Education Subsidy, Fertility, and Growth*

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Abstract

In this paper, we show that replacing a public-education regime by a private regime with public subsidization of education, causes agents to completely internalize the effect, on their offspring education, of their fertility decisions. As a result, fertility is lower compared to a public regime, while growth is enhanced. (*JEL*: H20)

Keywords: Education subsidy; Fertility; growth; Income tax.

1 Introduction

Empirical studies in the population and growth literature have long warned that failure by policymakers to consider the interactions between fertility and growth, can result in inefficient policies. Recently, the literature on the economics of education has acknowledged the role played by individuals' fertility decisions in the understanding of the growth effects of public investment in education (e.g. Zhang and Casagrande, 1998). In this paper, we use a simple stylized endogenous growth model to compare the growth performance of three education regimes: a public regime, a private regime with public subsidization of education, and a purely private regime. The conclusions reached by our model differ from those obtained in related models that do not consider individuals' fertility behavior (e.g. Glomm, 1997).

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Our model differs from Zhang and Casagrande's (1998) in that, to establish the superiority of a private regime with education subsidies, we do not resort to more than one fiscal instrument (only a proportional income tax is considered), nor do we rely on an infinitely-lived-dynasty specification of preferences. The model is presented in section 2. Concluding remarks in section 3 close the paper.

2 The Setting

There is a single consumption good. This good can be used for either consumption or investment in human capital, and is produced using human capital (H) according to a production function described by $Y_t = H_t$, where Y_t ($t = 0, 1, ...$) is the output of the representative firm. Output is the *numéraire* and its price is normalized to unity.

In each period t, two generations of agents are alive. A typical agent lives for two periods, has one parent, and n identical children, which creates inter-generational links. When young, a typical agent makes no decisions. When old, (s)he has preferences over family consumption (c_t), the number of children (n_t) that (s)he wants to raise, and each child's human capital (h_{t+1}). We specialize the utility function representing these preferences to

$$u_t = \ln c_t + \log h_{t+1} + \gamma \log n_t \tag{1}$$

all t ($t = 0, 1, ...$), where $\gamma > 0$.

All agents are endowed with one unit of non-leisure time. When old, a typical agent allocates a fraction ϑn_t of her/his unit of time to child-rearing, and the remaining fraction $(1 - \vartheta n_t)$ to labor activities, as in Zhang and Casagrande (1998), where $0 < \vartheta < 1$. When young, a typical agent obtains human capital by attending school, and how much (s)he gets depends upon her/his parent's human capital (h_t) and the school quality (e_t) measured in units of the unique consumption goods. This human capital is described by

$$h_{t+1} = \theta e_t^{\alpha} h_t^{1-\alpha}, \tag{2}$$

where $0 < \alpha < 1$. The family budget constraint thus is $c_t \leq (1 - \tau_t)(1 - \vartheta n_t)h_t - (1 - s_t)n_t e_t$, where c_t denotes family consumption at date t; τ_t is the proportional tax rate supporting public financing of education; s_t is the date t subsidy rate, with $0 \leq s_t \leq 1$; and $s_t e_t = \tau_t(1 - \tau_t)(1 - \vartheta n_t)h_t n_t^{-1}$ denotes the per child education subsidy, implying a balanced government budget under distortionary taxation with convex collection costs, as in Perotti (1993). Note that $s_t = 0$ means that education is privately financed, while $s_t = 1$ means it is publicly provided. And as long as $0 < s_t < 1$, private expenditure on education is subsidized.

Economy-wide resource constraints are given by $H_t \leq (1-\vartheta n_t)h_t N_t$ and $N_t\left[c_t + (1-s_t)e_t n_t\right] + E_t^g \leq Y_t$, where N_t is the date t total number of adult agents, $E_t^g = \tau_t(1-\vartheta n_t)h_t N_t$, denotes the total tax revenue collected. Next, we compare the performance of three education regimes: a public-education regime (denoted by f, for "free"); a private regime with education subsidies (denoted s); and a purely private regime(denoted by p). The variables of interest are n^j and g^j denoting, respectively, the fertility rate and the growth rate under regime j ($j = f, s, p$). The characterization of these variables is the focus of the following two sub-sections.

2.1 Public-Education Regime

In this regime, $s_t = 1$, and the per child education expenditure is exogenously given by $e_t = \tau_t(1-\tau_t)(1-\vartheta n_t)h_t n_t^{-1}$. A *competitive equilibrium* for this public-education economy is a sequence of allocation-production plans $\{(c_t, n_t)\,; H_t\}_{t=0,1,\ldots}$ such that for all t, and given h_0, N_0 and τ_t, (c_t, n_t) solves (1) subject to the budget constraint; H_t maximizes the representative firm's profit; $h_{t+1} = \theta e_t^{\alpha} h_t^{1-\alpha}$, and $N_{t+1} = n_t N_t$; and all markets clear.

Upon substitution of the budget constraint into (1) using $s_t = 1$, a typical old agent's problem reduces to

$$\max_{\langle n_t \rangle} \left\{ \ln\left[(1-\tau_t)(1-\vartheta n_t)h_t\right] + \log h_{t+1} + \gamma \log n_t \right\}.$$

The first order conditions for the optimal choice of fertility rate lead to $n_t^f = \gamma\left[\vartheta(1+\gamma)\right]^{-1}$. Define $g^f = h_{t+1}h_t^{-1}$, the (gross) growth rate of the economy under a public-education regime. Substituting in $e_t = \tau_t(1-\tau_t)(1-\vartheta n_t)h_t n_t^{-1}$ and $n_t^f = \gamma\left[\vartheta(1+\gamma)\right]^{-1}$ using eq.(2) yields $g^f = \theta\left(\gamma^{-1}\vartheta\tau_t(1-\tau_t)\right)$. Obviuosly, growth is higher, the higher the tax rate supporting public education.

2.2 Private Regime with and without Subsidy

In this section we consider the case where $0 \leq s_t < 1$, and agents choose the level of per child expenditure on education (e_t) as well as their fertility rate (n_t). In this environment, balanced government budget implies $s_t = \tau_t(1-\tau_t)(1-\vartheta n_t)h_t\left(e_t n_t\right)^{-1}$. A *competitive equilibrium* for this private-education economy is a sequence of allocation-production plans $\{(c_t, e_t, h_{t+1}, n_t)\,; H_t\}_{t=0,1,\ldots}$ such that for all t, and given h_0, N_0 and τ_t, (c_t, e_t, h_{t+1}, n_t) solves (1) subject to (2) and the budget constraint; H_t maximizes the representative firm's profit; $h_{t+1} = \theta e_t^{\alpha} h_t^{1-\alpha}$, and $N_{t+1} = n_t N_t$; and all markets clear. After substitution, the old agent's maximization problem reduces to

$$\max_{\langle e_t, n_t \rangle} \left\{ \ln \left[(1-\tau_t)(1-\vartheta n_t) h_t - (1-s_t) n_t e_t \right] + \log \theta e_t^{\alpha} h_t^{1-\alpha} + \gamma \log n_t \right\}$$

The first order conditions for the optimal choice of e_t and n_t are

$$\begin{aligned} -n_t(1-s_t) \left[(1-\tau_t)(1-\vartheta n_t) h_t - (1-s_t) n_t e_t \right]^{-1} + \alpha e_t^{-1} &= 0 \\ -\left[\vartheta (1-\tau_t) h_t + (1-s_t) e_t \right] \left[(1-\tau_t)(1-\vartheta n_t) h_t - (1-s_t) n_t e_t \right]^{-1} + \gamma n_t^{-1} &= 0. \end{aligned}$$

Agents in this environment do not have any children unless $\gamma > \alpha$.[1] Assuming that $\gamma > \alpha$, and given the level of s_t, the policy rules that solve the above system of equations are $e_t = \alpha \left[(\gamma - \alpha)(1-s_t) \right]^{-1} \vartheta (1-\tau_t) h_t$ and $n_t = (\gamma - \alpha) \left[\vartheta (1+\gamma) \right]^{-1}$. Observe that whether or not there is subsidization of education does not affect agents' fertility choices, as in Zhang and Casagrande (1998). As a result, $n_t^s = n_t^p = n_t^*$. However, since $\alpha > 0$, $n_t^f > n_t^*$, implying that the fertiltity rate is higher under a public education regime than under a private regime, with or without education subsidies. Furthermore, using the policy rules and the definition of s_t, the growth rate of the economy when $0 \leq s_t < 1$ is

$$g^j = \begin{cases} \bar{\theta} \left[\alpha^{-1} (1-\tau_t) \left(\alpha + \tau_t (1+\alpha) \right) \right]^{\alpha} & \text{if } j = s \\ \bar{\theta} & \text{if } j = p, \end{cases}$$

where $\bar{\theta} = \theta \left[\alpha \vartheta (\gamma - \alpha)^{-1} \right]^{\alpha}$. It is straightforward to see that as long as $\tau_t < (1+\alpha)^{-1}$, $g^s > g^p$, implying that an education subsidy financed by a (distortionary) income tax enhances growth. And for appropriately chosen α and γ[2], $g^p > g^f$, implying that a private education regime with or without education subsidies outperforms a public regime, contrary to what is found in Glomm (1997).

3 Concluding Remarks

In this note, we showed that public provision of education, when financed by a distortionary income tax, causes altruistic agents to raise their fertility

[1] Note that since $0 < \alpha < 1$, $\gamma \leq \alpha$ includes the case where parents' preference bias towards quality relative to quantity of offspring is too strong.

[2] In particular, γ can be chosen to be sufficiently close to α, implying that parents,in this environment, have a stronger preference bias towards quality relative to quantity of offspring. This scenario is consistent with the demographic transition observed in most advanced industrialized countries.

rate relative to its level under a private-education regime. We also showed that replacing a public-education regime by a private regime with public subsidization of education, causes agents to completely internalize the effect, on their offspring education, of their fertility decisions. As a result, fertility is lower compared to a public education regime, while growth is enhanced.

References

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