The role of natural capital in regional development

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Abstract

As global climate change becomes scientific reality the role of natural capital in development is getting more and more attention. However, it is clear that the relationship between natural capital and regional development is a relatively neglected area of research.
In our study we analyse both sides of the development-nature relationship. At first we examine what effect growing regional income has on natural capital. The scientific debate regarding the environmental Kuznets curve hypothesis offers a proper frame for this part of our analysis. Afterwards we analyse what role natural capital plays in the economic process and how it influences regional development. Our conclusion is that the topic of regional development should not be considered separately from ecological processes and our present ecologic knowledge should be more precisely integrated into regional development thinking.

Keywords: regional development, natural capital, ecosystem-functions, ecological processes, biodiversity, spatial uncertainty

1. Introduction

Both the notions of (regional) development and sustainability are nowadays among the most popular expressions both in the media and among politicians. However, none of them is a well-defined one. Nor is their relationship. Since the concept of sustainable development was "popularised" by the Bruntland Report [1] it became extensively discussed in the economic development field. By now it is clear that it is extremely difficult to "operationalise" the sustainability-development relationship, but the core of the concept is "to evaluate economic growth in view of its impact on people and nature." [2]

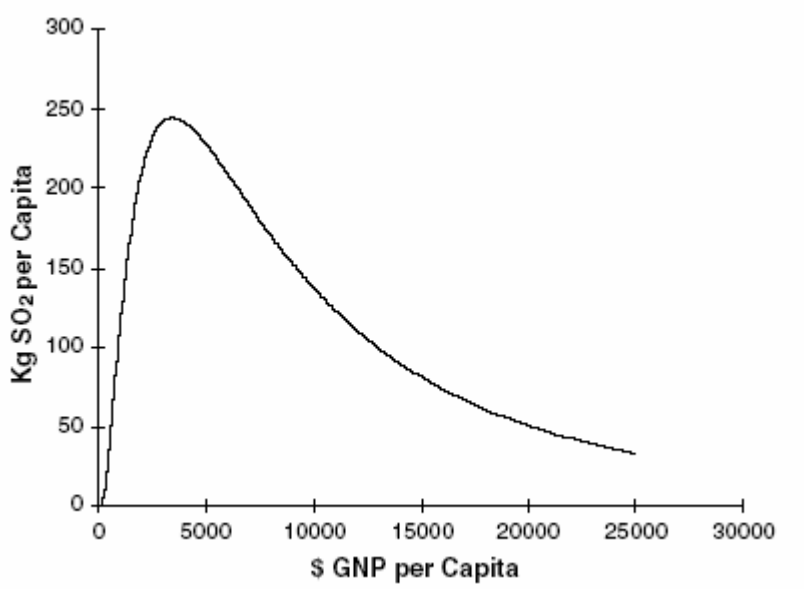
In our study we try to highlight some new - and to our knowledge until now neglected - aspects of the regional development-sustainability relationship. When analysing this relationship we define regional development as growth in per capita regional income. It is quite often emphasized that economic growth and development are not synonyms – see e.g. [2] for the possible distinctions between growth and development. Still, economic growth is considered to be the most important measure of development and it is in the focus on regional development studies – especially compared to other (social and environmental) dimensions of regional development. Something similar can be told in the case of regional competitiveness [3]. In this paper we use them as synonyms since per capita income growth is the most accepted measure of development both among economists and political decision makers. On the other hand we try to conceptualise sustainability through the notion of natural capital [4] that we later define and analyse in detail.

2. The development-sustainability relationship

2.1. The EKC hypothesis

There is a long ongoing scientific debate in economic thinking on the relationship between economic development and the natural environment. The subject of the debate is whether the biosphere sets constraints in front of present and future economic activity [5, 6, 7]. One aspect of this debate is the presence (or possibility) of de-linking human transformation of the biosphere from economic growth, or rather weather economic growth is beneficial for the environment. The most often used method of analysis in the debate is the so-called environmental Kuznets curve hypothesis. This hypothesis "proposes that indicators of environmental degradation first rise, and then fall with increasing income per capita." [8] The theoretical background for that are the scale effect and time effect. While the former is connected to the notion of economies of scale, the latter consists of several different changes, namely structural change, the change in the input- and output-mix and the changes in technology [8, 9, 10]. If the hypothesis is justified it means that de-linking is possible (or is already present) and economic growth (development) may be (or is) in itself beneficial from an environmental aspect.

Figure 1. **Environmental Kuznets curve for sulphur emissions [4]**



2.2. Spatial critique of the hypothesis

Although this hypothesis holds quite strongly among economists and political and business decision makers it is a subject of extensive scientific criticism since its appearance. To give an overall critique of the hypothesis is far beyond the scope of our study, an enormous body of literature deals with it in detail [8, 9, 10, 11, 12, 13]. We only criticize it to the extent which is relevant from the aspect of regional development.

First of all we emphasize that the empirical results are to a high extent determined by the sample used – which differ in the examined countries, spatial scale (county data/average national data) or pollutants. An analysis e.g. on the non-OECD countries showed a turning point at extremely high-income levels while an OECD sample a within sample turning point

[8]. It means that given our present knowledge it seems to be extremely difficult to "quantify" the income-nature relationship. Also, note that we only speak of income-pollutant relationship and not the income-nature one, which are quite different from each other [12] and the latter is even lot more difficult to quantify.

Second, the inverted U-shape relationship was only found (when found at all) in the case of local pollutants (NO_x, SO_2), while at global ones e.g. at carbon dioxide it was not. Neither was an EKC-type relationship found between income and the state of the biosphere or total environmental impact indicators, e.g. total energy use [8] or ecological footprint [14]. Such researches rather found a linear relationship - the increase in income resulted in a proportional increase in environmental impact.

Third, the spatial aspect, i.e. the possible outsourcing of environmental impacts makes the quantification of the income-environment relationship more difficult. The reason for that is that an EKC-type relationship in different regions may be to some extent a result of international trade and its effects on pollution distribution [8, 12]. According to the Hecksher-Ohlin model each country specializes „in the production of goods that are intensive in the factors that they are endowed with in relative abundance: labour and natural resources. The developed countries would specialize in human capital and manufactured capital intensive activities." [8] It means that under free trade pollution is redistributed from the developed to the developing. The process may be reinforced by environmental regulation. E.g. Berlik et al. showed how policy-based inner protection of a national natural resource may lead to resource overexploitation in other regions [15]. Also, some talk about the phenomenon of runaway industries [16] e.g. textile industry, ship industry and metallurgy. These industries of high environmental impact tend to move from developed (high income) to less developed (low income) areas. Such observations led some to form the pollution haven hypothesis, according to which „To the extent that differences in the environmental impact of production processes between domestic and imported commodities can be accounted for, what is important is the changing ratio between domestic consumption and domestic production. Even if domestic production stays the same or increases, if domestic consumption rises faster, then some of the increase in consumption must be met by importing goods (ignoring changes in inventories)… In this case, however, the demand for environmental quality, which is assumed to rise with increased income levels, does not lead to a shift to a cleaner production process in the country where the demand is generated, but rather to a movement of the production process to a location outside of the country." [12] Although the debate on the (spatial) environmental effects of free trade and environmental regulation is by far not conclusive see e.g. [8, 12, 17] a possible outcome is that growing income may result in a less polluted local environment, but not necessarily in a less polluted global one. At first sight this process does not necessarily seems to be a negative one and fits into the theory of the EKC hypothesis. Here the demand for environmental quality (the marginal utility of clean environment relative to that of income) is higher in developed countries than in developing ones so it is possible that everybody is better off through "pollution trade". However, at least two problems emerge. First, it is not clear how developing countries are going to be able to reduce pollution when their demand for clean environment increases with increased income. Since there are not going to be any regions to export pollution they face a new and a lot more difficult challenge than developed countries today [12]. Second – as we are going to point out later – the growing human impact on the biosphere may result in the destruction of natural capital.

The aforementioned critiques highlight the point that even if the emission of certain pollutants at certain areas in a certain time frame is reduced, and even if it is a result of per capita income growth, it does not mean that growth is beneficial for the environment. Rather, the case of total environmental impact indicators and the ongoing deterioration of nature on a global scale [18, 19] foreshadow another tendency. In this case, if natural capital is a non-

substitutable crucial resource in the development process – as we argue in the next section – than short term and long term development may be contradictory goals. Namely, short-term development may undermine the chances of long-term one.

3. Natural capital and regional development

3.1. The role of natural capital in the economic process

In economics „the essence of the concept of capital is that it is a stock that possesses the capacity of giving rise to flows of goods and/or services." [4] Accordingly, natural capital is the stock which produces a flow of services [20, 21] or functions [4, 12] for the economy. We consider it important to not here that the notions of nature, environment, living environment, natural resources and natural capital are often used simultaneously and confusingly in the special literature. Here all of these terms are identical to the former definition of natural capital.

Table 1. **The functions of natural capital, based on [4]**

Source functions	the capacity to supply resources	non-renewable and renewable resources (including e.g. fish stocks and forestry)
Sink functions	the capacity to neutralise wastes, without incurring ecosystem change or damage	capability of the receiving media to disperse, absorb, neutralise and recycle them, without disturbing other functions
Life-support functions	the capacity to sustain ecosystem health and function	ozone layer; climate patterns; capability of the receiving media to disperse, absorb, neutralise and recycle toxic emissions into air, soil and water
Other human health and welfare functions	the capacity to maintain human health and generate human welfare in other ways	capability of the receiving media to disperse, absorb, neutralise and recycle toxic emissions into air, soil and water; landscapes of special human or ecological significance, because of their rarity, aesthetic quality or cultural or spiritual associations

Scientists examining natural capital agree that it provides functions (ecosystem functions) or services (ecosystem services) that are essential for the economic system and for human life (from here on we use ecosystem services and ecosystem functions as synonyms). The ability of natural capital to provide these functions is secured through ecological processes (ecosystem processes) that are maintained by biodiversity. According to Chapin et al. "Ecosystem services are defined as the processes and conditions of natural ecosystems that support human activity and sustain human life." [22] It means that ecosystem functions are only present as a result of ecosystem processes and biodiversity. Different levels of biodiversity are necessary to maintain different functions, but such levels cannot be scientifically determined to our present ecological knowledge [4].

The enormous and still growing human impact on the biosphere (the functioning of the socio-economic system) results in the continuous and even growing damage of biodiversity and ecosystem processes [19, 23, 24] thus threatens different ecosystem services. That is why it becomes an even more serious problem from the aspect of development. The loss of different ecosystem services result in the following problems [25]:

(1) reduced aesthetic quality of the environment;
(2) deterioration of human economic opportunities; and
(3) loss of crucial ecosystem services.

As aforementioned, the different ecosystem functions are based on ecosystem processes. These effects emerge because economy influences the quality of ecosystem processes. To our present knowledge many of these functions cannot be substituted (or at least not at an affordable price) by man-made capital (any human technology) [19, 21, 26]. Thus we can say that ecosystem processes are the direct and indirect sources of any human welfare or economic goods [26]. This means that losing ecosystem services may undermine future development opportunities to a high extent.

From the aforementioned it becomes clear that according to our present knowledge natural capital is a key resource in development. This view of natural capital is getting accepted also in economics. Besides the last IPCC report on global climate change [27] the Stern Review also admits that "climate change threatens the basic elements of life for people around the world - access to water, food production, health, and use of land and the environment" and "estimates that if we don't act, the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year… If a wider range of risks and impacts is taken into account, the estimates of damage could rise to 20% of GDP or more." [28]. Here, it becomes clear that a distinction between short term and long-term development must be made because short-term development processes do seem to undermine the conditions of long term well-being by destroying non-substitutable vital development resources.

3.2. The nature of biosphere change

Several characteristics regarding the transformation of the biosphere are important from the aspect of regional development. First, besides the direct damage of ecosystem functions and loss of ecosystem services the process of human transformation of the biosphere may have longer term and presently non-foreseeable indirect effects through altering ecological processes. As biodiversity is reduced and ecosystem processes change the adaptation potential of ecosystems is also reduced [29, 30, 31, 32]. Furthermore, the change in species diversity changes organismal traits that influence ecosystem processes, thus they result in a change in the biotic and abiotic conditions. This means further adaptation pressure and may lead to further biodiversity change and hence loss, and further loss of adaptation potential. Thus we arrived to a positive feedback loop [22]. Therefore, the effects reducing biodiversity are not only added but also synergic [29], so ecosystem processes are characterised by a high level of inertia and certain processes are irreversible [28].

Second, developing regions are a lot more vulnerable to the effects of biosphere change in the short run than developed ones [27, 28]. However, the concrete effects of the process of global biosphere change are rather uncertain [33, 34]. Concrete, relatively precise, and certain predictions are hardly possible to make, but as biosphere change increases in the long run all regions of the world are to suffer relevant losses in income (see the aforementioned assessment from Stern) [27, 28]. This latter statement is no surprise if we consider the complex aspects of ecological change.

According to these, and as a third consequence of global biosphere change every effects pass on through the whole ecosystem – in the whole biosphere – so it affects every other elements of the system directly or indirectly (e.g. that it is why it is extremely difficult to understand the functioning of the biosphere). Thus, complex interdependencies among the elements of the ecosystem emerge [35, 36, 37] also on a global scale – see e.g. the climatic influence of the change of vegetation [38]. As a result the notion of national or regional boundaries are not definable in the case of ecological problems. The effect is that environmental effects of certain regions' economic activity affect the welfare of other regions (e.g. acid rains, global climate change, and ozone lawyer depletion) and none of the regions is able to cut themselves adrift from the environmental problems caused by other regions.

These facts have several important implications from the aspect of regional development. First, global biosphere change is not a reversible process – it seems that we can not fix these processes in the near future. As the Stern Review diagnosed the 5 to more than 20% loss of GDP is for "each year, now and forever." [28]

Second, we do not have proper knowledge on the regional distribution of the effects of global biosphere change but in the long run each region will lose on the process. If scarcity becomes global the opportunities for the spatial transfer of natural capital fall, ecosystem processes are not transferable spatially at all. Thus the process will have negative effects on the development of the al off the regions – even the presently economically most developed ones. It means that even if there would be an EKC-type relationship – which is at least questionable, as we argued – in a world where most of the population lives under the EKC's turning point [8] growth can easily be counterproductive [12]. So as long as developing regions do not reach the turning point of the EKC they cause more and more environmental harm that undermines the conditions of further development globally. As a result even if regions that are more developed at the present and are even ecologically sustainable lose their development resources on the long run.

4. Conclusion

In our paper we tried to outline three tendencies regarding the regional development-natural capital relationship. First, it seems that present development patterns do undermine the possibilities of long-term development by destroying natural capital essential for economic activity. Second, too much human transformation of the biosphere results in high levels of inertia and uncertainty. Third, none of the regions are able to cut themselves adrift from global environmental effects and thus the (ecological) consequences of other regions economic activity.

These three statements have important implications for both policy and science. In the case of policy it is important that decision makers start to use regional development measurement methods which do include environmental measures. Science may contribute to it by the redefinition and reshaping the measurement of regional development in a way that it includes environmental aspects to an extent as economic ones (for examples see [4, 39]). Second, because of the high level of inertia and uncertainty the precautionary principle should be lifted among top development principles. Research on the better understanding of the concrete role of natural capital in regional development may help this policy goal. And last but not least since regions are unable to cut themselves adrift from the negative effects of global biosphere change the contribution of the regional level to the environmental crisis and its role in the possible solutions worth scientific research.

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