of commodities and institutions) has to be interpreted as a proof of the fact that the two concepts are similar in meaning but different in substance. In fact, economic growth refers to the increasing ability of a nation to produce more goods and services, while economic development essentially takes into consideration how to reduce or eliminate poverty in order to improve the wealth of the individuals of that nation

[Helpman, 2004; Mankiw, Romer and Weil, 1992].

The World Bank has its own indicator called the World Bank Development Indicator, as well as the United Nations Development Program developed a number of different ways for measuring economic development (the Human Development Index, the Gender Empowerment Measure, the Human Poverty Index and the Human Freedom Index). The main development indicator used is the Human Development Index (HDI) which combines economic growth and social welfare⁶.

The theoretical framework that, over time, has provided several models and different approaches on development problems, is characterized by the following theories, 1) the *neoclassical growth theory*; 2) the *development economic theory* (at its basis there is the refusal of the idea that there exists only one development path, underlying, indeed, the importance of welfare redistribution); 3) the *dependency theory* (adapted to Marxism even though sharply different from it)⁷; 4) the Newly Industrialized Economies' theory, characterized by a mixture of liberal and mercantilist elements; 5) the *neo-liberalist* approach that brings back to the *growth theory*, but this time with more political rigidities; 6) and lastly, more recently, the two different views of the concept of development: the one on the human development and the other on the sustain-

⁶ The HDI takes into account three major factors: life expectancy, levels of educational attainment, Gross Domestic Product per capita. The Gender Development Index, instead, compares the HDI between male and female populations; the Gender Empowerment Measure tends to show gender inequality in economic and political opportunities; the Human Poverty Index (HPI) measures similar outcomes to the HDI, but examines the extent of disadvantage faced by people who are being deprived of human development. The World Bank Development Indicator (WBDI) mainly measures the quality of life, the success of measures to reduce poverty, malnutrition, traffic congestion, tax rates, life expectancy, population size, educational standards such as literacy and infant mortality.

⁷ Raul Prebisch was one of the first theorists of Dependency Theory whose research found that the wealth of poor nations tended to decrease when the wealth of rich nations increased. Former Brazilian President Fernando H. Cardoso wrote extensively on dependency theory.

able development that represent the new heterodox development theories, by taking into consideration non monetary aspects of welfare, too.

The growth theory has been the dominant economic theory from the afterworld war II period up to the end of the 60's, with main theorists such as R. Solow, R. Harrod, E. Domar, W. Rostow⁸, characterized by the recurring argument for which convergence of developing countries should follow the same developing pathway adopted by industrialized countries.

The development economic theory, with main theorists such as A. Lewis, R. Prebisch, A. Hirschman, G. Myrdal, M. Singer, P. Rosenstein-Rodan, C. Freeman, instead, have analyzed the world economic system in a different way from their colleagues of growth theory, by adding to the analysis a distinguished element: the wealth redistribution. In other words, for those scientists, appeared mainly but not only in the 50's, it is not possible to have development without equality. Those economists argued that instead of a *catching up process* (provided by economists of the growth theory) what was happened was a *lagging behind* situation, that is, the less developed countries were unable to integrate themselves within the world economic system and to achieve the industrialized countries' development levels. Therefore, development economic theory was born, in some sense, as a reaction to the missed economic convergence of the poor countries.

The majority of the development theorists sustain that the roots of underdevelopment cannot be identified with the incapacity or the inefficiency of the poor countries (as hold, instead, by the growth theorists), but, rather, they should be found in some other factors that are out of their control. In this framework, one of the main causes of underdevelopment is represented by the unfavorable exchange relationships. According to Raul Prebisch, in fact, the main reasons for underdevelopment should have been found in the structure of the international trades and in the international division of the workforce. Many of the development theory economists believe that the *catching up* proc-

⁸ Rostow is one of the most known growth theorists; in the *The Stages of Economic Growth: A Non-Communist Manifesto* he shows the exact pathway that a non developed country should follow to reach the so called *modernity*.

ess of the developing countries is unachievable without the introduction of extraordinary measures. To this extent, the economist Gunnar Myrdal [1957], for instance, considers that only throughout the adoption of extraordinary measures it is possible to rescue the poorest economies from the pangs of poverty.

The difficulty toward convergence and toward higher levels of economic growth that the low developed countries have been facing has severely exploded in 1982, when Mexico had to deal with a financial crisis that the international economic system was unable to manage following the traditional policies' prescriptions. The crisis, then, affected also almost all the not industrialized countries; the roots of this crisis have to be found in the 1973 and 1979 oil shocks, when the oil price (according to a decision taken from the OPEC countries) raised, all of a sudden, of more than 400%. This situation caused severe deficits in the balance of payments of the involved countries that were, therefore, constrained to get into debt with the banks of the rich countries. These conditions became unbearable when, in 1979, after the second oil crisis, the Federal Reserve decided to adopt a stricter monetary policy by increasing the interest rates on loans, in order to reduce the high level of inflation that was weakened the US economy. Subsequently, the interests on the loans taken by the developing countries grown so much that they become extremely high and thus, considering also the worldwide recession and the losses in income deriving from exports, practically impossible to repay. Later on, in 1989, with the decline of the communist ideologies, fell down also the idea that an interventionist State could have produced growth and development.

Both the Keynesian approach and the development economics approach (for what concerns the public intervention) were profoundly criticized mainly for their failures deriving from the devastating consequences of the debt crises; the new liberalism approach, in fact, commemorates the end of the "old" economists on development and points out that the economic theory is only one and it must be perceived as a universal science applicable to every society. The new liberalists believe that underdevelopment would be the result of public intervention; they do not emphasize so much the markets' failures rather the State's failures, among which there are the responsibilities for excessively high inflation rates and for the enormous public debts. The State, in the new liberalist perspective, should 1) not alter prices, 2) rely on the market's foundations, 3) not put the hands in the economy, and 4) open up the market to the international competition. These directions were embraced, in the 80s, by Ronald Reagan in the US and by Margaret Thatcher in UK.

From 1990, the United Nations, through the United Nations Development

Programme (UNDP) publish annually a Report on the human dimensions of development. Narayan and others [Narayan, Patel, Schafft, Rademacher, and Koch-Schulte, 2000] in their study, *Voices of the Poor: Can Anyone Hear Us?*, indicate in raising income, in greater security in life and in a more sustainable environment the main factors able to reduce poverty.

In 2004, a joint initiative of the Yale Center for Environmental Law and Policy (YCELP) and the Center for International Earth Science Information Network (CIESI) of Columbia University, in collaboration with the World Economic Forum and the Joint Research Centre of the European Commission also attempted to construct an Environmental Sustainability Index (ESI). The ESI is a composite index tracking a diverse set of socioeconomic, environmental, and institutional indicators that characterize and influence environmental sustainability at the national scale; in 2005, New Zealand was ranked 1st in the world, Italy was ranked 21st, the United States of America was ranked 28th in the world, China was ranked 94th in the world⁹. The Pilot 2006 Environmental Performance Index focuses on countries' current environmental performance within the context of sustainability and makes a major effort to construct an effective policy set of environmental performance indicators to jumpstart environmental progress in the context of sustainable development.

In the literature, the relationship between economic growth and environment has been studied for the last twenty years and the scientific research seems to be leaning toward empirical analysis of functional forms relating measurements of pollutants and GDP. Environmental quality and economic growth are, generally, considered conflicting phenomena. The increase of pro-

⁹ In the 2006 Pilot Environmental Performance Index, top-ranked countries are New Zealand, Sweden, Finland, the Czech Republic, and the United Kingdom (all place significant resources and effort to environmental protection, resulting in strong performance across most of the policy categories). The five lowest-ranked countries result to be Ethiopia, Mali, Mauritania, Chad, and Niger (underdeveloped nations with little capacity to invest in environmental infrastructure, such as drinking water and sanitation systems, or in aggressive pollution control). To see more, http://www.yale.edu/epi/2006EPI_MainReport.pdf.

duction's and consumption's levels requires the employment of natural resources, as inputs in the manufacturing processes or as ecological functions. This could reduce their future availability, and under certain conditions, could jeopardize the ecosystems' capability in guaranteeing the fundamental environmental functions in support of human life.

As it is known, many environmental health indicators (i.e., water, air pollution, etc.) show an inverted U-shape Kuznet curve¹⁰ between the level of economic activities and the environment: in the beginning of economic development, little weight is given to environmental concerns, raising pollution along with industrialization; after a threshold, when basic physical needs are met, interest in a clean environment rises, reversing the trend. This relation holds most clearly true for a few pollutants (such as sulfur dioxide and nitrogen oxide), but there is little evidence that the relationship holds true for other pollutants or for the environment in general. For example, energy, land and resource use do not fall with rising income. However, it is important to note that this does not necessarily invalidate the theory [Arrow *et al.*, 1995; Harbaugh, Levinson, and Wilson., 2002; Dasgupta, Laplante, Wang, and Wheeler, 2002]¹¹. However, all this demonstrates that between economic growth and environmental quality there is not, necessarily, always and in any case, an inverse relationship, a trade-off.

In the debate over growth and environment there are two views: optimistic and pessimistic. Proponents of optimistic views argue that sustainability is fea-

¹⁰ The economic Kuznets curve is the graphical representation of Simon Kuznets's theory (known as Kuznets hypothesis) that economic inequality increases over time, then at a critical point begins to decrease. When investment in physical capital is the main mechanism of economic growth and in early stages of development, this happens because inequality encourages growth by allocating resources towards those who save and invest the most. In mature economies, instead, human capital accumulation takes the place of physical capital accumulation as the main source of growth, and inequality slows growth by lowering education standards because poor people lack finance for their education. See Bella [2003].

¹¹ On the environmental Kuznet curves the literature is vast; a classic reference is that of T. Panayotou [2000]; a more recent one is that by Galeotti M. [2003].

sible: in the early stages of development, economic growth will produce a higher level of environmental degradation but, continued economic growth will produce less polluted and more resource rich world (new technologies can reduce resource depletion, pollution and environmental degradation to acceptable levels [Ophardt, 1997]). Beckermann [1999] claims that growth is beneficial due to supporting social improvement. On the contrary, pessimists believe that economic growth (because of high rates of resource use and unnecessary waste) will cause unacceptable regional and global resource depletion, pollution and environmental degradation [Helm, 2000].

Since the existence of environmental problems pushes insistently governors and policy makers toward the adoption and the implementation of the best instruments for an efficient protection compatible with the economic growth's needs of the more developed and the developing countries (see for example Cairns, 2005), too, particular attention in this sense is given to the choice of the several instruments, both economic and legal, for controlling environmental risk, as well as to the ex ante (command and control system) and to the ex post regulatory approaches (tort liability). In particular, the economic literature has focused mainly on these two kinds of regulatory systems for the environment: 1) the ex-ante regulatory system works on the potential harmful activities before the occurring of some damages (examples are the imposition of a pigouvian tax, the determination of an environmental standard or the release of marketable permits); 2) the ex-post approach, instead, works subsequently and once that some damages occurred.

Given that neither an ex-ante regulatory system nor an ex-post approach are able themselves to provide agents (individual and firms) with the socially optimum level of care (necessary for preventing risky activities), the solution proposed by S. Shavell [1984a; 1984b] suggests to employ the two regulatory systems in a strict complementary way. As it has been also underlined by Kolstad, Ulen and Johnson [1990] there exists a complementary and not a substitutive relationship between a regulatory system that works ex-post - throughout the burden of some kind of liability and the consequent incentives for the adoption of the most opportune precaution measures - and a system that works ex-ante - primarily throughout the settling of environmental taxes and standards.

3. THE ENVIRONMENTAL LAW AND ECONOMICS: SOME MAJOR ISSUES

The law and economic theory consists in the evaluation of the complex set of rules, norms, sentences, etc. throughout the use of economic instruments; it

is, in other words, the study of the legal phenomena from an economic point of view. The idea of applying economic concepts to gain a better understanding of law helps either in explaining how legal rules evolve and what might be the consequences of alternative rules. One of the most controversial principles of law and economics is the so called “efficiency criterion” which emphasizes that the primary objective of a legal system has to be efficiency and that rules have to be evaluated for their capability of supplying incentives for the maximization of the society’s aggregate benefits; in fact, the “wealth maximization” principle proposed by Posner is a mean of applying the efficiency test [Posner, 1972; 1983; Landes and Posner, 1987]. In the related literature, have been distinguished two streams of analysis: one that is intended to measure the internal efficiency of the juridical rule, and the other, instead that is mainly focused in evaluating its suitability to realize the optimal allocation setting.

In particular, the law and economic theory borrows from economics two elements: the variables, that is to say concepts such as costs, benefits, transaction costs, social welfare, utility, etc., and the assumption of rationality. As it is well known, the roots of the law and economics movement have to be found in R. Coase seminal article *The Problem of Social Costs* [1960], in which one of the strongest law and economics subjects is proposed: the idea for which legal rules and norms should be structured in such a way to facilitate the performance of markets’ mechanisms. However, it is only in the 70’s that the movement evolves significantly thanks to the crucial contributions of two important jurists, Richard Posner and Guido Calabresi, that are considered the founding fathers of two of the most influential schools of thought: the school of Chicago (more oriented toward pro-market positions) and the school of Yale (more skeptical about the self-regulating market’s skills). From the middle of the 70’s, several economists (among others, Shavell from Harvard is predominant) joined the work of the jurists by defining analytically the formal foundations of the most part of the models used in the economic analysis of law.

It might be difficult to delineate the boundaries of the environmental law and economics literature, since the legal literature, by one side, mainly deals with environmental laws and does not address the issue of controlling environmental risk from an economic perspective (i.e. pollution taxes, tradable permits); the environmental economics literature, by the other side, analyses the effects of economic instruments to control environmental pollution but the legal instruments (i.e. nuisances, liability law) are not usually considered [Faure, 1998]. However, it is essential to mention few of the textbooks on environmental economics, some of which also discuss the relevance of the legal instru-

ments, such as Ackerman, Rose-Ackerman, Sawyer and Henderson [1974], Baumol and Oates [1979], Eide and van den Bergh [1996], Endres [1985], Field [1994], Kahn [1995], Oates [1996], Pearce and Turner [1990], Portney [1990], Revesz [1997], Richardson, Burrows and Ogus [1982], Tietenberg [1992] and Ward and Duffield [1992].

The comparison between legal and economic instruments to control environmental risk is one of the main issues, among others, that the traditional economic analysis of law deals with. In fact, environmental law and economics studies both “legal” instruments (such as liability rules and the traditional command and control mechanisms like environmental standards and targets) and “economic” instruments (such as taxes and marketable pollution rights) in order to control environmental risk. However, this terminological distinction can be misleading in view of the fact that the legal instruments are also economic, in the sense that they provide an incentive to comply with certain policy goals. Likewise, the economic instruments are also legal in the sense that a system of taxes or marketable pollution rights needs a legal framework to be effective [Faure, 1998].

Considering a law and economics approach allows choosing among instruments that have an incentive objective (the efficient deterrence of environmental degradation) and a remedy objective (the efficient clean-up of damages and the proper compensation of victims). The economics literature, on one side, helps understanding how an incentive regulation framework should be designed, while the legal literature, on the other side, analyzes how a system of legal liability can provide compensation to victims, internalizing the social cost of hazardous activities.

Laws and regulations play an increasingly significant role in the determination of particular environmental issues and the development of the appropriate policies, but economics is also very important in order to provide society with the right strategies and instruments according to a sustainable development criterion. As argued by Boyer and Laffont [1999], one advantage of the regulation instrument is that policy makers, using their knowledge on the economy, could choose the more appropriate regulatory policy.

4. LEGAL AND ECONOMIC INSTRUMENTS TO CONTROL ENVIRONMENTAL RISK

As said before, much of the environmental law and economics literature deals mainly with the two fundamental questions: 1) what is the optimal level of emissions?, and 2) how can the law give incentives to comply with this opti-

mal level? There are two forms of environmental protection policies: the "*command and control*" strategy is a direct regulation of activities that discharge pollutants, while the "*economic incentive*" policy encourages polluters to reduce pollution voluntarily by providing economic incentives, such as tax benefits and subsidies. Under the command and control policy, the authority sets specific environmental standards for activities that may cause pollution, and requires polluters to satisfy these standards; law punishes violators of these standards. The economic incentives, instead, employ the market mechanism and aim to reduce environmental pollution through the provision of economic incentives. The authority induces polluters to reduce pollution by imposing specific costs or taxes on activities that generate pollution¹². The task for public policy is to define an acceptable risk by balancing the costs and benefits of controlling the use of hazardous substances.

To the question "what is the optimal level of pollution", traditional economists would answer that the right incentives can be given by imposing a tax (Pigouvian tax) on the polluting activity. By equaling the marginal tax rate to the marginal costs caused by the harmful activity the polluting firm would get incentives to reduce pollution in an optimal way. Over 80 years ago, the Cambridge economist Arthur Pigou proposed a theoretical solution to externality problems, under which the government levies a uniform per unit tax on emissions set equal to the marginal damage imposed on others [Pigou, 1920]. A Pigouvian tax, in fact, is a tax levied to correct the negative externalities of a market activity; for instance, a Pigouvian tax may be levied on producers who pollute the environment to encourage them to reduce pollution, and to provide revenue which may be used to counteract the negative effects of the pollution. For a Pigouvian tax to reduce emissions to a socially optimal level, three conditions must be satisfied: 1) the impact of emissions should be uniformly distributed; 2)

¹² The most widely used form of economic incentives is the Pigouvian tax, in the form of emission charges and pricing that incorporates the cost of items to the environment, tradable emission permits and a deposit-refund system. Emission charges should be calculated on the volume of emission discharged by the pollution source, but it is technically very difficult and requires considerable administrative costs.

emissions must be measurable, and 3) the marginal net damage of emissions must also be measurable.

However, Coase in his seminal article on the problem of social cost showed that if transaction costs are zero an optimal allocation of resources will always take place irrespective of the contents of the governing legal rule [Coase, 1960]. The main question, therefore, is not how the law should give incentives to induce the firm to reduce emissions, but which of the two actors (firm or victims) should be limited in their activity. The Coase theorem is used as a starting point for discussing the role of environmental law and, more generally, the need for legal instruments to control environmental pollution [Baumol and Oates 1979; Oates, 1983]. A shortcoming of the Coase theorem is that in real life the situation given in the example of one polluting firm that would affect just one or two victims never happens. Usually there are cases of multiple victims where transaction costs will be very high; Coasian negotiations, thus, will not occur and some intervention of the legal system will then remain necessary to reach an internalization of the externality [Mishan, 1971; Kapp, 1970].

Baumol and Oates [1971] proposed the use of standards and prices for protection of the environment, but the use of standards implicates the problem of how to set them efficiently. It is opportune to distinguish between different standards; economists usually refer to “target standard” or “quality standard” which defines the optimal environmental quality for a certain environmental component. A second type of standard often used in environmental policy is the “emission standard” that usually determines the amount and quality of the substances that can be emitted into the environment (the quality and quantities of the emissions are regulated, too). A third category of standard is the “production standard” that regulates, at an early stage of the production process, the firm’s production technology. Firm may prefer standards because they have more influence over the level of the standard (technical knowledge) and because standard may be better at keeping entrants out of the market. Governments, instead, should prefer taxes because they bring in revenue, but often prefer standards because they allow greater political influence.

Taxes are generally preferred to standards for several reasons: firstly, taxes can decrease the level of pollution at a lower cost since for the application of standards it is necessary to equally evaluate them for all firms on the whole; secondly, taxes can create strong incentives to install new equipments able to further on reduce polluting emissions.

Emissions’ trading is another important instrument and consists in the process by which one party reduces its emission levels, and transfers that reduc-

tion to another party who can use the purchased reductions to meet an emissions target. The emissions trading system has been used for decades in the United States to reduce overall emissions of pollutants; now it is being applied on a global scale. In 2002, it was suggested by the European Union as one of the main regulatory instruments for achieving Kyoto targets. A system of marketable permits work on the basis of the following postulates: 1) it is possible to obtain a legal right to pollute; 2) these rights are clearly defined; 3) only a governmental agency can determine the total number of permits and their initial allocation; 4) permits are freely transferable; there exists a markets for them, too. The Kyoto Protocol emissions trading system is a cap-and-trade system. Cap-and-trade basically means that total emissions are limited or “capped”; each country or company involved receives an equal amount of permits. Among the several benefits deriving from a system of emissions trading, have been considered, in particular, cost-effectiveness, long-term effects, dynamic efficiency, etc.; there is, however, still a great deal of discussions about the degree of trade. The European Union wants its own countries to trade amongst themselves, whereas the US votes for a larger degree of trade. Lomborg [2001] in his book *The Skeptical Environmentalist* argues that trading emissions permits may not be an efficient way of reaching Kyoto targets because developing countries are not included in current measures. He does however mention that including all these countries in the process may make the initial allocation of permits much more difficult (because of the necessary redistribution from developed to developing countries).

From a pure theoretical economic point of view, however, taxes, standards and tradable permits, all achieve the goal of reaching the optimum, even though there are some differences lying in the distributional outcomes.

Another important instrument to control environmental risk is environmental liability, which is now used as one of the most effective legal instruments to deter environmental pollution. Liability has been analyzed in terms both of its capacity to provide (ex ante) incentives to avoid environmental damage and of its capacity to guarantee (ex post) the proper compensation of victims. The choice between using a strict liability standard versus a negligence standard is, in fact, the subject of much discussion in the law and economics literature. Under the economic theory [Polinsky and Shavell, 2000] there are two potential candidates for imposing liability, strict liability and fault-based liability. The basic economic assumption of public enforcement of law’s theory is that individuals or society make decisions with the goal of maximizing their expected utility. In the oversimplified scenario, there is no concern with risk

bearing, since parties are presumed to be risk neutral, nor with the size of administrative costs, since legal system is assumed to operate free of such costs, nor with distributional equity, since for the welfare criterion, the benefits are derived by parties from engaging in harmful activities less the cost of crime and less the cost of enforcement. Another assumption is that, by definition, all that an injurer needs to do to avoid the possibility of liability is to exercise due care if he engages in the activity.

Under strict liability, a risk neutral individual will commit the crime if and only if his gain from doing so exceeds the sum of the expected sanctions and, an injurer is assumed to pay for all damages suffered by victims. Under fault-based liability, an individual will be held liable if he committed the harmful activity without taking reasonable precautions to prevent harm: this means that he will be held liable if he committed the harmful activity when his gain is less than the fault standard set at the socially optimal level. The injurer, under negligence, has to pay for damages only if his level of care is less than the due care level. A further assumption is that the level of activity usually is not considered in the formulation of the due care standard; the answer could be that the courts would have difficulty in trying to employ a standard of due care that includes the level of activity.

Under negligence standard, thus, injurers are liable if two conditions are satisfied 1) the injurer must have acted negligently (he must have exercised less than due care) and 2) the injurer's negligence must have caused damages. Thus, if an individual meets the required standard of care ("due care") there will be no liability. Under strict liability, instead, injurers are liable for damages they cause regardless of the level of care they exercise. Injurers will be induced to choose the socially optimal level of care since they know that they will be held liable for any damage caused by their use of pollutants.

Optimal deterrence is achieved when each potential defendant takes the level of care at which the social marginal cost of care equals the social marginal benefit of care. By definition, if the injurer takes care that equals or exceeds the required level of due care, he will not be found at fault and made liable. Therefore, the victim retains some residual risk and will not be compensated. The reason is that the injurer's level of care will not prevent all damages, but rather only that quantity that is socially desirable to prevent. Since in some cases victims will be damaged and left uncompensated, it turns out to be a serious question the fairness of applying a negligence standard.

Arguments for and against fault-based, as opposed to strict liability thresholds are many. Issues along these lines are many and the associated literature is

vast. Both strict liability and fault based liability lead to socially desirable levels of care. To efficiently control accident risks, it is necessary to limit the expected damages, allowing society to escape the burden of substantial clean-up costs, while minimizing the total costs of taking care.

Strict liability has the advantages over negligence that the problem of establishing the socially optimal level of due care is irrelevant and, there is no need for a court to establish an injurer's actual level of care. Another practical advantage over a negligence standard is represented by the ease of proof. Under a negligence standard, polluters will have no incentives to take optimal precautions if they believe that victims will be unable to prove in court that actual care fell below the required level of due care. Strict liability avoids this proof problem because the victims do not have to prove that the level of actual care fell below the due care.

Making the polluter pay for the entire damages he caused would result in more precaution and, thus, in prevention of environmental damages. A strict liability regime might encourage investment in research and development for improving knowledge and technologies more than those created by a fault-based regime. But there is not any empirical evidence that a strict liability standard will generate more incentives for a cheaper pollution prevention technology.

Under an economic perspective, thus, in the short run, efficiency can be reached by either making the injurer strictly liable for all damages or imposing a negligence rule under which the injurer would be liable for damages only if he had not met the standard of due care¹³. The negligence rule is efficient, provided that the standard of due care set by the court is the efficient level of care. Even from a deterrence efficiency viewpoint there is no difference between

¹³ This symmetry between strict liability and negligence does not hold when the injurer can also modify his activity level in a way that can affect expected damages. Strict liability, on the other hand, would provide an incentive for both increased care and decreased use of pollutants, since either of these would reduce expected damages and thus reduce expected liability. In the long run, only strict liability is efficient since the number of injurers is allowed to vary.

strict and fault liability; under either regime, individuals will take care if doing so is cheaper than paying for environmental damages. Whether strict liability produces superior deterrence incentives has not any relevant evidence. Recent empirical evidence suggests that strict liability, in comparison to fault-liability, does not result in fewer spills; in fact, it may cause more spills than fault liability [Alberini and Austin, 1999].

But any attempt to establish the general theoretical superiority, in efficiency terms, of either of the instruments over the other is destined to failure, since there is no compelling case showing the most desirable liability regime. Therefore, political feasibility represents the only factor that could determine the choice of one or another. Issues of distributional justice as well as equity should be considered.

5. THE EX-ANTE AND EX-POST APPROACHES

A variety of efficient control alternatives exist, at least in principle. In fact, it is important to distinguish between privately and state-initiated controls, and between, as already said, *ex ante* and *ex post* control [Shavell, 1987]. A control is privately initiated if it is employed only after victims take some legal action or report their situation to a social authority. State-initiated controls are employed by the state at its discretion, regardless of any actions taken by victims. A control is *ex ante* if it is applied before, or at least, independently of the occurrence of harm while *ex post* controls are applied after the fact.

Several legal, administrative, and economic factors suggest that privately initiated controls may not be sufficient to ensure that potentially polluting activities are managed non-negligently. First of all because the damages are generally disperse; second, detection and assessment of pollution and its related risks require extensive monitoring, testing, and scientific expertise. Frequently a social authority will be better positioned to conduct proper inquiries about risks and to document the occurrence and source of harm. Once a determination has been made that state-initiated control measures will be required, the application of the controls must be addressed. As with state- and privately-initiated controls, *ex ante* and *ex post* approaches are not mutually exclusive.

In the US, the activity of the Environmental Protection Agency (EPA) provides a clear example of *ex ante* regulation by an independent environmental authority. This agency acts through the setting of preventive standards and their enforcement, the performance of inspections and, possibly, of actions brought to the federal courts. With respect to *ex ante* regulation we cannot mention the EU experience given that a standard setting system has not been

established at a European level and that the European Environmental Agency (EEA) plays only a very limited role¹⁴.

At the *ex post* regulatory level, the US experience can be again considered as an example, too, given that the issue of environmental damage liability has emerged since the early 80's, when the Congress enacted the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA) and created a *Superfund* for the quick and effective clean-up of dangerous waste sites¹⁵. The US liability system for environmental damages considers all operators retroactively, strictly, jointly and severally liable for all damages through a system of extended liability [Boyer and Porrini, 2002].

The US liability system, administered by the courts and governed mainly by state law, played an extensive role in regulating, among other environmental risks, air pollution, water pollution and hazardous waste disposal. It provides a mechanism for compensating victims, property, and health injuries by a strict liability system¹⁶.

¹⁴ The European Environment Agency was formally established by EEC Regulation 1210/90 in 1990 (amended by EC Regulation 933/1999 and EC Regulation 1641/2003). The decision to locate in Copenhagen was taken in 1993 and the Agency has been operational since 1994. The European Environment Agency is the leading public body in Europe dedicated to providing timely, relevant and reliable information to policy making and the public, to support sustainable development and to help achieve significant and measurable improvements in Europe's environment. The EEA mission statement is «to provide decision-makers with the information needed for making sound and effective policies to protect the environment and support sustainable development». The Agency ensures this information is available to the general public through its publications and website (www.eea.eu.int). The EEA does not make or enforce European Union environmental policy or legislation: this is the responsibility of the European Commission and the other EU institutions.

¹⁵ The Superfund enabled the government to begin cleaning-up of priority sites placed on the National Priority List (NPL) with money generated principally by taxes on cruel oil, corporate income, petrochemical feedstocks, and motor fuels.

¹⁶ Beside the tort system, there exist a system of private and public insurance, both for the firms' liability and for the consequences on individual health.

The European Community has been trying for many years to define a common system of assignment of liability for environmental damages. In 1993, the European Commission published the *Green Paper on Remedying Environmental Damage*¹⁷. The Commission published a detailed environmental liability model for the EC in March 1999 and finally the *White Paper on Environmental Liability* in February 2000¹⁸. The EC White Paper liability system is similar to the US system because both of them are based on a strict liability regime, but they are also different regarding several aspects. For example, while the CERCLA provisions cover any damage including the damage to natural resources, the *White Paper* covers only traditional damages, such as personal injury and damage to property. In the US system, the Superfund was created to quickly clean-up the environmental damage, while no such fund is established by the *White Paper*. Differences exist also in the definition of lender liability and financial responsibility.

One of the major differences in environmental law between the EU and the US can be seen in the area of compliance. The US has mandatory compliance that is strictly enforced by the EPA and the court system. The EU has only voluntary compliance because of a lack of a binding enforcement mechanism.

Policies adopted to control environmental risks cannot be evaluated only on the basis of efficiency criteria. The different approaches, generally, can get adapted for practical and political feasibility, but the conceptual differences remain a primary source of tension between those focused on economic policymaking and those focused on environmental policymaking. Using the considerations outlined above would sensitize an analyst to the wide range of factors that would determine the political feasibility of either a strict liability or a fault-based regime. Liability possesses unique advantages where a regulatory authority will not be expected to have good information about risk or the occurrence

¹⁷ Commission of European Communities, Communication from the Commission of the Council and Parliament: *Green Paper on Remedying Environmental Damage*, COM (93) 47 final, Brussels, 14 May 1993, OJ 1993 C 149/12.

¹⁸ Commission of European Communities, *White Paper on Environmental Liability*, COM (2000), 66 final, Brussels, 9 February, 2000.

of harm, and where the deterrence inherent in liability will not be weakened by injurers' inability to pay for harm or the possibility that they will escape suit [Shavell, 1987].

«A complete solution to the problem of the control of risk evidently should involve the joint use of liability and regulation, with the balance between them reflecting the importance of the determinants» [Shavell, 1987]. As confirmed by Kolstad, Ulen, and Johnson [1990] between an ex post regulatory system which works throughout the attribution of liability and an ex ante regulatory system which works throughout the imposition of standard, there exists a complementarity's and not a substitutability's relationship.

6. SOME FINAL REMARKS

The challenges at stake are certainly serious. Creating an environment for successful development requires surely an integrated approach linking economic, legal, and institutional factors. The objective of sustainable development poses, in fact, a growing need for institutions, policy makers and government, to effectively cooperate also at international level in order to choose the proper regulatory and legal framework suitable to implement environmental policies.

This is a difficult task that requires structured and incisive analysis; that is why, I believe that in order to model the interactions between the different decision makers (governments, firms, regulators, etc.) it could be particularly helpful, then, to combine the economic and the legal theories under just one comprehensive framework able to evaluate, in a social welfare perspective, the social value of environmentally risky activities, the cost of care, the asymmetric information of the different actors and the liability system's efficiency.

REFERENCES

- Ackerman, B.A., Rose-Ackerman, S., Sawyer, J.W., jr. and Henderson, D.W.
1974 *The Uncertain Search for Environmental Quality*, Free Press, New York.
- Alberini, A. and Austin, D.H.
1999 "Strict Liability as a Deterrent in Toxic Waste Management: Empirical Evidence from Accident and Spill Data", *Journal of Environmental Economics and Management*, XXXVIII, Nr. 1, Pp. 20-48.

Arrow, K. *et al.*

1995 “Economic Growth, Carrying Capacity, and the Environment”, *Ecological Economics*, XV, Nr. 2, Pp. 91-95.

Banuri, T.

1999 “Sustainable Development and Climate Change”, *Policy Matters. Newsletter of the IUCN Commission on Environmental, Economic and Social Policy (CEESP)*, Nr. 4, Pp. 1, 4-7.

Bartelmus, P.

1994 *Environment, Growth and Development. The Concepts and Strategies of Sustainability*, Routledge, London-New York.

Baumol, W. and Oates, W.

1971 “The Use of Standards and Prices for Protection of the Environment”, *Swedish Journal of Economics*, LXXIII, Nr. 1, Pp. 42-54.

1979 *Economics, Environmental Policy, and the Quality of Life*, Prentice Hall, New York.

Beckermann, W.

1999 “A Pro-Growth Perspective”, in *Handbook of Environmental and Resource Economics*, edited by J.C.J.M. van den Bergh, Elgar, Cheltenham.

Bella, G.

2003 “Does Pollution Affect Economic Growth?”, paper presented at the European Summer School in Resources and Environmental Economics, September 1-6.

Boyer, M. and Laffont, J.-J.

1999 “Toward a Political Theory of the Emergence of Environmental Incentive Regulation”, *RAND Journal of Economics*, XXX, Nr. 1, pp. 137-157.

Boyer, M. and Porrini D.

2002 “The Choice of Instruments for Environmental Policy: Liability or Regulation?”, in *An Introduction to the Law and Economics of Environmental Policy: Issues in Institutional Design*, edited by T. Swanson and R. Zerbe, Elsevier Science, Oxford, Pp. 247-269.

Cairns, R.D.

2005 “Accounting for Sustainable Development or for the Environment?”, paper presented at the International Conference of the Greening of Industry Network, April 28-29, University of Twente, Enschede, The Netherlands.

Coase, R.H.

1960 “The Problem of Social Cost”, *Journal of Law and Economics*, III, Nr. 1, Pp. 1-44.

- Daly, H., Cobb, J.B. and Cobb, C.W.
 1989 *For the Common Good: Redirecting the Economy toward Community, the Environment, and a Sustainable Future*, Beacon Press, Boston.
- Dasgupta, S., Laplante, B., Wang, H. and Wheeler, D.
 2002 “Confronting the Environmental Kuznets Curve”, *The Journal of Economic Perspectives*, XVI, Nr. 1, Pp. 147-168.
- Ehrlich, P.
 1971 *How to Be a Survivor: A Plan to Save Spaceship Earth*, Ballantine, London.
- Eide, E. and van den Bergh, R. (eds.)
 1996 *Law and Economics of the Environment*, Juridisk, Oslo.
- Endres, A.
 1985 “Market Incentives for Pollution Control”, *Ricerche Economiche*, XXXIX, Nr. 4, Pp. 526-539.
- Faure, M.
 1998 “Environmental Regulation”, in *Encyclopedia of Law and Economics*, Edward Elgar and University of Ghent Publishers.
- Field, B.
 1994 *Environmental Economics: An Introduction*, McGraw-Hill, New York.
- Galeotti, M.
 2003 “Economic Development and Environmental Protection”,
<http://www.feem.it/NR/rdonlyres/212F3813-CB01-4C60-A083-18AD7E28E6E2/900/8903.pdf>.
- Harbaugh, W.T., Levinson A. and Wilson D.M.
 2002 “Reexamining the Empirical Evidence for an Environmental Kuznets Curve”, *Review of Economics and Statistics*, LXXXIV, Nr. 3, Pp. 541-551.
- Helm, D.
 2000 *Objectives, Instruments and Institutions in Environmental Policy*, Oxford University Press, Oxford.
- Helpman, E.
 2004 *The Mystery of Economic Growth*, Harvard University Press, Cambridge.
- IUCN/UNEP/WWF
 1980 *The World Conservation Strategy: Living Resource Conservation for Sustainable Development*, International Union for Conservation of Nature (IUCN), Gland.

- Kahn, H., Brown, W. and Martel, L.
 1976 *The Next 200 Years: A Scenario for America and the World, Morrow*, New York.
- Kahn, R.
 1995 *An Economic Approach to the Environmental and Natural Resources*, Dryden, New York.
- Kapp, K.W.
 1970 "Environmental Disruption and Social Costs: a Challenge to Economics", *Kyklos*, XXIII, Nr. 4, Pp. 833-848.
- Kolstad, C.D., Ulen, T.S. and Johnson, G.V.
 1990 "Ex-Post Liability for Harm vs. Ex-Ante Safety Regulation: Substitutes or Complements", *American Economic Review*, LXXX, Nr. 4, Pp. 888-901.
- Landes, W. and Posner, R.
 1987 *The Economic Structure of Tort Law*, Harvard University Press, Cambridge.
- Lomborg, B.
 2001 *The Skeptical Environmentalist: Measuring the Real State of the World*, Cambridge University Press, Cambridge.
- Mankiw, N.G., Romer, D. and Weil, D.N.
 1992 "A Contribution to the Empirics of Economic Growth", *Quarterly Journal of Economics*, CVII, Nr. 2, Pp. 407-437.
- Meadows, D.H., Meadows, D.L., Randers, J. and Behrens, W.W., III
 1972 *The Limits to Growth*, Universe, New York.
- Meadows, D.H., Meadows, D.L., and Randers, J.
 1992 *Beyond the Limits. Global Collapse or a Sustainable Future*, Earthscan, London.
 2004 *Limits to Growth: The 30-Year Update*, Earthscan, London.
- Mishan, E.J.
 1971 "Pangloss on Pollution", *Swedish Journal of Economics*, LXXIII, Nr. 1 Pp. 113-120.
- Mitlin, D.
 1992 "Sustainable Development: A Guide to the Literature", *Environment and Urbanization*, IV, Nr. 1, Pp. 111-124.
- Myrdal, Gunnar
 1957 *Economic Theory and Under-Developed Regions*, Duckworth, London.
- Narayan, D., Patel, R., Schafft, K., Rademacher, A. and Koch-Schulte, S.
 2000 *Voices of the Poor: Can Anyone Hear Us?*, Oxford University Press, New York.

- Oates, W.
 1983 "The Regulation of Externalities: Efficient Behaviour by Sources and Victims", *Public Finance*, XXXVIII, Nr. 3, Pp. 362-375.
 1996 *The Economics of Environmental Regulation*, Elgar, Brookfield.
- Ophardt, C.
 1997 "Human Society and Environmental Impacts: Global Collapse or Sustainable Future?", <http://www.elmhurst.edu/~chm/onlcourse/chm110/labs/limits.html>.
- Panayotou, T.
 2000 "Economic Growth and the Environment", in *Handbook of Environmental Economics*, edited by K.-G. Mäler and J.R. Vincent, North-Holland, Amsterdam.
- Pearce, D., Barbier, E. and Markandya A.
 1989 *Sustainable Development: Economics and Environment in the Third World*, Elgar/Earthscan, Aldershot.
- Pearce, D. and Turner, K.
 1990 *Economics of Natural Resources and the Environment*, Harvester Wheatsheaf, New York.
- Pezzey, J.
 1989 "Economic Analysis of Sustainable Growth and Sustainable Development", *World Bank Environment Department Working Paper*, 15.
- Pigou, A.
 1920 *The Economics of Welfare*, Macmillan, London.
- Polinsky, A.M. and Shavell, S.
 2000 "The Economic Theory of Public Enforcement of Law", *Journal of Economic Literature*, XXXVIII, Nr. 1, Pp. 45-76.
- Posner, R.
 1972 *The Economic Analysis of Law*, Little, Brown, Boston.
 1983 *The Economics of Justice*, Harvard University Press, Cambridge.
- Portney, P.
 1990 *Public Policies for Environmental Protection*, Resources for the Future, Washington.
- Rees, W.F.
 1989 Defining "Sustainable Development", *CHS Research Bulletin* [University of British Columbia], 89-1.
- Revesz, R.
 1997 *Foundations of Environmental Law and Policy*, Oxford University Press, New York.

- Richardson, G., Burrows, P. and Ogus, A.
1982 *Policing Pollution: A Study of Regulation and Enforcement*, Clarendon, Oxford.
- Shavell, S.
1984a "Liability for Harms versus Regulation of Safety", *The Journal of Legal Studies*, XIII, Nr. 1, Pp. 1-25.
1984b "A Model of Optimal Use of Liability and Safety Regulation", *RAND Journal of Economics*, XV, Nr. 2, Pp. 271-280.
1987 *Economic Analysis of Accident Law*, Harvard University Press, Cambridge.
- Simon, J.
1981 *The Ultimate Resource*, Princeton University Press, Princeton.
- The Ecologist
1972 "A Blueprint for Survival", *The Ecologist*, II, Nr. 1, Pp. 1-43.
- Tietenberg, T.
1992 *Environmental and Natural Resource Economics*, Harper Collins, New York, 3rd edn.
- Ward, B. and Dubos, R.
1972 *Only One Earth. The Care and Maintenance of a Small Planet*, Deutsch, London.
- Ward, K. and Duffield, J.W.
1992 *Natural Resource Damages: Law and Economics*, Wiley, New York.
- World Commission on Environment and Development
1987 *Our Common Future*, Oxford University Press, New York.

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