VI. GEOGRAPHY AND ENVIRONMENT: FROM NATURAL RESOURCES TO NATURAL CAPITAL

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1. Introduction

In this study, I review the literature on geographical space and summarize some of the limitations of regional policy in light of an issue that appears to be essential to any approach involving regional analysis: the environment. The literature on regional development used to explain the welfare of regions on the basis of the stock of "natural endowments." Nowadays these conditions are understood as a particular form of capital (Kn "natural capital") that not only includes the stock of resources but something more complex — in the systemic sense of the term — such as "environmental services" do not necessarily represent the mere sum of existing resources. In other words, I attempt to introduce the issue of environment and sustainable development into regional and urban analysis and I have used a number of boxes to remind readers of basic analytical principles.

This presentation is divided into six sections: this introduction, in which I define space from the point of view of regional economy; the local and the global, in which I establish the spectrum between these extremes and their definition; the regional, in which I explain the analytical debate on regional development; regional systems and sustainable development, in which I outline the problem

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faced by regional analysis due to the introduction of the paradigm of sustainable development; *natural resources or natural capital*, in which I highlight conceptual and methodological differences in the use of these categories, and finally, a section on *conclusions*, in which I propose a methodology for evaluating urban-regional policy within the context of environmental transition.

As Higgins and Savoie point out (1997: 3), it is impossible to understand societies and their economies without analyzing the interdependence and overlapping between space, economic structure and society. Countries and national economies are in fact sets of spaces (regions), each of which has its own economic, social, political and power structures. Consequently, explanations of their economic, social and political performance vary largely as a result of the extent to which these spaces (regions) are integrated as national economic, social, political and administrative systems. When these do not perform satisfactorily as a whole, intervention is required at these regional and local levels, not only at the macro and micro level of the economy.

In this respect, the field of regional economy, which includes regional analysis, development, policy and planning, proves to be an integrating or catalyzing factor for social sciences in general. This was suggested by Isard in 1956 when he proposed his *Methods for Regional Analysis*, which constituted the first text within this trend.

According to Higgins and Savoie (*op. cit.*: 5-6,) space has traditionally been seen from four perspectives:

1) The first regards *geographical space as homogeneous*, whether explicitly or implicitly, but it realizes that there may be a set of spaces or geographical areas showing a stock of different physical and human resources, which creates opportunities for geographical specialization based on absolute or comparative advantages. The theory of international or inter-regional trade is drawn from this (see Krugman and Obstfeld, 1995).

2) The second fails to consider the friction of distance, since it *assumes an instantaneous, cost-free mobility of all the factors involved in production*, yet realizes that the difference in the endowment of factors or resources between regions and specialization as the basis of regional exchange would entail a cost for covering the "distance"
separating these spaces. It is therefore necessary, despite the fact that this affects the economy of analysis, to take into account transport costs and the limited mobility of factors. These considerations appear in the theory of rent from rural (Von Thünen, 1966) and urban land (Alonso, 1964; Mills, 1967; etc.).

3) According to the third perspective, the non-homogeneous distribution of resources requires making decisions about what type of activity is carried out, how and where. These decisions are determined by proximity to the market and resources as well as production and transport costs (Weber, 1909). Nowadays, access to information and technological development are also included in the determinants of population distribution and the location of productive activity (Norton, 2000). This has led to the theory of location (Krugman, 1996), including the Central Place Theory (Christaller, 1966; Lösch, 1954), and the Rank Size Rule (Richardson, 1973; Henderson, 1974) and the hierarchy of urban systems (Berry, 1970).

4) Politico-administrative limits and borders define spatial units such as nation states, states, provinces, municipalities and districts. According to the fourth perspective, these barriers affect decisions concerning trade, monetary, fiscal, price, wage, salary and land use policies. These differences have led to the analysis of policies in sub-national or supranational spaces (such as the European Union) although a great deal remains to be done in the specific analysis of cultural, social and political (even environmental) differences at various scales, ranging from the local to the global.

2. LOCAL AND GLOBAL

These extreme scales represent analytical approaches to Regional Economics or two aspects of the development or evolution of the “new economic geography” (Fujita, Krugman and Venables, 1999: 3). Firstly, it is a methodological issue within the discipline, related to the definition of “place;” secondly, it is the result of the explicit consideration of changes in technology and economic growth possible as a result of the expansion of the world capitalist system (Wallerstein, 1974). These processes have transformed the market and modified the relationship between man and nature, in other words, the value of natural resources and their economic use by society.
On the local scale, Harvey (1996: 207-209) points out that different societies have produced particular ideas about space and time depending on their economic, social and political organization and specific ecological circumstances. And although both concepts are regarded as social constructions, a great deal of confusion remains on the matter. Thus it is accepted that time and space are constituted on the basis of social relations and practices, although it is often said that social relations and practices occur within a pre-constructed spatial-temporal framework, as though the latter were a continent of the former. In fact, it is unclear whether time and space can be treated as though they were separate qualities in the analysis of our being or in the attempts to explain how the world in general operates. In formal aspects, however, both time and space are dealt with separately as explanatory but also as dependent variables (Giddens, 1990; Crosby, 1997). According to Harvey, the concepts of space and time are crucial to almost everything we think and do, the way we see the world that surrounds us and the way we theorize about it. Harvey attempts to find answers on the basis of an extensive, impressive review of the literature by disciplines such as history, geography and anthropology. These last two disciplines, however, have some limitations for regional analysis. This can be summarized by the fact that anthropologists have carried out their studies in particular places on particular human societies and groups yet in doing so, they have failed to place sufficient emphasis on the physical surroundings that support and interact with this social group in particular, nor have they been interested in comparing or finding similarities between one group/place and another. For their part, geographers are aware of the physical environment, but underestimate the social and cultural structures and the political and administrative framework that characterize the social group and define their interactions or relations with the environment.¹

¹ This last issue, involving interaction with the environment, affects the basic principles of the two main branches of geography, physical and human, and attempts to link them. See, for example, Gregory (2000), a recent text on physical geography that systematically deals with human activity and its reciprocal impact on the biophysical and bio-geochemical elements of ecosystems.
For Harvey (op. cit.: 208-209), the concepts of space and time provide the referent for establishing our location and defining our status and position in relation to what happens around us and in the rest of the world. This means that it is impossible, according to Harvey, to discuss space and time without using the term “site” or “place.” There are, he continues, dozens of words (such as environment, locality, locale, neighborhood, region and territory) that describe the generic qualities of a place. Other terms (such as city, town, village, megalopolis) designate particular types of places and still others (household, nucleus, community and nation) evoke powerful connotations of place, making it difficult to discuss one without the other. But place also has broad metaphorical meanings: “the place of art in social life,” “our place in society”, “man’s place in the universe”, which psychologically makes us feel that we belong to something and that we are acknowledged by others. Conversely, it can also express norms to locate people, events and things in an “appropriate” place or subvert these norms by defining new places: “in the margin,” “on the border”, from which one can think and act...

According to Harvey, this profusion of meanings and ambiguity (op. cit.: 118) can prove useful in explaining the processes of “socio-ecological” change that affect: 1) the environment in which we live (air, water, soil and landscapes), 2) the ecosystem that supports life in general (and the environmental services it provides) and 3) the amount and quality of the stock of natural endowments (both renewable and non-renewable) that permit the development of human activity.

At the other extreme is the global scale on which human life takes place on earth. Indeed, global changes affect local matters on a spatial-temporal continuum. Thus, the “socio-ecological” link identified by Harvey has elicited analytical interest in global processes. Regardless of the economic, ideological-cultural (Sklair, 1991: Chap. 5) or psychological impacts it may have on individuals’ quality of life and lifestyle in their immediate surroundings, globalization puts global environmental resources and services at risk. This raises the question of whether the scale achieved by human activities and productive processes is consistent with the decision to make human existence on earth sustainable or with
the need to ensure it without producing unacceptable consequences (Heal, 2000: 169). These processes are expressed, it is worth noting, on different scales through different variables.

3. Regional Issues

In order to explore the changes in economic geography on the regional scale, it is worth summarizing the factors from "real life" which, according to Higgins and Savoie (op. cit.: 7-10), have not been systematically considered by either neoclassical economics or the various Marxist schools:

1) Any society or social group lives in a particular place. Cultures are defined in terms of space, a fact that has not been explicitly recognized by regional economists.

2) These spaces are always geographically smaller than the space of the national state. No country can be regarded as homogeneous enough to be studied as a single culture or social complex.

3) In most countries, interest groups coexist. They differ from each other, and sometimes enter into conflict and occupy different social and political spaces.

4) The social and economic interests of social groups and particular spaces are closely linked to the predominance of economic values and therefore to the structure of the economy. Thus, when people live in a place and are engaged in the same activity or sector, common interests emerge.

5) People develop greater loyalty towards the "place" than towards the activity or sector in which they are engaged. Knowledge of how they should behave in these surroundings creates a sense of belonging in most people that live there. Consequently, there can be no in-

2 Note that this question is different from that raised in The Limits of Growth in 1972: What would happen if population growth continued in an uncontrolled fashion? Although this somewhat resembles other questions that were asked, such as what would the environmental consequences be if economic development continued at its present rate? What can be done to ensure a human economy that will provide enough for everyone and also fit into the physical limits of the planet?, the question was defined in relation to scale, but also to intra- and inter-generational equity when they said "enough for everyone" (Meadows et al., 1992: 19).

3 For an example on the basis of the metropolitan scale, see Graizbord, Aguilar and Rowland (2003).
stantaneous or cost-free mobility or mobility without an emotional burden, even if transport is free or appropriate social or economic infrastructure exists elsewhere. This fact should serve to assess the impact of certain policies, such as those of "work to the workers" or "workers to work" concerning the welfare of a particular population.

6) Most people do not think of welfare in terms of the nation state. Their nationalistic pride changes if they live in a backward place (region) [environment], they or their relatives do not have work and they live in crowded conditions, poverty and have inadequate or non-existent public municipal and social education and health services. The main criterion, then, should be to orient public services towards much smaller spaces (spheres) than the nation-state.

7) As a result of failure in the functioning of the market or flaws in public policy, the market does not operate in the way the theory says it should. An increase in national income will not necessarily guarantee the rapid solution of the economic and social problems of a particular group, sector or region. Thus, the criterion should be ad hoc policies with appropriate measures for each particular case.

8) The harmony of interests in a national economy or society is neither automatic or unlimited. If a group or sector of the economy enjoys prosperity, it may increase its consumption, but if the supply is inefficient and highly protected, as happened during periods of industrialization due to import substitution, then there will be sectors or groups that oppose this protectionist regime and seek to liberalize the economy in a way that will not necessarily benefit all.

9) These conflicts translate into or have a spatial referent. By virtue of the differences in competitive capacity, certain sectors or regions will be better prepared than others to cope with challenges and take advantage of opportunities. Thus there will be sectors, regions and social groups that will either be winners or losers.

10) There will also be some overlapping between the structure of the national economy and regional development. Changes in the occupational and sectoral structure in terms of regional development do not reach all regions or all sectors at the same time. The current fluidity in the location of the world’s economic activity leads to faster and unexpected changes inside a country, which affect regional spaces in more different ways than economic sectors. The same is true of the spread of innovations, since it is impossible to explain what is happening in a country without having an idea of what goes on in its regions. An example of this is the dynamics proposed in Geyer and Kontuly’s (1993) “differentiated urbanization” model.
11) A regional equity policy cannot replace a policy for national economic efficiency, since the two are complementary. Indeed:

a) Countries with a high per capita income tend to display few, small regional differences, whereas those with a low per capita income display sharp disparities between regions.

b) Countries with acute inter-regional differences tend to have high inflation and unfavorable unemployment rates, while those with smaller gaps maintain a favorable combination of inflation and development.

c) Regions with slow growth have greater fluctuations in their economies with shorter periods of growth and longer periods of depression, unlike regions with high growth which maintain stability with long periods of growth.

d) Regional convergence is achieved with growth rates sustained for long periods.

12) There is no evidence of a general tendency towards equilibrium in a market economy in terms of regional balance or in the sense of full employment without inflation. Nor is “accumulative causation” (Myrdal, 1959) which leads economies away from equilibrium by virtue of a disturbance or alteration, empirically evident, either in terms of regional convergence or divergence or any tendency towards equilibrium. What happens instead is a sequence of movements towards or from the point of equilibrium. Indeed, cyclical economic theories depend on this type of alterations, as noted by Krugman (1999: 46-49) and Berry (1991).4

4 After asking whether there are enough reasons to accept a theory of cycles (of long duration), Berry (1991: 128) states that, “technically, there are waves of long duration and cycles because the process is endogenous: the essence of a cycle — he explains — is the internal dynamic that gives rise to repetitions.” He then goes on to report on the extensive empirical evidence of cyclical recurrence in economic growth, but also of other political and even climatic phenomena (ibid: 168-172) which, he speculates, are surprisingly linked. See Graizbord (1995) for an account of metropolitan cycles.
Equilibrium

Equilibrium, a term borrowed from physics, is used to describe a situation in which economic agents or their aggregates such as markets, for example, have no pressure or incentive to alter their economic behavior. In other words, when applied to markets, equilibrium denotes a situation in which the buyers and sellers in the aggregate are satisfied by the combination of prices and amounts bought and sold and therefore are under no pressure to modify their actual behavior... [which usually never actually happens!] (Pearce, 1992: 129-130).

This summary of the experience of evaluating regional policy by Higgins and Savoie is provided by Fujita, Krugman and Venables (op. cit.: 9) on the basis of "two useful [and I would add 'permanent'] questions:"

1) When is a spatial concentration of economic activity sustainable? In other words, under what conditions could the advantages obtained from the economies of agglomeration be sufficient to maintain this concentration? and

2) When, in the absence of spatial concentration, is equilibrium unstable? In other words, under what conditions do slight differences between localities produce a tendency towards greater differences in time, in such a way that the symmetrical equilibrium between two identical localities is destroyed?

These are two analytical questions on spatial economic dynamics: the breaking point and the point at which equilibrium is maintained. In other words, the question about regional development is answered by the possible balance between centripetal forces that promote a spatial concentration of economic activity and centrifugal forces that oppose this concentration, although the former asks whether a situation constitutes an equilibrium and the latter asks whether this equilibrium is stable. The authors expand the meaning of equilibrium using two examples (op. cit.: 9):
1) If we assume a world comprising just two regions, in which the entire manufacturing industry is located in just one of them, in which a worker decides to migrate to the other region and find that his real salary improves, this will mean that the concentration of manufacturing does not constitute a point of equilibrium.

2) If the manufacturing industry is equally divided between the two regions, the movement of a small number of workers from one region to another, which increases or decreases relative salaries in the destination, will mean that the initial symmetrical situation is unstable in the face of minor disturbances.

4. REGIONAL SYSTEMS AND SUSTAINABLE DEVELOPMENT

The discussion on the differences or inequalities in economic development between countries or regions within the framework of the globalized economy is raised in the “Endogenous Growth” or “New Theory of Growth Model” in which technological innovation is endogenously determined by decisions taken by the public and private sectors within the economy and is not exogenous to the system, as assumed in conventional theory. In other words, if investment in the public and private sectors in human capital and innovation is optimal (or at least adequate), then it is possible for an economy to achieve a constant, sustained rate of growth in both production and consumption (Barbier, 1999: 126).

The original question is why do economic growth rates in poor countries as a whole fail to converge with those of rich countries in the long term? The answer is, quite simply, “Poor countries do not achieve high growth rates because they do not manage to generate or use the new technology to take advantage of greater economic opportunities” (Barbier, op. cit.: 126): “the main feature distinguishing a set geographical area [city, region or country] from another is the quality of its public institutions.” Those with the most competent and effective mechanisms for supporting collective interests, particularly those concerning the production of new ideas, will be the most successful. Thus the difficulty of poor countries in achieving economic take-off can be attributed to “failure of politicians” and weak institutions. Indeed, the literature reports that with relatively low levels of initial physical and human capi-
tal, national efforts are less effective at reducing poverty and responding to economic growth (Datt and Ravillon, quoted in Pernia and Quising, 2003: 14).

This is not quite the whole story, however: "in many countries with poor economies, the exploitation and degradation of natural resources — fertile lands, woods, forests, bodies of water and fisheries — contribute to this instability and institutional disturbance. The shortage of resources may cause social conflicts and affect the institutional and political environment required to produce and use new ideas and absorb useful knowledge from the rest of the world" (Barbier, op. cit.: 128) or of traditional communities, I would add! These means that shortage does necessarily limit economic growth although it can directly affect innovative potential. However, endogenous growth theories have not concerned themselves with the contribution of natural resources to economic growth or with the role of innovations in overcoming the shortage of resources. Some economists, though, such as Stiglitz (1974) for example, or environmental economists such as Neher (1990), have explored the effects of scarce resources on economic growth. For example, they use neoclassical growth models such as $Q = KLRe^r$, in other words, aggregate product $Q$ as a function of the stock of physical capital $K$, labor $L$ and resource input $R$, the exponent $r$ being the constant rate of technological progress during a set period $t$. The results of these analyses are optimistic and conclusive (even with high population growth and a limited supply of natural resources): resources can effectively increase in such a way that a sufficient assignment of human capital to innovations ensures that in the long term the exhaustion of resources can be indefinitely postponed, while there is the possibility of achieving an endogenous rate of growth that will enable a level of consumption to be sustained and even indefinitely increased.

According to Barbier (op. cit.: 132) however, we can consider two scenarios in the case of countries or regions that maintain a high rate of exploitation of their resources:

1) One in which the long-term rate of innovation exceeds any adverse effect of shortage of resources, meaning that net innovation proves positive and
2) another in which, as a result of the shortage of resources, long-term effects may affect additional innovations, in other words, disturb technical and social innovation to such an extent that it is nullified (which could, although not necessarily, mean the collapse of the economy).

The national and regional economies caught up in this second scenario would rank below those that were not faced with a shortage of resources or else those that manage to overcome the barriers to innovation.

**Resources and Scarcity**

Generally speaking, a resource is something that is directly or indirectly capable of meeting a human need. For economists, there are three categories: capital, labor and natural resources. Capital refers to the type of resource produced not to be directly consumed but with the purpose of creating or achieving a more efficient production process. Labor includes the productive capacity that mankind possesses in both the physical and mental sense for carrying out its activities and producing goods and services. Natural resources constitute the stock of living or inert materials found in the physical environment that have an identified potential to be used by human beings (Hussen, 2000: 4).

The economy considers that resources for direct consumption undergo modifications but are used as production factors, in other words, as a means for producing objects to satisfy society's needs. This notion is strictly anthropocentric, as Hussen points out (2000: 4), which implies, from this point of view, that they are not regarded as having an intrinsic value or any other value than the economic one defined by human and therefore commercial needs. In addition, however, resources are only of interest to the economy because of their scarcity. Finally, as production factors, resources are used in combination and are or can be, according to Solow (quoted in Hussen, 2000: 5), replaceable. In other words, none of them is considered absolutely essential per se for the production of goods and services, which does not mean that they are not scarce.

This gives rise to basic questions such as what can be done to satisfy mankind's need for goods and services in a world of
scarcity. How does one maximize the set of goods and services available at a given moment? How can we justify rationing limited resources? The answer is in Hussen (2000: 6-7):

"Make decisions and define priorities: choose.

"Consider associated costs (opportunity costs) and therefore sacrifice something to obtain something else.

"Seek efficiency and reduce waste to a minimum by using the best 'technology' possible or available.

"Create rules and social institutions to reduce the conflict caused by the allocation and distribution of scarce resources, the market system being one of the means for achieving this."

5. NATURAL RESOURCES OR NATURAL CAPITAL

Sometimes natural resources such as soil, water, fossil fuels and the natural environment are included in what is called "natural environment" or natural capital (Gilpin, 1996: 33). Natural environment includes: natural parks, biosphere reserves and other spaces for the protection of flora and fauna, coasts and islands, bodies of water (rivers, lakes, marshes and swamps); geological landscape forms, forests, fields or tundra, landscape features of scientific interest (such as limestone sinkholes and cavities) and ecosystems in general; zones showing botanical, geological and geo-morphological evolution; the habitat of endangered species and, finally, any feature that has not been disturbed by human activity or which has aesthetic qualities. These goods are obviously modified over long periods of time and are the result of climate changes, the variation or evolution of flora and fauna and, finally, of human action (Gilpin, 1996: 155-6).

Environmental degradation is said to be due to institutional failures (Swanson, 1996: 4). The importance of institutional development is highlighted in a seminal article by Hardin (1968) which spawned a vast amount of literature that questioned the "tragedy of the commons" or the inexorable tendency to exploit and undermine resources when individuals or firms have free access to them. According to Ostrom (2000), there is a distinction between
free access and resources for common use. The latter achieve sustainability as a result of the development of institutions that express the organization of the social group that ensures that they remain communal property or else agrees on their use on the basis of cooperative principles. At the international level, Young (1997) points out the need and options of mankind to develop intergovernmental systems that will protect global assets from free access, such as, for example, the oceans, atmosphere, poles and, generally speaking, the environmental services provided by nature.

If the aim is to sustain the production of goods and services indefinitely, then it is essential to think in terms of the concept of natural capital, in other words, to accept the idea that one should take advantage of or live off interest rather than touching capital (Gilpin, 1996: 206). This would, however, require also accepting the concept of "strong sustainability," which refuses to accept the fact that any other type of capital (whether physical, economic or human) should substitute or complement natural capital. According to Hackett (2001: 335), strong sustainability optimizes the economy on the basis of ecological and environmental capacity. The latter conditions economic activity, rather than the other way around, which in any case cannot be realistically accepted. Is there an intermediate, acceptable point, therefore, and if so, what is it?

If, as was once the case, regional development were based on "natural endowments" and wealth were based on the stock of resources, the solution would be to rationalize their use and, in this respect, profits would depend on the degree of scarcity. Conventionally, the goods and services produced that use resources that are exhausted or become scarce can be replaced.

However, in the analysis of natural resources (Neher, 1990: 84), the latter are valued as much for their ecological benefits and the amenities they produce as for their exploitation. Thus the value of the stock is considered, together with the flow of goods that it produces. The question then is how to strike a balance between the short-term benefits of the flow generated by the exploitation of the natural environment (which includes renewable and non-renewable resources) and the concomitant, lasting ecological damage to this stock. In formal terms, the social benefit ($U$) is a func-
tion obtained from the resources of the product in the form of ordinary consumption (C) or natural amenities (A), where \( C + A = 1 \) in \( U = U(A, C) \).

The intermittent curve indicates the point at which the functions slope changes from negative to positive. Thus any combination to the left keeps the social benefit at a constant unitary value (Neher, 1990: figure 3.1, 84-85). To the right of dotted line A, more amenities or environmental expense would appear to prevent a level of well-being and quality of life. Thus society may agree to forego some of C while obtaining less A (natural environment). But there is also the question of supply. In other words, the atmosphere has a "natural" capacity to support a given level of consumption C and amenities A, which may be depicted as \( C^*, A^* \) in the graph, representing an optimum combination, although what actually happens is that market economies tend more towards C and enjoy less A than at this point of the \( C^*, A^* \) combination, since A has a surcharge in consumers' preferences in general (Neher, 1990: 86-87). Moreover, it is also likely that an increase in the scale of the economy (i.e. a larger economy) will also make it more acceptable, at least during the first phase, to opt for more environmental amenities.

According to this argument, a richer economy or one with increasing economies of scale \( U>1 \) or that has achieved a high degree of consumption (over \( C_0 \)) would be more willing to sacrifice consumption (C) in order to gain environmental amenities.

At the same time, on the basis of its expectations (opportunity costs), society determines a discount rate that enables it to establish the optimum social rate for exploiting resources. It overlooks the fact, however, that the cost of extraction may increase as the resource is definitively decreased (in the case of non-renewable resources) or that its capacity for recovery over time (in the case of renewable resources) is not the same as the rate at which it is exploited. In this respect, the scale is crucial and the shortage of certain resources may become permanent, since resources cannot be replaced. This is obvious in the services provided by nature, particularly those to which there is free access: the world's climate system and the atmosphere's capacity for absorbing greenhouse gases; the natural carbon sumps; the wealth of flora and
fauna offered by biodiversity; the photosynthetic processes that take advantage of and transform solar energy into food and create oxygen by creating carbohydrates and the bio-geochemical processes, such as chlorophyll production which absorbs solar energy by converting it into chemical energy. Mankind and scientific development are a long way from achieving a satisfactory result and, in any case, without wishing to sound apocalyptic, time does not appear to be on our side.

Neoclassical Economics and Ecological Economics: How Should Sustainability Be Understood?

The idea that an economy can continue to function without natural capital lies behind the notion of discount rate and the effect that this could have on technical progress.
The notion of discount rate refers to people's preferences for present consumption (profit) over future consumption. Thus, people will only be prepared to substitute their present consumption (profit) for future consumption (profit) in return for a "prize" in the form of a discount rate: sacrificing one cent of present consumption requires a reward that exceeds the value of one cent of future consumption. Consequently, future consumption is discounted at a set discount rate indicating the replacement of present consumption by consumption at a later date. The question is, why are discounts given on the future? The answer is that people are short-sighted or there is uncertainty about the future. Individuals are more short-sighted and uncertain than society. Thus, choosing or determining the discount rate is crucial. The individual places less importance on the future, which is more a social and ethical issue, since his decision will affect future generations; a low discount rate favors future generations. However, according to Hartwick-Solow, this is not a serious problem, since the effect of a positive discount rate could be affected by the growth rate of technical progress and therefore it is neither immoral or wrong to use a discount rate, especially if the prize for keeping the sum or stock of different types of capital (physical, human or environmental) is used wisely.

There are, however, six possible reasons for thinking that this rule on sustainability or the optimal (efficient) inter-temporal route has a weak basis (Hussen, 2000: 185-6):

1) It assumes that the capital created by man and natural capital are interchangeable whereas in fact they are complementary...

2) Intergenerational efficiency requires that all goods and services reflect their social value. However, it is not known or else assumed that there is no difficulty in solving the distortions due to externalities...

3) Some economists argue (Perrings, 1991, quoted in Hussen, 2000: 186) that the idea of a positive discount rate is wrong and fails to consider every aspect of the welfare of future generations.

4) The approach adopted by this rule does not take scale explicitly into account, in other words, it does not regard the
size of the human economy in relation to natural ecosystems as something that should be considered.

5) The economic process is conceptualized as something separate from ecological systems, without understanding the complex interactions that exist between the two systems.

It ignores the fact that human activities may cause irreversible damage to the natural environment (and ecosystems) while realizing that there is some uncertainty about the risks that these effects can cause on life support systems and the quality of human life.

Thus, unlike what the Hartwick-Solow approach suggests about sustainability (the probability of substitution and the role of technical progress), an economy as a system will find it difficult to continue operating without natural capital. At least this is the position of the strong ecological economics approach. And this means, on the one hand, considering intergenerational equity and, on the other, keeping natural capital constant, preserving natural resources and defending ecological conditions at any cost.

On the basis of these principles, the policy rules or criteria will be the following, as summarized by Hussen (2000: 188):

1) The rate of exploitation of natural resources cannot exceed the rate or rhythm at which they are regenerated.

2) The emission of residues (pollution) should remain at the same or a lower level than the capacity for absorption of the environment (ecosystem). However, there will be persistent emissions whose rates should be zero, since the ecosystem lacks the capacity to absorb them or else this would require enormous time spans (e.g. DDT, radioactive substances, CFC, etc.).

3) The extraction of non-renewable resources (fossil energy) should be consistent with the development of renewable substitutes. According to Hussen (2000: 1888), this is equivalent — paradoxically enough — to Hartwick's Rule of Substitution.

As one can see, economic considerations are ignored, meaning that the usefulness of this approach for guiding public policies is limited, leaving the problem of sustainability unsolved! And this raises Hussen's question: is sustainable development
a useful term or a vague, qualitatively empty concept? But this leads us to the (intra- and inter-generational) disjunctive with efficiency, meaning that the question of the trade-off between the two remains unresolved.

* Represented by Boulding and his idea of ecological limits; Georgescu-Roegen (1993) and his concept of energy as a limiting factor; and Daly (1996) and his approach involving the economy in a stationary condition.

This is not a discussion of the limits of growth (Meadows et al., 1972). Its importance has been reduced by virtue of the fact that the debate now centers not on how long it will take for resources to be depleted but rather on the effects and implications of their use on regional and global pollution, which in fact varies between countries and regions. The biosphere is regarded as a candidate for conditioning economic growth, rather than the supply of mineral resources and fossil fuels. The methodology used by Meadows' team may have overestimated results and therefore reduced the effect of the message which, it should be noted, was the first to indicate the "finitude" of the earth (Meadows et al., 1974) and its capacity to "accommodate" human activities in an unlimited fashion (Bowers, 1997: 180-181).  

As El Serafy (1991: 168-169) pointed out, capital 6 comprises earth, which is a real asset that enables goods to be produced... and which, according to Marshall (quoted in El Serafy, 1991: 169), constitutes, as Ricardo proposed, an "inherent" and "indestructible" good, even though these qualities of the earth have been modified (i.e. enriched or impoverished) by the work of numerous generations. Hence we can — as El Serafy points out (ibid.: 169) — extend the definition of land to nature as a production

5 The finitude of or limits on exploitation (Turvey, 1954) and the need to regulate their use had already been recognized in the 1950s within the framework of the collapse of the fisheries, a period that also marked the start of the debate on resources for common use (Gordon, 1954). Nevertheless, it was Lotka (1925) who originally formalized the dynamics of populations.

6 An economy's capital is its stock of actual goods that produce goods and services in the future.
factor. In the last analysis, the arguments of this author aim to convince us that an economy's income would be overestimated if national accounts\(^7\) ignored the deterioration of the environment, whether it is conceived of as raw material for the production of goods or as a dump in which we deposit the emissions resulting from production processes.

But what is the appropriate sphere of analysis? Open systems — and regions are defined as such — are characterized as flows that cross their politico-administrative and geographical borders or limits, which are often poorly defined yet crucial if one wishes to analyze the dynamic of regional growth based on this link between economy and ecological systems or natural environment (Isard, 1972, quoted in Braat and Steetskamp, 1991: 270).

Within the context of sustainability of development, time implies inter-temporal negotiations, intergenerational equity and long-term planning and the horizon is arbitrarily defined as a suitable moment in the future or else is regarded as qualitatively infinite. Conversely, space in the range of the biosphere considers global, regional or continental, national and regional systems. The determinants of these spatial delimitations take three forms: the physical properties (natural endowments) of a system; the self-imposed limits (institutional development), and the technological level (the capacity for the complementation or substitution of factors).

Within this analytical framework proposed by Braat and Steetskamp (1991), although we can unconditionally agree to live in a "healthy" planet and pass it on to future generations, it is not easy to decide how to distribute the benefits and burdens internationally, interregionally or locally (Elster, 1992).

In order to demonstrate the difficulties faced by designing environmental policy due to the spatial and sectoral interdependence of

\(^7\) Incorporating the costs of exploiting resources and nature in general or the benefits of protecting is not easy. According to Peskin (1991: 179), conventional national economic accountancy has flaws in the way it measures economic and social performance. It is inconsistent in the way it deals with wealth and ignores variables that could explain economic activity; it has not developed a perfect accounting system for taking into account or appropriately identifying environmental expenditure/profit. One of the reasons that interests us here is the definition of the physical-geographical units of national resources.
the various elements and factors, I include the following proposal by Braat and Steetskamp (1991: 269-288), from a set of strategies for the development of a region (conceived of as an open system):

1) Replace local resources (exploitation of resources) with external resources (import primary goods).  
2) Use renewable energy resources to the limit (extinction) and replace them with alternative external resources.  
3) Provide space facilities (location) and input (water and energy) for activities that import primary goods and export intermediate or final consumption products.  
4) Change the use of a renewable resource from one function to another; forest for obtaining wood → to obtain resin → for recreation, by offering or applying subsidies to achieve this functional transformation.  
5) Shift from extensive to intensive uses in livestock production (and perhaps agricultural production, such as hydroponics).  

These authors realize the interregional and international dependence this would entail, together with the fact that not all regions can export the same resource (or be in a condition to make changes) at the same time. They also consider that by attracting industry that will import primary goods, this industry may generate residues and therefore require processes for the transformation, recycling and disposal of these residues (*ibid.*: 286).

6. Conclusion: Environmental Transition and Urban-Regional Policy

Within the global context and on the basis of comparative studies of regions and nations, it is possible to trace the link between en-

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8 According to Cleveland (1991: 294), the only factor or primary production good that is independent of the economic system is low entropy energy, since it is the only one that an economic system is unable to produce with its production factors: labor, capital and land (natural resources) that are interdependent, internal and intermediate, rather than external, independent or primary. Indeed, all the vital processes on the earth increase entropy, understood as disorder and therefore reproduce the available energy that can be used. This is what is known as the Second Law of Thermodynamics.
Environmental transition and the idea of "compression of space-time" (Harvey, 1996; Marcotullio *et al.*, 2003). These concepts, added to Kondratieff's "cycles of long duration" developed by Berry (1991), suggest a spatial-temporal differentiation of ecological processes with different impacts for countries or regions at different stages of development or different economies (national or regional and even urban-metropolitan) according to their per capita income, as argued by Marcotullio *et al.* (2003) (Figure 2).

Environmental transition or the shift from one environmental condition to another has policy implications. It is defined as a change from a "brown" to "gray" and then "green" agenda (see Figure 3). The first includes, on the local scale and in "backward" countries and regions, aspects such as access to safe drinking water, inappropriate waste and pollution management, overcrowding and congestion, and the degradation and use of vulnerable land. The second implies, in countries and regions immersed in rapid processes of urbanization and industrialization, air pollution problems related to the emissions of certain polluting gasses such as \( \text{SO}_2 \) and suspended particles as well as water pollution from industrial effluents. Finally, on the global scale and in relation to highly developed countries with high per capita income levels and post-industrial economies, the "green" agenda represents the pollution of non-specific sources and very high consumption levels that produce \( \text{CO}_2 \) emissions and generate enormous amounts of residues and persistent chemicals (CFC). The impacts and risks are different and range from the local to the global scale in which the climate change affecting the world ecosystem is expressed.

It is worth noting that there is certainty in some of the risks but uncertainty in others. According to Meadows *et al.* (1992: 127-129), there are three basic uncertainties in the context of climate change: 1) what would the global temperature be without human interference?; 2) what would an Earth with rising temperatures imply for the temperature, wind, currents, precipitation, ecosystems?

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9 Especially in relation to "multiple endogenous causality" (pp. 127-132), which includes a causal link with recurrence over time.

10 Indeed, current advances are linked to the pioneering research work of Mexican Nobel prize winner Mario Molina (Molina and Rowland, 1974; Molina and Molina, 1992).
Figure 2
Experiences of Urban Environmental Transition

The western experience

Traditional risks

Risks related to industrialization

Contemporary risks

Impact of globalization (compression of space-time)

Source: Marcotullio et al. (2003).

Income or time

Environmental risk

Income or time
tems and human economy in each specific place on the earth?, and 3) no-one knows how the various positive and negative feedback responses interact or which of them will dominate (particularly between carbon and energy flows).

The problem at the national level is that, because of the various levels of regional development (20% poor and agricultural; 60% industrial; 20% rich and tertiary or post-industrial), environmental policy should include three agendas. This demands, among other things, more than just “thinking globally and acting locally,” thinking and acting on the appropriate scale and at the same time in all of them, by virtue of the “spatial-temporal compression” that results from globalization.

From the perspective of sustainable development and regional policy, these are the economic and environmental or, in Harvey’s terms, socio-ecological challenges facing the country and its regions in the future, which can already be envisaged.

Source: Elaborated on the basis of Marcotullio et al. (2003).
7. References


