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Population growth in polluting industrialization

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ABSTRACT

Recently, many contributions have focused on the relationship between capital level, growth and population dynamics, introducing fertility choice in macro-dynamic models. In this paper, we go one step further highlighting also the link with pollution. We develop a simple overlapping generations model with paternalistic altruism according to wealth and environmental concerns. One can therefore explain a simultaneous increase in capital intensity, population growth and pollution, namely a polluting industrialization. We show in addition that a permanent productivity shock, possibly associated to technological innovations, promotes such a polluting development process, escaping a trap where the economy is relegated to low levels of capital intensity, population growth and pollution.

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1. Introduction

Pollution and its effects persist over time, even after the disappearance of the cause. Therefore, our present actions determine the well-being of future generations. From that, it seems crucial to look at individuals' behavior to understand long-term trends of pollution. Historically, the development of human activities has generated a huge increase in pollution, starting with the industrialization. This

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event represents a break in the effects of mankind on his environment and even the beginning of a new geological era: the *Anthropocene*. This term, coined by [Crutzen and Stoermer \(2000\)](#),¹ describes the current geological epoch where the impacts of human activities on earth and atmosphere are becoming predominant. Still informal, the large diffusion of this expression in the geological literature and its recognition by the Stratigraphic Commission of the Geological Society of London show the importance of the phenomenon and lead us to look into this period of development.²

The awareness of this phenomenon is confirmed by the extensive literature in environmental economics (e.g. [John et al., 1995](#); [Michel and Rotillon, 1995](#); [Jouvet et al., 2000](#) or [Xepapadeas, 2005](#)). Nevertheless, as emphasized by [Brock and Taylor \(2005\)](#), “the relationship between economic growth and the environment is and may always remain controversial”. While some economists see the pollution–income relationship (PIR) as monotonically positive, others consider it as an inverted U-shaped curve, also known as the environmental Kuznets curve (EKC), discovered by [Grossman and Krueger \(1991\)](#) and so-called by [Panayotou \(1995\)](#). According to the second group, the economic growth increases pollution in the early stages of development, but beyond some level of per capita income, the trend reverses, so that at high income levels, economic growth leads to environmental improvement.

Here, we will introduce an important missing dimension inside this debate: the demographic one. Indeed, many papers highlight that population is a key element in the economic development process (e.g. [Ehrlich and Lui, 1997](#); [Galor and Weil, 2000](#) or [De la Croix and Licandro, 2013](#)). Economists have rarely focused on the relationship between population, economic and pollution growth, as underlined by [Robinson and Srinivasan \(1997\)](#) and [Chu and Yu \(2002\)](#). We will study the effect of endogenous population growth *a la* [Barro and Becker \(1989\)](#) on factors accumulation during industrialization, focusing then on the first part of PIR where pollution and economic growth evolve in the same way.

Our motives for focusing on this complex link, at low development levels, stems from several intuitive elements. Concerning growth and population, a positive adjustment of population size to an increase in per capita income was observed empirically during industrialization.³ However, expansion of population has allowed a very important increase in production through a heavy increase in demand and in supply, favoring cumulative growth process ([Bairoch, 1997](#)). Regarding the connections between growth and pollution, we know that the production process often causes environmental damages. Nevertheless, as [Dasgupta \(2003\)](#) reminded, environment is widely seen as a luxury good: when a country is richer, environmental concerns are also stronger. With regard to population and pollution, on one hand, population growth generates *a priori* more pollution and resources depletion. But on the other hand, pollution, affecting well-being, influences reciprocally the demographic behaviors.

The aim of this paper is to develop a simple growth model with endogenous fertility and pollution change allowing to understand the evolution of capital intensity (a proxy of GDP per capita), population growth and pollution, during the process of industrialization.⁴ In order to study the intergenerational aspects, we use an overlapping generations model. As in [Jouvet et al. \(2000\)](#), we consider a model with pollution, where a central role is given to altruism, but we adopt a paternalistic altruism: parents experience a warm glow from leaving bequest to their offspring, *i.e.* joy-of-giving.⁵ As in [Agee and Crocker \(1998\)](#), we assume that parents' decisions for consumption impact the environmental quality that they leave to their children. Nevertheless, instead of studying the interactions of this environmental bequest with the parent's investment in children's human capital, we analyze the interactions with capital bequest which are better suited to the industrialization period (*i.e.* early stages of development). Environmental altruism is considered through the level of pollution that agents deem reasonable to leave to their children with respect to development, meaning that there exists a perception index of pollution adjusted to development. When households anticipate an increase in standard

¹ Crutzen is the Nobel prize winning atmospheric chemist (1995) for discovering the effects of ozone-depleting compounds.

² See [Zalasiewicz et al. \(2008\)](#).

³ This is shown in the study directed by [Wrigley and Schofield \(1981\)](#).

⁴ There is a consensus in literature on the fact that there are two major events in development: industrialization and demographic transition. In this paper, we are only interested in the first process which represents early stages of development.

⁵ This form of altruism is more suitable to study intergenerational externalities than dynastic altruism *a la* [Barro \(1974\)](#).

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