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ANALYSIS

Environmental degradation as engine of undesirable economic growth via self-protection consumption choices[☆]

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ARTICLE DATA

Article history:

Received 17 April 2008

Received in revised form

1 September 2008

Accepted 15 September 2008

Available online 22 October 2008

Keywords:

Substitutes for environmental goods

Environmental defensive expenditures

Undesirable economic growth

Negative externalities

Jel classification:

Q56; Q01

ABSTRACT

We analyze growth dynamics in an economy where the well-being of economic agents depends on three goods: leisure, a free access environmental good and a private good that can be consumed as a substitute for the environmental resource. The processes of production and consumption of the private good by each agent impose negative externalities on other agents through the depletion of the environmental good.

This paper shows that, in such context, the existence of private substitutes for environmental goods may fuel an undesirable economic growth process. This process is driven by the continuous increase in agents' needs for private consumption generated by the progressive reduction in free consumption of the environmental good.

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1. Introduction

The impact on individuals' well-being of environmental deterioration caused by the processes of economic growth in industrialized countries is evident. Less known are some undesired effects of environmental deterioration acting as a factor that conditions individuals' choices. Environmental degradation encourages behavior perceived as rational at an individual level, that is to say capable of increasing personal well-being; however, at an aggregate level, such behavior may lead to a reduction in collective well-being. We can outline the mechanism from which these undesired effects may stem as follows. In order to defend themselves from environmental

degradation, economic agents make self-protection choices by utilizing certain private goods. The production and consumption of such goods further aggravates environmental degradation, and stimulates yet more production and consumption of goods used as a means of self-protection. The result may be a self-enforcing vicious circle that produces undesirable economic growth, in other words economic growth coupled – paradoxically – with a reduction in individuals' well-being.

In this paper, we aim to analyze the possible scenarios that the above-described mechanism may generate. In particular, we study growth dynamics in an economy where only one private good is produced, a good that may be consumed as a substitute for a free access renewable environmental good or to satisfy

[☆] The author would like to thank two anonymous referees of this journal for very useful suggestions and Dr. Paolo Russu for the elaboration of the numerical simulations contained in the paper. The usual caveats apply.

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needs different from those satisfied by the environmental resource. The production and consumption processes of the private good deteriorate the environmental resource; such deterioration (*ceteris paribus*) induces agents to increase their labor input in the production process of the private good, in order to produce and consume it in higher quantities as a substitute for the environmental good. Since economic agents take as exogenously given the aggregate negative impact of economic activity on the environmental good, production of the private good (which is assumed as non-storable) generates negative externalities. However, the production process of the private good generates also positive externalities via technical progress (which is assumed to be a pure public good) generated by a learning-by-doing mechanism of accumulation of knowledge.

In this context, the negative externalities deriving from the substitution process described above may result in better exploitation of positive externalities by agents and drive the economy away from a poverty trap. However, we show also that growth paths may exist along which the (cumulative) effect of positive externalities is unable to counterbalance the effect of negative externalities. In other words, the economy may approach a stationary state characterized by relatively high consumption of private goods and technical progress, which is Pareto-dominated by other stationary states with lower private consumption and technical progress. In this case, economic growth is the consequence of a coordination failure, and the existence of private substitutes for environmental goods generates socially undesirable effects.

The idea that negative externalities deriving from economic growth may *fuel* the growth process through the enforcement of defensive consumption has been discussed in economic literature at least since [Hirsch's famous work \(1976\)](#). The idea that environmental negative externalities can be an engine of undesirable economic growth was first introduced in a mathematical model by [Antoci \(1996\)](#) and [Antoci and Bartolini \(1997\)](#)¹ who analyzed the selection process of labor inputs and of consumption patterns in an evolutionary game context without accumulation of assets. Similar results were obtained by [Bartolini and Bonatti \(2002\)](#) in a neoclassical model without capital accumulation and in [Antoci et al. \(2005a\)](#), where the role played by economic agents' expectations (that can be right or wrong) on the future environmental quality in determining labor input and capital accumulation was studied via a simple two-periods static model.

Finally, [Bartolini and Bonatti \(2003\)](#) and [Antoci et al. \(2005b, 2007a\)](#) have analyzed neoclassical models with perfect foresight and physical capital accumulation². These works focus only on local stability analysis of stationary states due to analytical complexity of the proposed models; differently from these contributions in this research line, our model allows a full description of economic dynamics and an easy comparison between the dynamics with and without substitutability between the environmental and the private goods. Furthermore, it shows that environmental negative externalities can contribute to better exploit the positive externalities generated

by the production process. As a matter of fact, by inducing the agents to work and consume more, negative externalities can accelerate technical progress, leading the economy in some (particularly virtuous) cases on a Pareto-improving path.

In our model and in the above cited literature, a low endowment of natural resources stimulates economic growth. Several recent works (the literature on the *curse of natural resources*) have focused on various mechanisms through which the scarcity of environmental resources may stimulate growth processes (see e.g. [Matsuyama, 1992](#); [Sachs and Warner, 1995, 1999, 2001](#); [Gylfason et al., 1999](#); [Gylfason, 2001](#); [Auty, 2001a,b, 2007](#); [Papyrakis and Gerlagh, 2007](#); [Hodler, 2006](#)). Most current explanations for the *curse of natural resources* have a crowding-out logic: natural resources crowd-out activity *x*; activity *x* drives growth; therefore, natural resources harm growth. For example, [Sachs and Warner \(1995, 1999\)](#) identify *x* with traded-manufacturing activities and the crowding-out mechanism is the following: an increase of natural resources endowment may create an increase of demand for non-traded products driving up their prices. If these non-traded goods are inputs in the production process of traded-goods (e.g. labor), the increase of non-traded goods' prices reduces profits in the traded good sector (which sell its products on international markets at relatively fixed prices). The consequent decline of the traded activities inhibits economic growth. [Matsuyama \(1992\)](#) identifies *x* with the *industrial sector*; in particular, he analyses an economy with two sectors – the agricultural sector and the industrial one – in which the scarcity of natural resources is represented by low productivity in the agricultural sector. Economic agents react to the low productivity of the agricultural sector by increasing labor input within the industrial sector, where an accumulation process of knowledge driven by a learning-by-doing mechanism works³. In these studies, well resource endowed countries have been identified according to per capita land, primary export share or abundance of point resources (mining, oil)⁴ while in our model the environmental good is a pure public good which is a final good and not an input. Furthermore, in the literature on the curse of natural resources, economic growth is always desirable; that is, an increase in the activity level of sector *x* always leads to an increase in the well-being of economic agents. In our model, the development of sector *x* (production of private goods used as substitutes for environmental goods⁵) generates negative externalities which may lead to an undesirable expansion of sector *x*.

The paper is organized as follows. Sections 1 and 2 deal with environmental self-protection choices; in sections 3, 4 and 5 we present the model; in sections 6, 7 and 8 we analyze it. Finally, Section 9 concludes the paper.

³ Matsuyama's model is based on the open economy assumption, that is to say, economic agents can import goods not produced by the domestic agricultural sector.

⁴ Mineral resources and oil can be considered examples of 'point' resources because they are typically characterized by concentrate ownership.

⁵ The possibility of substituting natural resources with an increase of the activity level in sector *x* has essentially been contemplated in many of the theoretical works on the resource curse. For example, in Matsuyama's model the possibility of substitution is made possible by foreign trade, which – through the export of the goods produced in sector *x* and the import of agricultural goods – allows a reduction of the damages generated by the low productivity of the domestic agricultural sector.

¹ See also [Antoci and Bartolini \(2004\)](#) for a further development of these evolutionary models.

² In [Antoci and Bartolini \(1999\)](#) and in [Antoci et al. \(2005c, 2007b\)](#) growth models have been analyzed where economic agents can substitute 'deteriorated' social capital by private goods.

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