



# On human capital externalities and aggregate fluctuations

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## Abstract

This paper analyzes the specific contribution of the external effects of human capital in explaining labor market fluctuations when Lucas' (1988) endogenous growth model is considered. In particular, this article considers a generalized version of Ozlu's (1996) stochastic human capital investment model with one modification: human capital externalities are included. It is found that hours worked fluctuate considerably more than productivity and that these externalities provide quantitative improvements in the so called *productivity puzzle*, since the correlation between output and productivity and between hours worked and productivity are reduced. These correlation results depend on the stochastic properties of human capital shocks, although the higher the size of the externality, the smaller the shock required. © 2001 Elsevier Science Inc. All rights reserved.

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## 1. Introduction

The contribution of endogenous growth models in explaining the economic growth in the long-run has already been studied by Lucas (1988), Rebelo (1991) and King & Rebelo (1990) among others. They focused their papers on the ability of this kind of models to explain certain observed growth patterns, which the standard exogenous growth model fails to account for.<sup>1</sup> Furthermore, King & Rebelo (1993) have analyzed from a quantitative standpoint how important the transitional dynamics of the basic exogenous growth model are in

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order to explain sustained cross-country differences in growth rates, and have concluded that the diminishing returns to physical capital induce extremely counterfactual implications. As a result, they suggest modeling the engine of growth as an endogenous growth process. Uzawa (1965) and Lucas (1988), among others, suggested human capital as the engine of growth, and the latter analyzed the results obtained when human capital accumulation produces a positive external effect on the final good production function. Moreover, Lucas (1988; 1990) found evidence supporting its existence in order to explain differences across countries in wage levels for equally skilled labor and why capital doesn't flow from rich to poor countries. Einarsson & Marquis (1996) have also found evidence about the magnitude of the externality required for the Lucas' (1988) model to replicate a set of stylized facts concerning the long-run properties in the data; but they suggest a higher value for the externality than the one obtained by Lucas. This kind of external effects have also been used to explain why countries with the same initial conditions differ so much after some years not only in levels, but also in the rate of growth (see Benhabib & Perli (1994); Chamley (1993) and Alonso (1995)).

Most Real Business Cycle models assume a strict exogenous engine of growth. The contribution of different endogenous growth models to this literature has already been analyzed, for instance, by Gomme (1993) and Ozlu (1996) among others, and they show that this assumption may not be innocuous. Moreover, the latter finds that, when allowing human capital accumulation to be stochastic, learning by doing and human capital investment endogenous growth models perform better than the standard exogenous growth model in explaining certain economic fluctuations. However, these authors do not consider the positive external effects above mentioned.

The aim of this paper is to examine the specific contribution of the external effects generated by human capital accumulation in characterizing business cycle regularities. In particular, this article considers a generalized version of Ozlu's (1996) stochastic human capital investment model with one modification: the external effects generated by human capital accumulation are included as suggested by Lucas (1988). Results reveal that the introduction of these external effects provides some quantitative improvements in the results obtained for the labor market. In particular, hours fluctuate considerably more than productivity and we obtain lower correlations between output and productivity as well as between hours worked and productivity even for smaller human capital shocks.

This paper is organized as follows: Section II describes the endogenous growth model considered and defines the competitive equilibrium and the calibration procedure used. In Section III, the solution method used is briefly described and the quantitative results obtained are shown. Finally, Section IV concludes.

## **2. The model**

This paper considers a stochastic version of Lucas' (1988) model in discrete time with one modification: agents do not only derive utility from consumption but also from leisure.

We consider a closed economy, without public sector, with competitive markets, and with identical and rational agents. We assume that the population remains constant. There is a

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