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Growth effects of fiscal policy in presence of altruism and human capital*

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ABSTRACT. – We analyze the relationship between economic growth and fiscal policy in an overlapping generations economy with joy-of-giving altruism, where endogenous growth is driven by the accumulation of human capital through formal schooling. The government finances public expenditure through labor income taxes and debt. We show that for each public expenditure level there exists a debt level that maximizes the economic growth rate.

Les effets sur la croissance des politiques budgétaires avec présence d'altruisme et du capital humain

RÉSUMÉ. – On analyse la relation entre la croissance économique et les politiques budgétaires dans une économie de générations imbriquées avec altruisme, où la croissance endogéne est menée par l'accumulation du capital humain grâce à la scolarisation. Le gouvernement finance les dépenses publiques avec dette et impôts sur les revenus du travail. On montre comment pour chaque niveau de dépenses publiques existe un niveau de dette qui maximise le taux de croissance économique.

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1 Introduction

The purpose of this paper is to investigate the relationship between economic growth and fiscal policy in an overlapping generations economy with joy-of-giving altruism, where endogenous growth is driven by the accumulation of human capital through formal schooling.

Since the seminal paper of BARRO [1974], which concluded that when individuals are altruistic, bonds have no effect on wealth, the relationship between debt and wealth has bulked large in the economic literature. The discussion has concentrated on the assumptions of the basic dynastic model, *i.e.*, parents derive utility from the utility of their offspring; see, for example, BERNHEIM [1987] for a survey, or LAPAN and ENDERS [1990] and CABALLÉ [1995, 1998] for endogenous fertility decisions and inoperative bequests, respectively. Taken together, however, these papers fail to explain why there are countries with a similar growth rate (and therefore wealth growth rate) but different public expenditure and debt levels.[1]

In this paper, we try to shed some light on the relationship between economic growth and public expenditure and debt levels by using joy-of-giving altruism instead of dynastic altruism. Under joy-of-giving altruism, first analyzed by YAARI [1965] and more recently by GLOMM and RAVIKUMAR [1992] and ECKSTEIN and ZILCHA [1994], among others, parents care about the size of bequests and/or the amount of education they leave to their offspring. In this paper we use both, the amount of education (as in the previous two works) and bequests (as in GALOR and ZEIRA, [1993]) as the joy-of-giving altruistic factors. KOTLIKOFF and SUMMERS [1981, 1986] estimate intergenerational transfers to represent between 45% and 80% of the capital stock held by households in the United States and, therefore, bequests should not be disregarded as a relevant form in which altruism takes place.

Since in our model endogenous growth is driven by the accumulation of human capital, we must specify how education is implemented, *i.e.*, the education system. For GLOMM and RAVIKUMAR [1992] the human capital of an individual is determined by the human capital of her parents and the quality of the school she attends (or, equivalently, the investment in goods made by them). ECKSTEIN and ZILCHA [1994], however, propose that the human capital of the offspring is determined by that of the parents and the percentage of their leisure time that parents devote to their children. In our work we explore a third possibility, which we call the school system: parents hire a person to teach their children (this could also be interpreted as having the parents sacrifice labor time to do the teaching themselves). This school system implies a two sector economy for the production of goods and human capital.

We assume that public expenditure is financed through labor income taxes and debt. We show, in a very simple and stylized model, that for each public expenditure level, there exists a unique debt level and, hence, taxes that maximize the economic growth rate, and therefore an increase in debt may enhance, be neutral or depress growth depending on the magnitude of existing

1. The Belgian public debt case is among the most remarkable.

public expenditure. The rationale is that given a constant level of public expenditure, substituting taxes for debt increases household income, which, in turn, causes education investments to increase. But at the same time, an increase in debt implies a reduction of the productive stock of capital and this affects factor prices and, therefore, household income. When public expenditure is below the level that makes an increase in debt neutral for growth, an increase in debt causes a proportionally large decrease in taxes and low decrease in productive capital, and therefore enhances economic growth. Thus, although the aim of this paper is not to provide a positive theory for debt but rather to indicate how to design a fiscal policy to foster economic growth, we find that bonds may be net wealth (even if funds raised through government borrowing are completely wasted).

The paper is structured as follows. In section 2 we present the basic model. In section 3 we analyze the effects of debt on the growth rate. The last section concludes.

2 The basic model

We construct a two-sector OLG model with constant population, whose mass is normalized to one, and where agents live for three periods. In the first period an individual obtains education from her parents; this education gives her a human capital level h_t. She is endowed with one unit of labor time that will be supplied inelastically in the second period, where she also receives a physical bequest b_t from her parents and has an offspring. Then she decides about consumption in that period c_t, the provision of education (or human capital) of her offspring h_{t+1}, and savings s_t, whose gross returns will be used in the third period for consumption c_{t+1}, and a bequest b_{t+1} to her offspring. Following GLOMM and RAVIKUMAR [1992], GALOR and ZEIRA [1993] or KAGANOVICH and ZILCHA [1999], we assume that the utility of an individual born at $t-1$ is

$$(1)\quad U_{t-1}\left(c_t, c_{t+1}, h_{t+1}, b_{t+1}\right) = \alpha_1 \ln c_t + \alpha_2 \ln c_{t+1} + \alpha_3 \ln h_{t+1} + \alpha_4 \ln b_{t+1},$$

where $\alpha_i > 0 \quad \forall i$ and, whithout loss of generality, we normalize $\sum_{i=1}^{4} \alpha_i = 1$.

The unit of labor time inelastically supplied by an individual at time t becomes h_t efficiency units of labor. Thus, the individual budget constraints are:

$$(2)\qquad c_t + e_t + s_t = b_t + w_t h_t \left(1 - \tau_t\right),$$

$$(3)\qquad s_t \left(1 + r_{t+1}\right) = c_{t+1} + b_{t+1},$$

where e_t is the total expenditure on the education of the offspring, τ_t is a proportional tax on the wage at t, w_t is the wage paid for one efficiency unit of labor at t and r_{t+1} is the interest rate at $t+1$.

The production function is, as in LUCAS [1988], $y_t = F(k_t, l_t) = k_t^{\gamma} l_t^{1-\gamma}$ where $\gamma \in (0,1)$, k_t is physical capital and l_t is measured in efficiency units of labor and is equal to the human capital of the worker times the time she works, *i.e.* $l_t = n_t h_t$ where n_t is the time for which the firm hires her. Physical capital depreciates completely every period. Since firms are able to observe the skill level of each worker and are competitive, factors are paid their marginal products:

$$1 + r_t = \gamma k_t^{\gamma-1} (n_t h_t)^{1-\gamma}, \tag{4}$$

$$w_t = (1-\gamma) k_t^{\gamma} (n_t h_t)^{-\gamma}. \tag{5}$$

We assume a school system of education. As children go to school, the human capital they accumulate depends on the amount of schooling that their parents pay for, *i.e.*, the human capital of the teacher, h_t, and the time she is hired for, $\widehat{n}_t$. In order to generate endogenous growth, we assume, as LUCAS [1988], a linear human capital accumulation technology:

$$h_{t+1} = \theta \widehat{n}_t h_t, \tag{6}$$

where θ is a positive constant. The total expenditure of parents on education is

$$e_t = w_t \widehat{n}_t h_t \tag{7}$$

and is equal to the wage rate times the time she is hired for. Note that since both sectors are competitive, the wage paid to the teachers and to the workers of the goods firms must be the same.

In equilibrium, the amount saved by generation t is equal to the physical capital at $t+1$ plus the government debt at $t+1$, d_{t+1}. Thus,

$$k_{t+1} + d_{t+1} = s_t. \tag{8}$$

Also in equilibrium, the labor market clears, and therefore the time hired by the firm and the time hired by the parent for education must be equal to the supply of labor time of an individual. Thus,

$$\widehat{n}_t + n_t = 1. \tag{9}$$

The government budget constraint is

$$\tau_t w_t h_t + d_{t+1} = G_t + d_t (1 + r_t), \tag{10}$$

where G_t is the public expenditure at t. As the economy is growing, public expenditure is taken as a proportion of any growing variable. For simplicity, we use labor income: $G_t = g_t w_t h_t$ where g_t is a proportion, which is positive and may be larger than one. Also for simplicity, we measure total debt as a proportion of the physical capital: $d_t = \varphi_t k_t$ being φ_t this proportion at t. Therefore equations (8) and (10) become

$$k_{t+1}\left(1+\varphi_{t+1}\right)=s_t, \tag{11}$$

$$w_t h_t\left(\tau_t-g_t\right)=\varphi_t k_t\left(1+r_t\right)-\varphi_{t+1}k_{t+1}. \tag{12}$$

Note that both proportions are in turn proportional to the output.

3 Equilibrium growth rate and debt

The consumer maximizes her utility (1) subject to the budget constraints (2)-(3), the rule of human capital accumulation (6), and the total expenditure of parents on education (7), with b_t, h_t, τ_t, w_t and $\left(1+r_{t+1}\right)$ given. The optimality conditions are:

$$e_t=\alpha_3\left[b_t+w_t h_t\left(1-\tau_t\right)\right], \tag{13}$$

$$b_{t+1}=\alpha_4\left(1+r_{t+1}\right)\left[b_t+w_t h_t\left(1-\tau_t\right)\right]=\frac{\alpha_4}{\alpha_3}e_t\left(1+r_{t+1}\right), \tag{14}$$

$$s_t=\left(\alpha_2+\alpha_4\right)\left[b_t+w_t h_t\left(1-\tau_t\right)\right]=\frac{\alpha_2+\alpha_4}{\alpha_3}e_t. \tag{15}$$

In order to obtain the growth rate, the physical capital market clearing condition (11) along with (15) and (7) yields

$$\left(1+\varphi_{t+1}\right)k_{t+1}=\frac{\alpha_2+\alpha_4}{\alpha_3}w_t h_t \widehat{n}_t. \tag{16}$$

Substituting from (13) for b_{t+1} in (14), after substituting for e_t and e_{t+1} from (7), and using (16), (4) and (5), we have

$$\left[\frac{\widehat{n}_{t+1}}{\alpha_3}-\left(1-\tau_{t+1}\right)\right]\frac{1-\gamma}{\gamma}=\frac{\alpha_4}{\alpha_2+\alpha_4}n_{t+1}\left(1+\varphi_{t+1}\right). \tag{17}$$

Note that in absence of both taxes and debt, equations (17), (6) and (9) would determine directly the human capital growth rate as

$$\Psi_t=\theta\left(\frac{1-\gamma}{\gamma}+\frac{\alpha_4}{\alpha_2+\alpha_4}\right)/\left(\frac{1-\gamma}{\alpha_3\gamma}+\frac{\alpha_4}{\alpha_2+\alpha_4}\right)-1\forall t. \tag{18}$$

On the other hand, with taxes and debt, given a public expenditure and debt levels, taxes are determined by the government budget constraint. Thus, substituting from (16) for k_{t+1} into (12), and using (4) and (5) yields

$$\left(\tau_t-g_t\right)\left(1-\gamma\right)=\varphi_t\gamma n_t-\widehat{n}_t\frac{\varphi_{t+1}}{1+\varphi_{t+1}}\frac{\alpha_2+\alpha_4}{\alpha_3}\left(1-\gamma\right), \tag{19}$$

that can be solved for τ_t. Substituting its value in (17) and using (6) and (9), the human capital growth rate $\Psi_{t+1} = h_{t+1}/h_t - 1$ is

(20)

$$\Psi_{t+1} = \theta \frac{(1-g_t)\dfrac{1-\gamma}{\gamma} - \varphi_t + \dfrac{\alpha_4}{\alpha_2+\alpha_4}(1+\varphi_t)}{\dfrac{1-\gamma}{\alpha_3\gamma} + \dfrac{\alpha_4}{\alpha_2+\alpha_4}(1+\varphi_t) - \left(\varphi_t + \dfrac{\varphi_{t+1}}{1+\varphi_{t+1}}\dfrac{\alpha_2+\alpha_4}{\alpha_3}\dfrac{(1-\gamma)}{\gamma}\right)} - 1.$$

As implied by (5) and (16), Ψ_{t+1} is also the rate of growth of k_t, which in turn implies that production y_t grows also at rate Ψ_{t+1} and, therefore, the model displays no dynamics if the parameters are fixed. In particular, if the government decides to modify the amount of debt outstanding, as $\varphi_t = \varphi_{t+1}$, all variables values jump to their new steady state value. There would only be a transition if the government announced today that the debt level of tomorrow will change.

The next proposition shows the relationship between the public expenditure level and the debt level when the goverment objective is to maximize the steady state economic growth rate.

PROPOSITION: *In steady state, there exists* g^* *such that if* $g \leqslant g^*$ *then* $\frac{\partial \Psi}{\partial \varphi} \geqslant 0$, *and if* $g > g^*$ *then* $\frac{\partial \Psi}{\partial \varphi} < 0$.

PROOF. Differenciating (20) with respect to φ, we have that

$$sign\frac{\partial \Psi}{\partial \varphi} = sign\left\{(1-g)\left[(\alpha_2+\alpha_4)\frac{(1-\gamma)}{\gamma}\frac{1}{(1+\varphi)^2} + \frac{\alpha_2\alpha_3}{\alpha_2+\alpha_4}\right] + \frac{(\alpha_4+\alpha_2\varphi)}{1+\varphi} - \frac{\alpha_2}{\alpha_2+\alpha_4} - \frac{\varphi}{(1+\varphi)^2}(\alpha_2+\alpha_4)\right\} \gtreqless 0$$

$$\text{as } g \lesseqgtr g^* = 1 + \frac{\frac{(\alpha_4+\alpha_2\varphi)}{1+\varphi} - \frac{\alpha_2}{\alpha_2+\alpha_4} - \frac{\varphi}{(1+\varphi)^2}(\alpha_2+\alpha_4)}{(\alpha_2+\alpha_4)\frac{(1-\gamma)}{\gamma}\frac{1}{(1+\varphi)^2} + \frac{\alpha_2\alpha_3}{\alpha_2+\alpha_4}}.$$

Given a constant level of public expenditure, the substitution of taxes for debt increases the income of the individual, who can then devote part of the extra income to increase the expenditure in the education of her children. But at the same time, more debt implies a reduction in the productive capital stock of the economy and a change in factor prices and, therefore, in the household income. When public expenditure is below g^*, an increase in debt causes a proportionally large decrease in taxes and a low decrease in productive capital, and therefore enhances the equilibrium economic growth. Note that as the only role of human capital is to generate growth, the debt effects on growth are in fact level effects. We ilustrate the proposition with the following numerical example, which shows that lower public expenditure levels allow higher debt levels in order to maximize the economic growth rate.

EXAMPLE: Setting $\gamma = 0.4$, $\alpha_1 = 1/3.1$ and $\alpha_2 = \alpha_3 = \alpha_4 = 0.7/3.1$ (this implies that bequests are 50 % of the physical capital; further, as the expenditure in a child includes not only schooling but also consumption, we have fixed it near the consumption of an adult individual) then $g^* = 0.653$ if $\varphi = 0$, $g^* = 0.2$ if $\varphi = 0.4$ and $g^* = 0$ if $\varphi = 0.6$. Note that a monotonic negative relationship exists. The rationale is that when public expenditure is very high, physical capital is very low, and then a higher level of public debt depresses physical capital too much and thus the growth rate decreases. When public expenditure is low, physical capital is very high, and then growth may be enhanced by a higher level of public debt through higher education.

This example also underscores the importance of the existence of bequests for the result. In order to underscore this feature, bequests can be supressed by setting $\alpha_4 = 0$; this results in $g^* < 0$ for all $\varphi > 0$. The rationale is that, as parents may proporcionate only education to their offspring, the government acquires a saving role that was played by the parents when $\alpha_4 > 0$. Thus, eliminating bequests from the model has strong implications on the relationship between debt and economic growth. Indeed, making $\alpha_2 = 0$ we can underscore the importance of the type of saving in the result. In this case we have $g^* = 1/(1-\gamma)$ and $\varphi = +\infty$. A higher public debt increases the resources of the individual dedicated to education and bequests. Consequently the offspring disposes of larger resources whatever the burden of public debt.

The model is very simple and stylized so that policy recommendations can be derived from it. In particular, the convergence criteria of the European Union mandate, which requires a maximum debt level of 60 % of GDP, is a rather arbitrary debt level and more discussion is warranted. Note, for instance, that in the previous example $\gamma = 0.4 = rk/y$, which combined with the convergence criterium $d = 0.6y$ gives $\varphi = d/k = 1.5r$. Assuming that one period in the model corresponds to twenty five years, and that the one-year interest rate is 3 %, $r = 0.0937$ and therefore $g^* = 0.49$. As $1 - \gamma = 0.6 = wh/y$ and $G = gwh$, then $G = 0.294y$. That is, for the current european levels of public expenditure,[2] increasing debt above the specificied convergence criterium of 60% of GDP could cause the economic growth rate to increase.

4 Concluding remarks

This paper attempts to underscore the role of fiscal policy when there is intergenerational financing of human capital. We find that for each public expenditure level, there exists a debt level, and hence taxes, that maximize the economic growth rate, and therefore an increase in debt may enhance, be neutral or depress growth depending on the magnitude of existing public

2. Note that this public expenditure is consumption, *i.e*. waste.

expenditure. When public expenditure is below the level that makes an increase in debt neutral for growth, substituting taxes for debt increases growth because the increase in household income more than offsets the decrease of productive capital and therefore household expenditure in education increases.

Since our economy displays no transition, it seems natural to think that a higher growth rate implies a higher individual welfare. Nevertheless, as we have two generations living at the same time, we would need to know the initial allocation of the economy to determine the welfare implications of a change of the fiscal policy. ▼

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