

# Fiscal policy in an endogenous growth model with human capital and heterogenous agents<sup>☆</sup>

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## Abstract

This paper studies effects of fiscal policy in an endogenous growth model with human capital and heterogenous agents. Two types of households are considered. One household acquires human capital or skills through education while the other household remains unskilled. Sustained growth is the result of human capital accumulation which is a function of the existing human capital employed in the educational sector and of public spending for education. Aggregate production is given by a function with physical capital and labor as input factors, where total labor input is modelled by a CES function with skilled and unskilled labor as arguments. The paper studies effects of fiscal policy as concerns long-run growth and the distribution of income as well as concerns welfare of the two households. © 2007 Elsevier B.V. All rights reserved.

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## 1. Introduction

One force of sustained per capita growth in endogenous growth models is human capital. The seminal papers in this respect are the contributions by Uzawa (1965) and by Lucas (1988). While in the model presented by Lucas the representative individual decides how much of his available time is spent for the formation of human capital, the original contribution by Uzawa assumes that human capital is built in an educational sector with labor as the only input factor, which can be interpreted as teaching staff. If one takes the original approach as presented by Uzawa and if one assumes a decentralized economy, the question arises how educational spending is financed. While in the USA private financing of human capital plays the major role, in many European countries most of the expenditures for the formation of human capital are undertaken by the government sector.

In the economics literature one can find both the approach where human capital formation is only financed by the private sector and studies where only the public sector spends resources for the formation of human capital. In addition, there also exist contributions where human capital formation is the result of both public and private expenditures. For example, Glomm

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and Ravikumar (1992) and Blankenau and Simpson (2004) assume that human capital accumulation results from both private and public services. Glomm and Ravikumar present an OLG model with heterogenous agents where human capital accumulation is the result of formal schooling. They demonstrate that public education leads to a faster decline of income inequality whereas private education may lead to higher per-capita incomes. Blankenau and Simpson present an endogenous growth model with both private and public inputs in the process of human capital accumulation. They demonstrate that the response of growth to public education depends on the tax structure, on the level of government spending and on parameters of the production function. However, they do not allow for heterogenous agents but assume homogenous agents.

On the other side, Ni and Wang (1994) and Beauchemin (2001) present models where human capital is the result of public spending alone. Ni and Wang also assume homogenous agents and present an OLG model where human capital is the result of public education which is financed by an income tax. Using calibration exercises they derive that the optimal income tax rate is in the range of 6 to 10%. Beauchemin presents a political-economic OLG model of growth and human capital accumulation where human capital accumulation is the result of public education. The paper demonstrates that a sufficiently rapid population growth may generate economic stagnation. In Greiner (in press) a growth model with public education and public debt is presented and analyzed. There, the question of how public debt and deficits affect human capital formation and economic growth.

An early contribution that studies optimal fiscal policy in an endogenous growth model with human capital and productive public spending is the paper by Corsetti and Roubini (1996). These authors present a general framework where public spending may either enter the production of final goods or the production function of human capital formation. The goal of their paper is to derive optimal tax rates that can replicate the first best optimum. They show that in optimum tax rates are positive so that the externality related rents are taxed away and no public debt is necessary to attain the first-best solution. If there are restrictions as concerns the available tax instruments, the optimal policy may be obtained only if the governments borrows or lends in order to smooth distortions over time.

In this paper we will present an endogenous growth model with human and physical capital where investment in human capital is undertaken by the government, similar to the approach by Corsetti and Roubini (1996). Thus, we will assume that human capital formation is the result of public spending for teachers and of spending for teaching material. However, in contrast to Corsetti and Roubini, we consider an economy with two different types of households. One household supplies skilled labor, due to human capital formation, whereas the other household supplies unskilled labor but benefits from human capital accumulation through spill-over effects. Further, we posit that aggregate production is a function of physical capital and of total labor input, with labor given by a CES function with skilled and unskilled labor as arguments, in contrast to Corsetti and Roubini who consider a Cobb–Douglas production function.

Thus, our paper integrates heterogenous agents in an endogenous growth model, where the government plays an active role by fostering human capital accumulation and by taxing labor and capital income, which has not been done up to now as far as we know. The goal of the paper, then, is to derive growth effects of fiscal policy for the model on the balanced growth path and exemplarily for the model taking into account transition dynamics. In addition, we study effects of fiscal policy as concerns income inequality between the two types of households and we analyze how fiscal policy affects welfare of the households.

As concerns the empirical relevance of human capital, the survey by Krueger and Lindahl (2001) shows that there is strong evidence that education is positively correlated with income growth at the microeconomic level and the positive correlation seems to be quite robust. However, this does not necessarily hold for the macroeconomic level where the findings are more fragile. But this may be due to measurement errors and Krueger and Lindahl demonstrate that cross-country regressions show a positive correlation with economic growth if measurement errors are taken into account. It should also be pointed out that Levine and Renelt (1992) have demonstrated that human capital, measured by the secondary enrollment rate, is a robust variable in growth regressions. Because of that, building endogenous growth models with human capital as the engine of sustained growth is certainly justified.

The rest of the paper is organized as follows. In the next section, we present the structure of our growth model and analyze its dynamics. In Section 3, we derive growth effects of fiscal policy as well as distributional and welfare implications and Section 4, finally, concludes.

## 2. The structure of the growth model

Our economy consists of three sectors: A household sector which receives labor income and income from its saving, a productive sector and the government. First, we describe the productive and the household sector.

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