# Environmental policy in an endogenous growth model with human capital and endogenous labor supply

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### Abstract

   This paper analyses environmental fiscal policy within a two-sector endogenous growth model with elastic labor supply. Pollution is modeled as a side product of production. The framework allows us to analyze the consequences of an environmental tax on the economic dynamics. Both transitional dynamics and balanced growth path are computed and the response to an environmental tax change is explored. Short- and long-run welfare costs are also computed. We show that an environmental tax change induces a sharp contrast between short- and long-run effects. The magnitude of this contrast depends on the agents' aptitude to substitute studying time for leisure. © 2002 Elsevier Science B.V. All rights reserved.

## 1. Introduction

   Recent growth theory has made progress in analyzing the dynamic effects of taxes. Until recently, economic models that could offer insight into this question were lacking. The bulk of the growth literature focused on steady states with constant per capita output, whilst those that did consider sustained growth focused on exogenous trends. By definition, such taxation cannot impact on this long-run

exogenous growth path. It is only since the development of endogenous growth theory that a tool has existed for investigating how taxation affects growth. These new models explicitly model the processes through which growth is generated and, by doing so, can trace out the effects of taxation upon the underlying individual decisions. Thus, taxation incidences on growth can be rigorously understood and predicted. This is also true for efficient instruments, such as a Pigouvian tax, that internalize environmental externalities.

How environmental tax affects economic growth is an ambiguous issue. In the simplest endogenous growth model, the *AK* model, the growth effect of environmental policy is negative. This is shown by both Gradus and Smulders (1993) for a centrally planned economy with varying pollution weight in the utility function and Ligthart and van der Ploeg (1994) for a decentralized economy. In the literature on endogenous growth with human capital, it is shown that a tighter environmental policy might have a stimulating growth effect. In a Uzawa-Lucas set-up augmented with an explicit treatment of the environment, Gradus and Smulders (1993) find that the optimal growth rate is independent of environmental care. Only by assuming that pollution also negatively affects the efficiency in the human-capital sector did they detect positive growth effects.

Bovenberg and Smulders (1995) consider a two-sector model consisting of a consumption/capital good and a research and development sector generating knowledge about pollution-augmenting techniques. Since better environmental quality improves factor productivity in the consumption/good sector, positive growth effects of a tighter environmental policy are possible. In a pure human capital variant of the two-sector Lucas model, van Ewijk and van Wijnbergen (1994) also find positive growth effects of a tighter environmental policy by assuming that pollution negatively affects the production process.

Hence, the existing literature can only explain positive growth effects of tighter environmental policy by assuming direct positive productivity effects — positive environmental externalities in production — either in the education or in the consumption/good sector.

In contrast with this conclusion, we show in this paper that, in a two-sector endogenous growth model with leisure, a higher environmental tax might affect the long-run growth rate. The reason for this is as follows. Due to an increased environmental tax, firms increase their abatement activities, which reduces final output net of abatement at the expense of households' consumption. Households substitute education time for leisure time so as to counteract reduced consumption, and this finally boosts growth.[1]

Whereas most endogenous growth models dealing with environmental concerns restrict the analysis to the steady state, little has been said so far on the short-run effects of taxation. There are a few exceptions in the literature. Ligthart and van der Ploeg (1994) derive the transitional dynamics of linear growth model augmented with a renewable environmental resource. By increasing the disutility

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[1] In a similar model, Hettich (1998) shows analytically that changes in leisure may create a link between growth and environment, but he does not study the short-run effects in this structure.