E C O N O M I C S B U L L E T I N

Public versus Private Education in an Endogenous Growth Model with Social Status

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Abstract

This paper investigates which of publicly financed education or privately financed education is favorable for growth in an economy where development of new technology by specialists is the engine of growth and social rewards are bestowed upon growth enhancing activities. We show that when one quests for social status, the privately financed education could improve the allocation of human resource and the growth rate could become higher in the private finance regime than in the public finance regime.

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1. Introduction

Economic research shows that the importance of public education lies mainly in two salient effects. First, because public education engenders re-distributional effects, analyses focus upon investigation of how the externality caused by redistribution affects economic welfare and the growth.[1] Secondly, the leading role that the public sector plays in development of human capital has attracted researchers including Turnovosky (1996) and Capolupo (2000). They argue that the growth rate becomes higher if tax revenues are used to finance productivity-augmenting expenditures. This paper also focuses on the matter of efficiency of publicly financed education in developing human capital.[2]

In general, technological deepening is attributable to R&D of new technologies and to the diffusion of existing technologies, as suggested by Romer (1988) and others. Consequently, the necessity of developing new technologies implies that R&D activities are usually conducted by specialists whose skills require some aptitude. For that reason, technological developments and economic growth are regulated by the allocation of human resources for technology-improving professions. Excellent work of Fershtman, Murphy and Weiss (1996) (henceforth, FMW) specifically addresses the problem of allocation of human resources in an economy where social rewards are bestowed upon growth-enhancing activities. That study further analyzes distorting effects of emphasizing social status on growth. In their analysis, however, the cost of education to participate in growth enhancing professions is neglected for simplicity.

Introducing the cost of education into FMW allows evaluation of efficiency in terms of the growth rates for publicly financed and privately financed education. Comparison of incentive constraints between two regimes shows that the growth rate could become higher in a private finance regime.[3] The reason is that private cost dissuades *wrong* agents from participating in growth enhancing activities. The allocation of human resources is thereby improvable. This paper is organized as follows. Section 2 presents the basic model. In section 3, we compare the efficiency in technological development between

[1] See, for example, Glomm and Ravikumar (1992) and Gradstein and Justman (1996). Tanaka (2004) analyzes an economy in which agents have gains from the externality of public education and from co-existence of public and private education.

[2] The literature related to education and growth is vast: see, for example Benabou (2004), Benhabib and Spiegel (2002) and Hornstein, Krusell and Violante (2004), for comprehensive surveys of the literature.

[3] As a whole, our approach seems to be similar to that of Krueger and Kumar (2003, 2004) in which heterogeneous agents make educational choices. Individual choices according to government educational policies determine the growth rate of the aggregate economy.

the public and private education. Section 4 concludes the paper.

2. The Model

The basic setup of our model follows FMW. There are, however, differences between FMW and our study in two respects: we introduce the cost of education and assume that agents consume only in the latter half of their lives in an OLG framework.

The model is a two-period OLG model populated by heterogeneous agents. The size of the cohort of each generation is N. Heterogeneity is represented as two aspects: the innate ability μ and the share of claim for excess profit θ. Characteristics of agents are determined by drawing a parameter set (μ, θ) from the invariant joint distribution $F(\mu, \theta)$ for every generation.[4] $f(\mu, \theta)$ denotes the density of $F(\mu, \theta)$ and $(\mu, \theta) \in \Omega$ is a compact fixed set.

2.1 Production Technology

There are two occupations: laborer and specialist. Social production of the numeraire good in period t depends on the current level of technology in the economy A_t, the aggregate amount of human capital of laborers H_t^l, and that of specialists H_t^s as

$$Q_t = Q(H_t^l, H_t^s, A_t) = A_t^{1-\gamma} \left[(\beta H_t^l)^\rho + (H_t^s)^\rho \right]^{\gamma/\rho},$$

where $1 > \rho > -\infty$, $\beta > 0$, and $0 < \gamma < 1$. In the following analysis, we restrict our attention to the case of $\rho \to -\infty$ so that our results hold when we have the Leontief production technology. They will also hold when the elasticity of substitution between the laborer and specialist is sufficiently small. This assumption, as FMW argues, provides the maximum scope for our comparative statistics whereas we may miss the suggestion of Hanushek, Leung and Yilmaz (2003) that the magnitude of the elasticity of substitution between skilled and unskilled workers matters. See also discussion on p.123 of FMW, for consequences that the more general form of CES production technology will have on FMW and the present analysis.

Competitive wages w_t^l and w_t^e are paid respectively to laborers and for specialists in return for their inputs. Excess profits, $(1-\gamma)Q_t$, are redistributed among agents according to the claim that agents share. We designate $y_t(\theta)$ as the non-wage income of an agent with θ.

2.2 The Learning Process

[4] In the model, there are no bequests and correlation of ability within lineages.

Born-in-time t agents can choose to enter a school to become specialists in period $t+1$; otherwise they work as laborers in period t and $t+1$. The subset of Ω who enroll in the school in time t is denoted as Ω_t^s. The complements are denoted by Ω_t^l (laborers). The human capital of laborers consists of the current level of technology that is freely available: $h_{t,l}^y = A_t$ and $h_{t+1,l}^o = A_{t+1}$. Superscripts indicate young and old, respectively.

The human capital embodied by specialists is determined by the individual innate ability μ as well as the social knowledge at that period:

$$h_{t+1,s}^o(\mu) = \mu A_{t+1}, \quad where \quad \mu > 1.$$

During the educational process of specialists, new knowledge is added to the existing knowledge as a byproduct of learning, which they cannot appropriate. This represents an externality and serves as the engine of the growth. Specifically, a specialist with innate ability μ produces $a_t(\mu) = a\mu A_t$ units of new knowledge, where $a > 0$ is a parameter. The level of social knowledge in the following period is given as

$$A_{t+1} = A_t + aA_t \int\int_{\Omega_t^s} \mu f(\mu, \theta) d\mu d\theta.$$

The growth rate of technology, g, can be calculated as

$$g_{t+1} = \frac{A_{t+1}}{A_t} - 1 = aN \int\int_{\Omega_t^s} \mu f(\mu, \theta) d\mu d\theta.$$

2.3 Social Status

Our formulation of social status is identical to that of FMW: the social status of specialists is defined as the ratio of the average human capital of specialists to that of laborers as

$$s_t^s \equiv \left[\frac{\int\int_{\Omega_{t-1}^s} \mu f(\mu, \theta) d\mu d\theta}{\int\int_{\Omega_{t-1}^s} f(\mu, \theta) d\mu d\theta} \right]^\delta,$$

where $\delta > 0$ is a shift parameter.

2.4 Consumers

Agents consume only in the latter half of their lives. As assumed in FMW, social status is demanded by those who are endowed with a higher non-wage income. That is, status is the normal good. Specifically, the utility is given as

$$u_t^i = s_{t+1}^i c_{t+1}^i,$$

where c is the consumption and $i \in \{s, l\}$. Agents solve a standard optimization problem when they make occupational choices. The incentive constraint of the agent with (μ, θ) to enroll in the school is given as the following.

$$E_t[u_t^s(s_{t+1}^s, c_{t+1}^s)] \geq E_t[u_t^l(s_{t+1}^l, c_{t+1}^l)]. \tag{1}$$

The present framework includes an initial cost that is required for education. It must be financed either privately or publicly. Denote $I(A_t)$ as the cost which depends on the current level of the social knowledge. We assume here that $\partial I(.)/\partial A_t > 0$. The next section confines its scope to steady growth equilibrium (SGE) and derives incentive constraints for two education regimes, yielding a comparison of efficiency in terms of the growth rate.

3. Incentive Constraints and the Efficiency

For analysis of SGE, $\partial^2 I(A_t)/\partial A_t^2 = 0$ is required so that $I(A_t)$ is a linear function with the slope coefficient i.[5] As in FMW, we assume uniqueness and stability of SGE; the set of $\{(\Omega_s^*, \Omega_l^*), (w_s^*, w_l^*), (s_s^*, s_l^*), g^*, \tau^*\}$ defines SGE in our model. We will omit the superscript $*$ in the following analysis.

3.1 The Public Finance Regime

Denote the interest rate in the competitive capital market by r. When educational expenses are financed publicly, the government imposes an income tax on old agents. Denote the tax rate by τ; thereby, we can rewrite (1) for this regime as

$$\begin{aligned} & s_{t+1}^s(1-\tau_{t+1})\left\{y_t(\theta) + \frac{y_{t+1}(\theta)}{1+r} + \frac{w_{t+1}^s \mu A_{t+1}}{1+r}\right\} \\ & \geq s_{t+1}^l(1-\tau_{t+1})\left\{y_t(\theta) + \frac{y_{t+1}(\theta)}{1+r} + w_t^l A_t + \frac{w_{t+1}^l A_{t+1}}{1+r}\right\}, \end{aligned}$$

which, with steady growth equilibrium, can be rewritten as the following.

$$s_s\left\{\frac{2+r+g}{1+r}\tilde{y}(\theta) + \frac{1+g}{1+r}w_s\mu\right\} \geq s_l\left\{\frac{2+r+g}{1+r}(\tilde{y}(\theta) + w_l)\right\}. \tag{2}$$

The balanced budget condition for the government is given as

$$\begin{aligned} & \tau_{t+1}\left\{N(y_t(\theta) + \frac{y_{t+1}(\theta)}{1+r}) + \int\int_{\Omega_t^l}(w_t^l A_t + \frac{w_{t+1}^l A_{t+1}}{1+r}) f(\mu,\theta)d\mu d\theta \right. \\ & \left. + \int\int_{\Omega_t^s} \frac{w_{t+1}^s \mu A_{t+1}}{1+r} f(\mu,\theta)d\mu d\theta\right\} = \frac{I(A_{t+1})}{1+r}\int\int_{\Omega_{t+1}^s} f(\mu,\theta)d\mu d\theta. \end{aligned}$$

[5] If $\partial^2 I(A_t)/\partial A_t^2 < 0$, the analysis of SGE reduces to that presented by FMW because the educational expenses become zero in SGE. If $\partial^2 I(A_t)/\partial A_t^2 > 0$, it is easy to see that there is no SGE.

The $l.h.s.$ of this equation is the tax revenue from all born-in-time t agents and the $r.h.s.$ is the aggregate school expenses demanded by those who are born at $t+1$.

3.2 The Private Finance Regime

Assume that educational expenses are financed privately. This indicates that agents resort to the credit market if they wish to become specialists. In this study, we assume that the credit market is complete and that the incentive constraints determine occupational choices in the economy. (1) in this regime reads

$$\begin{aligned} s^s_{t+1}\left\{y_t(\theta)+\frac{y_{t+1}(\theta)}{1+r}+\frac{w^s_{t+1}\mu A_{t+1}}{1+r}-I(A_t)\right\} \\ \geq s^l_{t+1}\left\{y_t(\theta)+\frac{y_{t+1}(\theta)}{1+r}+w^l_t A_t+\frac{w^l_{t+1}A_{t+1}}{1+r}\right\}, \end{aligned}$$

which, for steady growth equilibrium, can be rewritten as

$$s_s\left\{\frac{2+r+g}{1+r}\tilde{y}(\theta)+\frac{1+g}{1+r}w_s\mu-i\right\}\geq s_l\left\{\frac{2+r+g}{1+r}(\tilde{y}(\theta)+w_l)\right\}. \qquad (3)$$

Notice that (3) derived here coincides with (2) if $i=0$.

3.3 Efficiency in Technology Accumulation

The sole purpose of this study is to compare efficiency in terms of the growth rates for two regimes with (2) and (3), by which the growth rate is determined completely. Following FMW, we denote the partition for occupational choices in Ω as $\mu(\theta)$, which can be written in SGE as

$$\mu=-\frac{(2+r+g^h)(s^h_s-s^h_l)}{(1+g^h)s^h_s w^h_s}\tilde{y}^h(\theta)+\frac{(2+r+g^h)s^h_l w^h_l}{(1+g^h)s^h_s w^h_s}+\frac{(1+r)i}{(1+g^h)w^h_s},$$

where $i=0$ in the public finance regime and $i>0$ in the private finance regime while $h\in\{pri,pub\}$ represents the valuables determined in the private finance regime and the public finance regime, respectively. As noted by FMW, the comparative statistics in the model of this class are difficult to interpret when there is no restriction on the production technology. Such difficulty arises because we should treat such a problem in a general equilibrium context. Some parametric changes engender opposite effects on occupational choices and the growth rate.

However, as we have Leontief production function and production inputs are demanded in fixed proportions, we obtain that a switch from the public

finance regime ($i = 0$) to a private finance regime ($i > 0$) dissuades *wrong* agents who have higher non-wage income, but lower ability, from entering school. Firms can then compensate the vacancy for those who are endowed with lower non-wage income, but with higher ability, thereby improving the allocation of human resources and raising the growth rate. This is summarized as the following proposition.

Proposition: Consider an economy in which social rewards are bestowed upon growth enhancing activities and in which it is costly to enroll in such activities. The growth rate becomes higher in the private finance regime than in the public finance regime when the Leontief production technology is adopted.

Proof: See the proof in the appendix.

Glomm and Ravikumar (1992) investigated the formal schooling aspect of human capital investment as an engine of growth and provided a comparison between public education and private education. Two remarks comparing Glomm and Ravikumar and the present work are in order here.[6]

First, they also show that private education engenders a higher growth rate than public education, although the mechanism that brings that result is different. In their model, lineages are connected with bequest motives within an OLG framework and agents are concerned about the quality of education that their own descendant receives. A lower growth rate results in a public education economy because parents, in the public education economy, take the quality of education as given and have less incentive to accumulate human capital for the next generation. On the other hand, in our model without intergenerational correlations, a higher growth rate in the private finance regime arises from the private cost of education, which dissuades *wrong* agents from participating in the knowledge-creation process.

Second, Glomm and Ravikumar suggest that income inequality declines in the public education economy and that it remains constant over time in the private education economy. The former holds because agents in the public education economy face the same quality of education. Thereby, the levels of human capital and income exhibit convergence. The latter is attributable to the fact that the educational quality for each agent in the private education economy depends on the level of human capital of parents; inequality among lineages remains with the condition to ensure the balanced growth path of

[6] The results of Glomm and Ravikumar cited here are those for steady growth equilibrium in their analysis (that is, the case for $\gamma + \delta = 1$ in their model).

the economy. On the other hand, our analysis assumes that agents have no inter-generational linkage. For that reason, new agents whose characteristics are determined by time invariant distribution $F(\mu, \theta)$ continue to enter into the economy. Consequently, heterogeneity among agents never disappears. This assumption greatly simplifies our analysis of the SGE, whereas Hanushek, Leung and Yilmaz (2004) and Sheshadri and Yuki (2005) point out the significance of intergenerational linkage. Future research should allow intergenerational linkage within the framework of FMW and ours.

4. Conclusion

In this study, we examined an economy in which growth is driven by development of new technology and in which social rewards are bestowed upon growth enhancing activities. This paper shows that a switch from the public finance regime to the private finance regime has the same qualitative effect on the growth rate as does negligence of social status (reduction in δ in FMW), thereby engendering a higher growth rate. A higher growth rate can be achieved because the allocation of human resources is improved by crowding the wrong people out of growth-enhancing professions. This insight is quite distinguishable because the growth rate declines in the public finance regime even though tax revenues are used for productivity augmenting expenditures, which contradicts Turnovsky (1996) and Capolupo (2000).

Our study may have important consequences on reformulation of the Japan Student Services Organization, which provided educational loans mainly for graduate school students. It is noteworthy that JSSO originally had a regulation stipulating that repayment of educational loan can be exempted for those who became college staff members. Those provisions could be regarded as measures to provide publicly financed education to train specialists; they were abolished in 2004. Although that change might seem to disturb the development of technology, according to our results, the reformulation does not always affect the growth rate negatively. Especially, if the conditions in our analysis are appropriate, administrative reform by the Koizumi Cabinet, that is, changing the educational regime from a public one to private one, has positive effects on growth.

Future research should consider two channels of intergenerational linkage in our model: the amount of claim θ and innate ability μ. Especially, if we consider an economy in which innate ability is serially correlated within lineages and agents care about the innate ability of their respective descendants, this augmentation will make the accumulation of knowledge dependent on the level of effort as well as μ; it is endogenously determined as in Freeman and Polasky (1992) and Leung (1995).

Appendix

This appendix proves our proposition. When we assume the Leontief technology, the production function is given as

$$Q_t = A_t^{1-\gamma}(\min[\beta L_t, S_t])^{\gamma},$$

where L_t denotes the quantity of laborers and S_t denotes the aggregated ability of specialists. Under the Leontief production function, $\beta L = S$ and $\gamma S^{\gamma-1} = w_l/\beta + w_s$ hold in a SGE. The former condition indicates that changes of parameters cause right- or left-rotation of $\mu(\theta)$ rather than a shift of the line to the right or to the left. The latter holds that the marginal productivity of bundle inputs in Leontief technology must equal the joint costs.

Under these conditions, FMW established that a right rotation of $\mu(\theta)$ causes the decrease of βL and S and *vice versa*, and that S is a increasing function of g.[7] It is then necessary that we prove that infinitesimal increase of i from zero makes $S(g)$ shift up, followed by a higher growth rate. In contrast, assume that a marginal increase of i from zero causes βL and S to decrease. When βL and S decrease, the marginal joint costs, $w_l/\beta + w_s$, increase and excess profits, which equals $(1-\gamma)S$, decrease. We have right rotation of $\mu(\theta)$ when βL and S decrease. Therefore, agents with low ability and high non-wage income replace those who are endowed with high ability and low non-wage income, and social status of specialists decline. Notice that right rotation of $\mu(\theta)$ requires a higher slope of the line. The slope is given as

$$\mu'(\theta) = -\frac{(s_s - s_l)(1-\gamma)S}{s_s w_s}\Gamma(g),$$

where $\Gamma(g) \equiv \frac{2+r+g}{(1+g)}$. Hence, for $\mu'(\theta)$ to be higher, w_s must decline while both $\frac{(s_s-s_l)}{s_s}$ and $(1-\gamma)S$ are decreasing. This indicates that w_l must increase because $w_l/\beta + w_s$ increases. Given these changes, no laborers will choose to become specialists. The wages of laborers increase, whereas those of specialists decrease and the life-time income of specialists are reduced by educational expenses i. The social status of specialists is reduced. Furthermore, the non-wage income of all agents decreases, causing a decrease in social interest in status. Thus such a right rotation is impossible. By this contradiction, we conclude that a marginal increase of i from zero causes a left rotation of $\mu(\theta)$ and results in higher βL and S for a given g. As S shifts

[7] For proof, see section 3.C of FMW.

upward, a higher growth rate is achieved in the private finance regime under the condition that S is an increasing function of g.[8] *Q.E.D.*

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