# Cultural and institutional constrains on ecological learning under uncertainty

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# Cultural and institutional constrains on ecological learning under uncertainty

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**Abstract**

Formal and informal institutions are a structuring response to the uncertainties individuals face in dealing with the complexities of human interaction for survival due to their limited perception and computational capacity of mind. The institutions are, in turn, molded by the mental constructs (cultural values) developed to decipher those complexities and they provide the society's structure of incentives which will direct the learning process. The history of technology is full of examples of societies whose cultural and institutional background has prevented the processes of learning by doing and learning by using from generating innovative and transforming technological trajectories. In capitalistic societies the structure of incentives which direct the way individuals acquire knowledge has been, historically, barely marked by environmental concerns. Although in the last thirty years the sheer weight of the scale of human activities has made it unavoidable for people in these societies to face the environmental issues, the new set of institutions required to redirect the learning process to achieve sustainability has not yet fully emerged. This new set of institutions will have to deal with the difficulties of creating a structure of incentives for a learning process whose feedback mechanisms are hampered by the controversial character of the scientific assessment of global environmental problems and by the fact that most impacts of global environmental problems will be felt by future generations. In this context the paper analyzes the implications for the decision making process of the fact that the extent of complexity and uncertainty of global environmental issues has produced a paradoxical situation: in one hand, the more and more scientific expertise is required for decision making; on the other hand, the evidence makes it clearer each day the limits of science in the assessment of global environmental impacts. The scientific optimism of the nineteenth century, based on a positive rationality, progressively is making room for a less optimist and more precautionary stance, based on a procedural rationality.

**Key words**: Culture and environment; Ecological learning.

**Resumo**

As instituições, formais e informais, representam uma resposta estruturante às incertezas que os indivíduos de uma sociedade sentem ao fazer face às complexidades da interação humana na luta para sobrevivência, devido às limitadas capacidades computacional e de percepção da mente. As instituições são, por sua vez, moldadas pelos construtos mentais (valores culturais) desenvolvidos para decifrar estas complexidades e elas fornecem a estrutura de incentivos da sociedade que irá direcionar o processo de aprendizado. A história da tecnologia é plena de exemplos de sociedades cujas

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especificidades institucionais e culturais impediram que os processos de aprendizado dessem origem a trajetórias tecnológicas inovadoras e transformadoras. Nas sociedades capitalistas a estrutura de incentivos que orienta o modo como os indivíduos adquirem conhecimentos tem sido, historicamente, muito pouco marcada pela preocupação com o meio ambiente. Mais recentemente, nos últimos trinta anos, apesar da crescente preocupação com os problemas ambientais, ainda não emergiu um novo conjunto de instituições necessárias para efetivamente se reorientar o processo de aprendizado no sentido da sustentabilidade. Estas instituições terão que enfrentar as dificuldades de se criar uma estrutura de incentivos para um processo de aprendizado cujos mecanismos de retro-alimentação são obstruídos pela controvérsia científica que envolve a avaliação dos impactos ambientais globais, cujos efeitos recairão sobre as gerações futuras. Dado este contexto, o trabalho analisa as implicações para o processo de tomada de decisões do fato de que os níveis de complexidade e incerteza das questões ambientais globais produziram uma situação paradoxal: por um lado, cada vez mais se exige a contribuição da ciência no processo de tomada de decisões; por outro lado, ficam também cada vez mais claros os limites da própria ciência na avaliação dos impactos ambientais globais. O otimismo científico prevalecente no século XIX, baseado na racionalidade positiva, progressivamente cede lugar para um sentimento menos otimista e mais precavido, baseado numa racionalidade procedural.

**Palavras-chave**: Meio ambiente; Cultura; Aprendizagem; Ecologia.

## Introduction

The paper aims at discussing the cultural and institutional constrains on ecological learning under uncertainty. Modern societies are not yet culturally prepared and institutionally equipped to deal with the challenges put by global environmental problems. It shows (section 1) how cultural values are crucially important for the societies' learning processes, following the analytical proposition of D. North (1990,1993). They mold the institutions which will provide the structure of incentives directing the learning process.

Also the environmental learning in neoclassical economic theory is addressed (section 2). It argues that, as a cultural value, it has contributed negatively to ensure the cooperative (altruistic) behavior societies need to tackle global environmental threats. Furthermore, it argues that its analytical structure is flawed as it eludes the risk of irreversible and catastrophic losses and takes into account only the environmental impacts on present generations.

The Precautionary Principle is discussed in section 3. As a new institutional device, it is presented as resulting historically from the changing of people's risk perception brought by the growing complexity of industrial civilization. Its ambivalence is pointed out (subsection 3.1) as to illuminate its potential to deal with the uncertainties brought by the controversial character of the scientific assessment of global environmental problems. The paper is closed with some final remarks on

the need of an ecological consciousness reflecting new cultural values which could make it much more important the role of non-economic constrains on the economic dynamics.

## 1 Cultural values and learning

The way people learn and react before the problems they face is constrained by the cultural values prevailing in their societies. Cultural values act as mental constructs developed to decipher the complexities of human interaction for survival and they mold the formal and informal institutions which are a structuring response to the uncertainties individuals face in dealing with these complexities due to their limited perception and computational capacity of mind. The institutions will provide the society's structure of incentives which will direct the learning process (North, 1990).

The history of technology is full of examples of societies whose cultural values and institutional framework have prevented the processes of learning (learning by doing, by using or other mechanisms) from generating innovative and revolutionary technological paths. On the contrary, the cultural values and institutional framework of western societies have created a favorable environment for innovation since its origins in feudal times. According to White (1968) the cultural values implied in the creation of this environment sprang from the Judeo-Christian anthropocentric philosophy that put nature to the service of humankind.

As invention represents a game against nature, it is more likely to occur in societies where the prevailing system of beliefs rises the propensity to change production methods, i.e., the willingness to challenge and to manipulate the physical environment. In this sense, the anthropocentric philosophy of Judeo-Christian religion represented an exceptional mentality change in history (Mokyr, 1990).

However, although these cultural values stimulate the productive transformation of nature, they don't imply necessarily its degradation. In feudal times, for example, the feeling of stewardship towards nature was present in the minutiae regulations about the use of land, forests and other natural resources. In the transition of feudalism to capitalism, however, the evolving institutional framework led to the abolishing of those feudal labor and land use regulations, based on community rights, and to their replacement by capitalist regulations, based on private property rights.

The feudal community rights represented a set of ***non-economic constraints*** (cultural, religious, ideological ...) on the individual pursuit of wealth that regulated production and income distribution. So, when they were substituted by private property rights as the core of the new institutional (capitalist) arrangements, the way was opened to the prevailing of a strictly economic rationality, unbounded by any constrains on human and nature exploitation.

Thus, the new institutional framework has provided a much more efficient structure of incentives for the individuals to realize the potential of gains associated with technical progress. On the demand side, a new pattern consumption emerged as a counter part of the new productive dynamics, characterized by an endless creation of new necessities. Long term management of natural resources ceased to be part of the feedback mechanisms in the society's learning dynamics.

## 2 The environmental learning in neoclassical theory

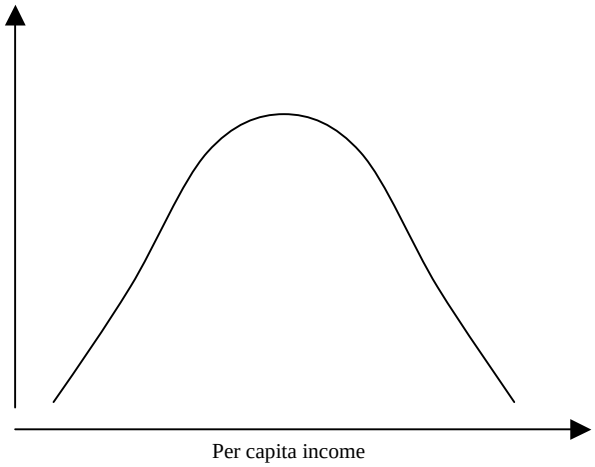
The evolving economic theory since Adam Smith have significantly contributed, as a **cultural value**, to justify the new capitalist institutional arrangements and has been denounced for that by its critics. (There is even strong empirical evidence that studying economics leads to non-cooperative behavior – Siebenhuener, 2000).

Confronted with the environmental issue the response of conventional economics has kept its basic postulates on human behavior and on the market's role: environment problems can be dealt with by egoists and rational utility maximizers economic agents acting through efficient market mechanisms, in a world without natural limits to economic growth (Daly, 1996).

The so called Kuznets environmental curve (Graphic 1) describes a learning process that fits those neoclassical postulates about human behavior and market's role: economic agents perform a benefit-cost analysis comparing the marginal utility of income to the marginal desutility of environmental degradation and can reveal their preferences in the market (willingness to pay) for more or less environmental goods or services – provide some arrangements be made to overcome the fact that most environmental goods and services are public.

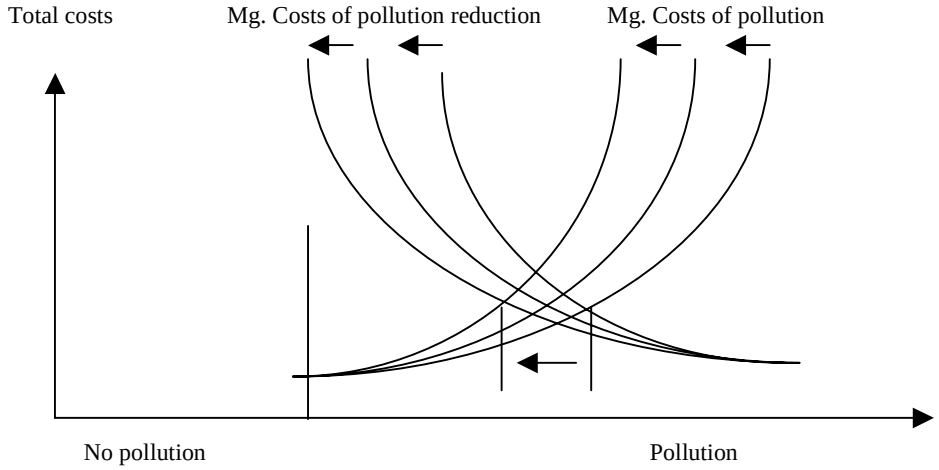
The simultaneous growth of income per capita and of environmental degradation rises the consumers' willingness to pay for environmental goods and services which, in turn, induces technical and institutional innovations aimed at saving them.

Graphic 1
Environmental degradation




On the side of producers, this historical trend implies higher costs in polluting, as people rises the values they put on environmental goods and services. On the other hand, induced innovations reduce the costs of pollution reduction (Graphic 2).

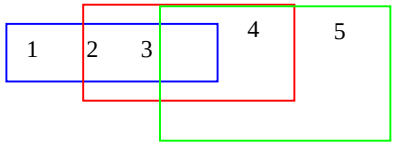
Graphic 2



From a learning point of view, however, it must be noted that the feedback mechanisms of this analytical model (a) concern only to the environmental degradation translating into a desutility to the economic agents and (b) don't include the risks of irreversible and catastrophic losses. So, in such a model, the amount of pollution (scale) admitted is just the result of a trade off between two marginal costs, regardless the risk of irreversible losses.

Regarding the future generations the decision making process of the economic agent is modeled as a problem of inter-temporal allocation of resources between generations. This process is regulated by what Howard & Norgaard (1995) have called altruistic "laissez-faire": each generation search to bequest to the next one the natural capital it judges important from his learning (desutility) experience; this kind of "overlapping generations models" presupposes that each period of common life between, in general, three generations could generate a sort of "altruistic chain", in which each generation bequest to the next a certain amount of environmental resources, so as the generations in a distant future could benefit from the environmentally friendly decisions taken in a distant past.

Figure 3




This kind of model suppose a learning process related only to reversible environmental problems having impacts on the utility level of the economic agent itself or on the utility level of its family (or kinship folk). So, this economic agent will be willing to bequest to its ***relatives*** an environment free from a ***known problem***, in a sort of "selfish" altruism.

However, dealing with global environmental problems implies a different learning process and presupposes a different attitude as their impacts will be felt only by distant generations in the future ahead, which implies (1) that the economic agents will be called upon to decide on behalf **of estrangers**,[2] not relatives (or kinship folk); (2) additionally, the extension and consequences of those impacts **are**

(2) Daly & Cobb (1988) point out that in five generations, the last one will be the great-great grandchild of fifteen different people in the current generation, many of their identities now unknown.

**not clearly known** by them because of the controversial character of the scientific assessment of global environmental problems; and (3) the risk of catastrophic losses is high.

In this case the environmental learning process is much more complicated and it presupposes, to begin with, that the economic agents will have to behave out of a pure ***altruistic stance***,[3] as they will have to sacrifice themselves on behalf of estrangers in a distant future. So, the well-being of future generations becomes a public good which implies a public choice process (Sen, 1982). Additionally, as there is no a certitude about the long term consequences of the problem, but there is the risk of catastrophic losses, society must adopt a ***precautionary position***.

## 3 The precautionary principle

A new institutional device the **precautionary principle** has been emerging historically out of the changing of people's risk perceptions brought by the growing complexity of industrial civilization.[4] It represents a historical process of institutional change concerning the social and juridical norms aimed at the handling of those risks. The collective organization of risk prevention is inherent to the building of the modern welfare states. People became inclined to question the collective responsibility of the institutions or the State and also the personal responsibility of public agents.

During the 19th century the prevailing cultural values informed an institutional framework in which the personal moral commitment of each citizen regarding himself and the others was much more important than the juridical ones. Due to the fact that this institutional framework was based on a liberal philosophy, it resorted lesser to the legal constraints than to the individual will and freedom. The legal obligations of each individual regarding the others were limited to the simple rule of not giving "offense to the brethren" (Ewald, 1997).

The virtuous citizen was that one who was responsible and prudent in the use of his freedom which meant to make the necessary arrangements to protect himself and his family from life hazards. As to the other citizens, he should not only not cause any harm, but also feel morally concerned to in the case of need and he should be willing to help. It was clear, however, for every person going through an unlucky event, i.e., having no other individual to put the blame on, that the society

(3) For a discussion of the role of altruistic behavior see Romeiro (2000).

(4) This subsection draws on Romeiro (2000).

as a whole could not be responsible for. The victims, whatever the compassion feelings they could inspire, were always supposed to be the only actors of their destiny and to act accordingly by being **provident**.

In 20th century, under the Welfare State, the legal obligations tended to outweigh the moral ones. A set of new social rights evolve out of a growing feeling that each citizen had a sort of general right of being compensated for the damages which resulted from almost all kind of events in their lives. For Ewald (1997), this new way of thinking about the responsibility society as a whole should have for each individual results, in a great extent, from a scientific and technological *utopia* where societies would be endowed with a great capacity of self control, submitting power to knowledge. Through applied science it would be possible to establish a **prevention**[5] policy efficient enough to internalize all kinds of risks. Infectious diseases, crimes, poverty, etc. would be all measurable risks.

This societal evolution induced the emergence of a new institutional framework (social security systems) to make it possible to express the new feelings of social solidarity, based on measurable risks, which were substituted for the individual feelings of moral obligation. The accidents in the working process, for instance, came to be considered as measurable risk factors, not singular events resulting from individuals errors. This notion allows for a new juridical stance establishing the right to be compensated for the fact itself, independently of its causes (i.e. the personal responsibility of the individual involved is not questioned). In this sense the problem of equality has been reformulated in economic terms rather than in moral ones.

In the last quarter of the twentieth century, however, this institutional framework progressively became inadequate to handle with a new set of problems, mainly environmental ones, the nature of which prevented science from measuring the risks involved in. The notion of uncertainty was substituted for the notion of probability, which amounts to the admission of society's incapacity to prevent catastrophic irreversible losses. Science became increasingly questioned for the doubts it raised rather than praised by the solutions it proposed which, in turn, induced society into a search for safety amid scientific uncertainty.

(5) For Ewald (1997) the evolving of the idea of prevention received a burst with Pasteur's discoveries. They make it clear that, in one side, the welfare of each individual was dependent not only on the personal conduct but also on the other ones; on the other side, a prevention policy was possible as science would offers the means (vaccines).

Amid these new societal problems, besides the environmental ones, it is worth mentioning two of them as particularly important and emblematic. They are the medical accidents and the potential of harmful consuming goods (food). Their importance lies in the fact that their nasty consequences became visible and that society came to realize that by their nature it will be very difficult to prevent them from occur again.

The case of aids infected blood in France illustrated the first sort of problem. It shows a very representative drama of modernity (Hermitte, 1997). It is representative because the origin of the disease (a natural and/or a human induced phenomenon associated to the destruction of natural habitats) and its spreading (due to cultural changes sexual practices and to the greater mobility of people which could have induced changes in virus ecology) have aroused scientific and moral controversy and also because of the health authorities' behavior before the scientific controversy about the ecology of the virus inside the human body (period of incubation) and the mechanisms of the virus transmission. Their behavior was characterized by the ambivalent attitude they assumed as they recommended certain new procedures in the blood collecting system (as the selection of blood donors according to their sexual lives records) but, simultaneously, they didn't care for properly enforce them. In almost all countries the health authorities have tried to conceal from people the most pessimist hypothesis about the disease that, unfortunately, was true.

The second problem was the case of the "mad cow" in England. It is also a very illustrating example of problem resulting from the complexity of modern industrial societies. The prevailing economic logic induced the firms in the agribusiness to the search for cost reduction innovations which were apparently justifiable in terms of the prevailing scientific criteria for establishing food safety standards. The case showed in a crystal clear and spectacular way a kind of relation of cause and effect which until so had been very difficult to prove. In the early 60's R. Carson in her "Silent Spring" had already described as a scientific hypothesis a similar kind of relation of cause and effect, namely, the effects of new chemical substances in nature and in human beings, but which one the "agribusiness establishment" has been largely capable of circumscribing and limiting its impact on public opinion and on authorities responsible for food quality.

The precautionary principle emerges, thus, out of this new context in which scientific uncertainty undermines the solidarity principle based on prevention, transforming the moral of individual providence into an ethic of collective action.

The precautionary principle represents an important institutional device for societies to handle with this sort of problems and, specially, with the global environmental ones that have the potential to cause catastrophic irreversible losses but which, in turn, can not be estimated in probabilistic terms. It offers a way to deal with the bargain between real economic costs in the short run and virtual benefits expected from the prevention of uncertain environmental losses in the long run.

### 3.1 The ambivalence of the precautionary principle

The ambivalence of the precautionary principle springs out of the fact that one need in applying it to rely, to a certain extent, on benefit-cost analysis and on scientific expertise that makes it possible; however, it is precisely the acknowledging of the uncertainty related to both of them which has been calling for the application of this principle. A precautionary decision implies considering science and technology in a more distrustful manner compared to the past prevention practices. In a sense it implies introducing "the wolf of irrationality in the "stable" of public decision" (Godard, 1997).

Actually, the precautionary principle lies in the middle of two opposites logic: in one hand, the need to base the public decisions in the scientific assessment of the risks involved in; on the other hand, the recognizing that scientific knowledge frequently is incapable to provide the information in need for substantive rational public decision. As a result, the administrations can be endowed with a discretionary power to make decisions without having to justify them scientifically. And there is no alternative to it because science can take too much time to provide the necessary information. That is the reason why the precautionary action is frequently interpreted as a way to establish the preeminence of political power in the decision making process. Simultaneously, however, it has been observed a growing dependence on technical and scientific expertise to engage a public action, in spite of all its frailties and social constraints.

The case of "greenhouse effect" illustrates the difficulties to apply the precautionary principle. The problems usually attributed to conventional benefit/cost analysis (BCA) - technical difficulties to reveal monetary preferences, collective preferences defined through the aggregation of individual ones, discount rate ambiguities, the use of subjective probability distributions to deal with uncertainty - are strongly increased in a context as that of the "greenhouse effect",

pervaded with non-measurable parameters such as: the non-linearity in the relations between the level of the gas concentration, the rise of temperature and climatic changes; the uncertainty about the social and economic consequences which would be brought about by climate changes; the instability of public opinion, alternating phases of apathy with phases of hyper-sensibility; and, last, but not least, the uncertainties about the costs to reduce emissions.

However, although the rejection of BCA by public opinion was great, specially after the publication of Nordhaus (1991) benefit/cost analysis[6], the need to debate the benefits and the costs of the different options could not be avoided. It means to invite all the stake holders, despite the difficulties, to express in the form of willingness to pay their vision of the problem. So, the BCA could play a role as a language of debate and bargain, providing a frame of references which would render explicit the bases of judgment and preferences of the social actors.

Nevertheless, such a bargain can not produce reasonable results because it offers to social actors the possibility to play with opposite scientific thesis to reinforce their respective strategic positions, which has destructive effects on the collective capacity of the National States to make a deal. So, conventional BCA can not resolve the problem of deciding how much money to spend in the short run to prevent a controversial environmental impact from occurring in a distant future. Hourcade (1997) proposes instead a "sequential approach", in which there is no need to reach the optimal decision for the next hundred years, but only the decisions to be made today which will create the best conditions for those who will decide tomorrow. In other words, it takes into account the flexibility and the value of future information.

A comparison of the behavior of two drivers can illustrate the point: a race driver in a race circuit and a ordinary driver on a mountain road in the winter. The race driver has an objective function, which is the maximization of speed amid uncertainties like the presence or not of oil/sand in a curve, the limits of tires adherence or the behavior of the pilot ahead. But decisions taken are based on his accumulated experience, which confers him a sort of statistical knowledge. In this sense, he would perform an optimization calculation: he chooses for once a path he considers optimum taking into account, implicitly, a probability distribution of uncertain parameters, trusting in his experience to stay within the limits of the possibilities to adapt given by his reflexes.

(6) Nordhaus reckoned in 0,4% of US GNP the cost the rise of 2,5 degrees in earth temperature, which would be inferior to the cost to reduce the emissions.

The ordinary driver "objective function" is to minimize the risk of accident. Differently from the race driver, he doesn't choose a path for once because the risks are very high as he doesn't know if what is going to limit his capabilities to adapt in a curve on a precipice will be a sliding ground or the coming of another car in the opposite sense; the distribution of probabilities is unknown. So, his option will be a sequential process where he seeks to extend the time available to acquire more information and to act accordingly: reduce de speed, breaking slightly and being prepared to break stronger or to re-accelerate a little bit, and so forth. In other words, he acts as to harmonize the car speed with the improving information in a **learning perspective**.

This ordinary driver behavior is the correct analogy to define a precautionary behavior before, for instance, a global environmental problem as the **greenhouse effect**. Science has no definitive responses for a central question: if it is true that the warming of the earth has mainly anthropogenic causes (the controversy on this has not yet finished), what would be the ideal pace of the carbon emission reductions to prevent humanity from a catastrophe?

In a precautionary standing point emissions should be reduced the **most possible**, while waiting for better responses and alternatives from scientific and technical research. However, to define what is the **most possible** (the desirable emissions **scale**) is not easy, as it implies a cost and that cost can not be equally **distributed** among the nations of the world. The Kyoto's Protocol case proves the point. The distribution issue concerns justice, but ultimately depends on nations' bargain power (although NGO's can have a say in favor of the less powerful ones). The decision about the scale is mainly dependent on the level of ecological consciousness of people in the developed world and it can not be taken for granted that a catastrophe will be prevented.

## 4 Final remarks

It is important to emphasize that the response to the question about ***how precautionary*** society should be implies the reintroduction of a benefit-cost analysis in the decision process but which should involve all the stakeholders and not only experts and governments officials. The concept of pos-normal science proposed by Funtowicz & Ravetz (1991), with its enlarged peer communities and extended facts give useful insights of how to deal with this kind of decision process.

In any event, however, the evolving institutions and their efficient use will depend on the corresponding cultural values which in this case are those related to the rise of population ecological consciousness. Those values, in turn, could allow for a much more important role of non-economic constrains on the economic dynamics. As signaled by Gorz (1991), modern societies were born precisely from the abolishing of all the previous non-economic constraints (religious, cultural, esthetical, and social) on the strictly economic rationality. However, the stabilization of global consumption of energy and raw materials as to keep the scale of human activities compatible with the carrying capacity of the planet, runs against the present logic of the capital accumulation and its corresponding life styles.

These life styles are natural resources intensive and they reflect the "ethos" of societies where "possessing" is better than "being" (Sachs, 1993). Ultimately, so, the capacity of modern societies to cope with the threats put by global environmental problems will depend on a radical change of their present cultural values.

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