Growth effects of an unfunded social security system when there is altruism and human capital

Fernando Sánchez-Losada*

Departament de Teoria Econòmica; Universitat de Barcelona and CREB; Av. Diagonal, 690; 08034 Barcelona, Spain

Received 6 January 1999; accepted 3 March 2000

Abstract

We investigate the relationship between growth and an unfunded social security system in an overlapping generations model with joy-of-giving altruism where endogenous growth is driven by the accumulation of human capital. We show that an unfunded social security system financed with a tax on labor income can increase growth. © 2000 Elsevier Science S.A. All rights reserved.

Keywords: Altruism; Growth; Social security

JEL classification: H55; I20; O40

1. Introduction

The purpose of this paper is to investigate the relationship between growth and an unfunded social security system in an overlapping generations model with joy-of-giving altruism where endogenous growth is driven by the accumulation of human capital. We show that an unfunded social security system can increase growth.

The way human capital accumulates has been recently studied by Glomm and Ravikumar (1992), and Eckstein and Zilcha (1994), among others. The firsts authors analyze the case where human capital of an individual is determined by the human capital of his parents and the quality of the school (or investment) he attends. Eckstein and Zilcha (1994) develop a model where human capital of the children is determined by that of the parents and the percentage of their leisure time that parents dedicate to their children. In our work we explore another possibility, that is, education takes place in a school and students learn things in classes. Thus parents hire a person to teach their children, who go to school (it could be interpreted as having the parents sacrifice labor time to do the teaching...
themselves). In the previous two works bequests are omitted and thus altruism only operates through the education given to the offspring. In this paper we also introduce, as Galor and Zeira (1993), bequests as a joy-of-giving altruistic factor. In fact, as Kotlikoff and Summers (1981, 1986) estimate, intergenerational transfers represent between 45% and 80% of the capital stock held by households in the United States. This means that bequests can not be forgotten as an important component of altruism.

In contrast with existing literature, we find that an unfunded social security system financed with a tax on labor income can increase growth. We show that the negative effect (as in Laitner, 1988) or the neutral effect (as in Barro, 1974) of this social security systems are the result of the particular assumption made on altruism, reflected in the dynastic preferences: i.e., parents derive utility from their offspring’s utility. In this paper, we have substituted this by the assumption of joy-of-giving altruism, which implies that parents derive utility directly from giving to their offspring.

Under this assumption, we show that an unfunded social security system can increase growth. The rationale is as follows. In this model there is a trade-off between the accumulation of physical and human capital. Because of the joy-of-giving altruism, it is possible that the share of savings in income is larger than the share of physical capital in output, and if this was the case physical capital would overaccumulate in the sense that decreasing physical capital (and thus increasing human capital) could increase the growth rate of the economy. When this occurs, the establishment of an unfunded social security has two effects. First, the tax rate increase causes savings and physical capital to decrease while, at the same time, education investment increases. Second, the reduction in income due to the tax rate increase reduces the investment in education. The first effect dominates the second when the share of human capital in the production is sufficiently large.

2. The model

We use an overlapping generations model with constant population. Each generation is formed by a continuum of identical individuals, being its measure normalized to one. Agents live for three periods: in the first, they obtain an education from their parents, which endows them with a human capital level. In the second period they have offspring, offer inelastically their one unit of labor endowment time and also receive a bequest (of goods) from their parents. Then they decide the consumption of that period, the provision of education for their offspring and savings. In the third period they distribute the return from their savings between consumption and bequests to their offspring. The utility of an individual born at \( t - 1 \) is

\[
U_{t-1}(C_t, C_{t+1}, h_{t+1}, b_{t+1}) = \alpha_1 \ln C_t + \alpha_2 \ln C_{t+1} + \alpha_3 \ln h_{t+1} + \alpha_4 \ln b_{t+1}
\]

where \( C_t \) is consumption at time \( t \), \( h_{t+1} \) is the human capital of his offspring, \( b_{t+1} \) is the bequest to his offspring and \( \alpha_i \)'s are positive numbers.

The human capital causes the unit of labor time inelastically supplied by an individual at \( t \), to be converted into \( h_t \) efficiency units of labor. Thus, the individual constraints are:

\[
C_t + e_t + S_t = b_t + w_h h_t (1 - \tau), \tag{1}
\]

\[
C_{t+1} + b_{t+1} = T_{t+1} + S_t (1 + r_{t+1}), \tag{2}
\]

where \( h_t \) is the human capital of the individual, \( e_t \) is the total expenditure on the education of the
offspring, \( b_t \) is the bequest inherited from the parent, \( S_t \) is the saving, \( w_t \) is the wage paid for one efficiency unit of labor at \( t \), \( \tau_t \) is the proportional tax on wages used by the government to finance the unfunded social security program, \( T_{t+1} \) is the social security benefit given to each old person at \( t + 1 \) and \( r_{t+1} \) is the interest rate at \( t + 1 \).

As children must go to school, human capital they accumulate depends on the classes that parents pay for. Therefore the human capital of the offspring depends on the time they attend classes and the human capital of the teachers. We assume, in order to generate endogenous growth as Glomm and Ravikumar (1992), a linear human capital accumulation technology:

\[
    h_{t+1} = \theta \hat{N}_t h_t,
\]

where \( \theta \) is a positive constant. The total expenditure of parents on education is

\[
    e_t = w_t \hat{N}_t h_t
\]

and is equal to the wage paid to a teacher whose human capital is \( h_t \), times the time he is hired for, \( \hat{N}_t \).

The consumer maximizes his utility subject to the budget constraints (1), (2), the rule of human capital accumulation (3) and the total expenditure of parents on education (4), with \( b_t, h_t, T_{t+1}, \tau_t, w_t \) and \( (1 + r_{t+1}) \) given. The optimality conditions are:

\[
    e_t = \frac{\alpha_3}{\alpha} \left[ b_t + w_t h_t (1 - \tau_t) + \frac{T_{t+1}}{1 + r_{t+1}} \right],
\]

\[
    b_{t+1} = \frac{\alpha_4}{\alpha_3} e_t (1 + r_{t+1}),
\]

\[
    S_t = \frac{\alpha_2 + \alpha_4}{\alpha_3} e_t - \frac{T_{t+1}}{1 + r_{t+1}},
\]

where \( \alpha = \alpha_1 + \alpha_2 + \alpha_3 + \alpha_4 \).

The production function is

\[
    Y_t = F(K_t, L_t) = K_t^\gamma L_t^{1-\gamma}
\]

where \( \gamma \in (0, 1) \) and \( L_t \) is the efficient labor and is equal to the human capital of the worker times the time the labourer works, i.e. \( L_t = N_t h_t \), where \( N_t \) is the time for which the firm hires the worker. From the maximization problem of the firm we have that factors are paid their marginal products:

\[
    1 + r_t = \gamma K_t^{\gamma-1} (N_t h_t)^{1-\gamma},
\]

\[
    w_t = (1 - \gamma) K_t^{\gamma} (N_t h_t)^{-\gamma}.
\]

In equilibrium, the amount saved by generation \( t \) is equal to the physical capital at \( t + 1 \). Thus,

\[
    K_{t+1} = S_t.
\]

Also in equilibrium, the labor market clears. 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,

\[
    \hat{N}_t + N_t = 1.
\]
The unfunded social security government budget constraint is \( w_t h_t \tau = T_t \).

In order to obtain the growth rate, the physical capital market clearing condition (10) along with the government budget constraint, (7), (8), (9) and (4) gives

\[
K_{t+1} = \frac{\alpha_2 + \alpha_4}{\alpha_3} \frac{\gamma N_{t+1}}{\gamma N_t + (1 - \gamma) t_{t+1}} (w_t h_t) \tag{12}
\]

Substituting from (5) for \( b_{t+1} \) in (6), after substituting for \( e_t \) and \( e_{t+1} \) from (4), using the government budget constraint, (8) and (9) and afterwards (12) and (12) one period forward and (11), we obtain, fixing \( \tau = \tau \) for all \( i \), evaluating at the steady-state and using (3), the growth rate of the economy \( g \):

\[
g = \theta \frac{2 \gamma^2 A + 2 \gamma (1 - \gamma) A \tau + \gamma (1 - \gamma) B + (1 - \gamma)^2 C \tau + \gamma (1 - \gamma)(1 - \tau) - \sqrt{D}}{2 \gamma A + (1 - \gamma) B} \tag{13}
\]

where \( A = \alpha_3 / \alpha_2 + \alpha_4, \ B = \alpha / \alpha_3, \ C = \alpha_1 + \alpha_3 / \alpha_4 \) and \( D = B^2 \gamma^2 (1 - \gamma)^2 + \gamma^2 (1 - \gamma)^2 (1 - \tau)^2 + C^2 (1 - \gamma)^2 \tau^2 + 2BC \gamma (1 - \gamma)^2 \tau + 2C \gamma (1 - \gamma)^3 \tau^2 - 4A(B - C) \gamma (1 - \gamma)^3 \tau^2 - 4B \gamma (1 - \gamma)^3 \tau (1 - \tau) - 2B \gamma^2 (1 - \gamma)^2 (1 - \tau) - 4A(B - C) \gamma^2 (1 - \gamma)^2 \tau^2.

The next proposition shows when an unfunded social security system may enhance growth.

**Proposition 2.1.** If \( \gamma \leq \hat{\gamma} = (\alpha_2 + \alpha_4)^2 / \alpha_3 (\alpha_1 + 2 \alpha_2 + 2 \alpha_3) \) then \( d g / d \tau \big|_{\tau = 0} = 0 \). And, if \( \gamma > \hat{\gamma} = (\alpha_2 + \alpha_4)^2 / \alpha_3 (\alpha_1 + 2 \alpha_2 + 2 \alpha_3) \) then \( d g / d \tau \big|_{\tau = 0} < 0 \).

**Proof.** Differentiating (13) with respect to \( \tau \) we have that for \( \hat{\tau} \) to be a maximum of \( g \), then \( d g / d \tau \big|_{\tau = 0} = 0 \); from that, we have \( - \gamma + 2 \gamma A + (1 - \gamma) C - 1 / \sqrt{D} \big|_{\tau = \hat{\tau}} [ (1 - \gamma)^2 \hat{\tau}^2 + \gamma (1 - \gamma)^2 (C(B + 1 - 2 \hat{\tau}) + B(4 \hat{\tau} - 2) - 4A(B - C) \hat{\tau}) + \gamma^2 (1 - \gamma)[B - (1 - \hat{\tau}) - 2A(B - C)]] = 0 \). Evaluating this condition at \( \tau = 0 \) we obtain the conditions stated in the proposition. \( \square \)

Note that any increase in the tax rate reduces the accumulation of physical capital but it may increase the accumulation of human capital as noted earlier in the introduction. Therefore, in this model, an increase in the tax rate may have a positive effect on growth when the share of human capital in the production is sufficiently large. We illustrate Proposition 2.1. with the following example.

**Example 2.2.** Setting \( \alpha_1 = 1, \ \alpha_3 = \alpha_4 = \alpha_2 = 0.7 \) (then bequests are 50% of the physical capital; as the expenditure in a child not only includes schooling, we have fixed it near the consumption of an adult individual) then \( \hat{\gamma} = 0.737 \), and with \( \gamma = 0.4 \) then \( \hat{\tau} = 0.278 \).

3. Concluding remarks

We have shown that an unfunded system could lead to a higher growth rate than a funded system in an economy where parents are joy-of-giving altruists and hire teachers for the education of their

\[\text{children.}\]

\[\text{We have two roots, but we may eliminate one because if we evaluate this solution at } \tau = 0, \text{ then } \hat{N} = 1, \text{ which is not optimal for the consumer problem.}\]
offspring. The effect of unfunded social security depends on the proportional tax on labor income used to pay for the unfunded social security system.

Acknowledgements

I am very grateful to Jordi Caballé, Omar Licandro, Valeri Sorolla, Juan Carlos Conesa, Patricio García-Mínguez, Carles Solà, Víctor M. Montuenga, Javier Coto, Howard Petith, Deirdre Herrick, José M. Ramos and an anonymous referee for helpful suggestions, and specially to Carlos Garriga and Xavier Raurich. Financial support from the Spanish Ministry of Education through FPI-AP93 grant and CICYT grant SEC96-1011-CO2-02 is gratefully acknowledged.

References