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Child labor, education aid, and economic growth

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Abstract

This paper studies the effects of the foreign aid allocation between public education and cash transfer on growth and welfare in developing countries. We consider a three-period-lived overlapping generations economy in which children are potential workers and then individuals face the trade-off between education and child labor. We show that the relationship between allocation ratio and growth rate is an inverted-U shaped. We further demonstrate that there is a case in which an increase in the tax rate raises the growth-maximizing allocation of cash transfer to compensate for family income. This result is not only Pareto-improving but also eliminates child labor. The characteristic of welfare-maximizing foreign aid allocation is also examined.

Keywords: Child labor; Foreign aid; Education; Cash transfer; Growth
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1. Introduction

Poor countries are plagued with deepening poverty and slow economic growth, often depending on foreign aid for government expenditure in their earlier stages of development. Economists are concerned with development-enhancing foreign aid, and there are numerous empirical studies that examine the relationship between foreign aid and growth (see, for example, Radelet (2003) for an excellent survey).[1] Recently, Hansen and Tarp (2001) pointed out that the aid-growth relationship depends not only on the level of aid, but also on the aid allocation. The World Bank (1998) argued that the allocation of foreign aid would have a greater impact on poverty reduction if it targeted the poorest countries. Collier and Dollar (2002) found that the actual allocation of foreign aid is radically different from the poverty-efficient allocation. Evidence has showed that foreign aid is allocated inefficiently in terms of poverty reduction. The first objective of this paper is to investigate the policy implications of allocating foreign aid for economic development.

For our purpose, we consider two types of policy options: one is education aid to improve the quality of public education, and the other is cash transfer to ensure school-age children of poor families go to school. Education has been recognized as a key factor determining economic growth for developing countries. However, most families in developing countries are so poor that they send their children to work and prevent them from going to school (Jensen and Nielsen, 1998). UNESCO (2004) pointed out that the governments in developing countries need to pay attention to children who have been left out of school due to the presence of child labor. Cash

[1] However, to my knowledge, there has been little theoretical research in the field of economic growth. A first attempt to introduce foreign aid transfer is that of Chatterjee et al. (2003), who investigated the link between foreign aid, growth and welfare using an endogenous growth model with public capital accumulation. Moreover, in the same setting, Chatterjee and Turnovsky (2006) examined the recipient government's intertemporal fiscal balance introducing endogenous labor supply. Dessy (2000) suggested that in developing countries public education is financed by the flow of aid under government management. However, they implicitly assumed this flow can be adjusted to stay constant over time.

transfer programs are one kind of program that has expanded in many developing countries, especially in Latin America.[2] Frequently, these are "conditional cash transfer" programs. Empirically, even if the cash transfer programs are unconditional, such programs have a positive impact on school enrollment and a negative impact on child labor (Schady and Araujo, 2006).

In the course of economic development, as stated in Garcia Penasola and Turnovsky (2005),[3] the governments of developing countries need to impose income tax to finance public services. So far many authors have argued that in the presence of child labor the government policy regarding education is growth-enhancing (Dessy, 2000; Krueger and Donohue, 2005) or welfare-improving (Baland and Robinson, 2000; Hazan and Berdugo, 2002). The second concern in this paper is to examine the effect of taxation to finance public education on growth and welfare taking into account the foreign aid allocation.

Most of the endogenous growth literature concerned with foreign aid adopts a numerical approach to study policy implications. Our purpose in this paper is to present a simple OLG model with the growth engine of human capital which has the following two features. First, and most importantly, we assume that children are potential workers. In developing countries, parents tend to substitute child labor for child education to earn more income, and hence fertility may be increased. In this sense, the existence of child labor brings about the trade-off between the quality and quantity of children.[4] We thus analyze the policy implications considering the joint determination of fertility and education.

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[2] See, for example, Mexico's Progressa program, and Brazil's Bolsa Escola.

[3] In developing countries, the direct taxation base is lower than the indirect taxation. However, since indirect taxes are already at a high level, when developing countries grow, increasing tax revenue will require higher personal income tax rates. See, for example, Auriol and Warlters (2005) and Garcia Penasola and Turnovsky (2005), among others.

[4] The trade-off between the quality and quantity of children has been analyzed, for example, by Becker and Lewis (1973). More recently, Moav (2005) and de la Croix and Doepke (2004) pointed out that the fertility choice of individuals plays an important role in economic development.

Second, we assume that the government of recipient countries finances educational expenditure not only by domestic tax revenue but also foreign aid. Recently, Chatterjee et al. (2007) focused on the problem of aid fungibility assuming that the aid allocation is determined by the donor. However, this issue is still controversial empirically (e.g., Park and Park, 1993; Feyzioglu et al., 1998). In this paper, we assume that the recipient countries decide on two policy variables, i.e., the allocation ratio of foreign aid between public education and cash transfer, and the tax rate so as to maximize the growth rate.[5]

The results of this study are as follows. It is shown that the relationship between the allocation ratio and growth rate is an inverted-U shaped. In addition, under the growth-maximizing policy, a change in the tax rate tends to raise the allocation ratio of cash transfer to compensate for family income. We also show that there exists an optimal foreign aid allocation which depends on the degree of parents' altruism toward their children. Finally, we demonstrate that an increase in the tax rate to finance public education is not only Pareto-improving but also eliminates child labor.

The remainder of this paper is organized as follows. In Section 2 a model is presented, and in Section 3 the steady-state growth path is characterized. The growth effect is examined in Section 4, and the welfare effect is analyzed in Section 5. Section 6 investigates the effect of taxation to public education. Finally, Section 7 offers some conclusions.

2. Model

Consider a small open overlapping generations model that consists of the recipient government and individuals populated by three-period-lived. Individuals are alike except for their ages. A representative individual goes to school and works in the first

[5] Since, in general, donor countries decide on the level of foreign aid, an investigation of its effect on growth goes beyond the scope of the present paper.

period (childhood), works and rears children in the second period (parenthood), and retires in the last period of his/her life (old age). He/She is endowed with one unit of time in childhood and parenthood, respectively. His/Her children mature within a period and leave home at the end of the period.

2.1. Recipient Government

The government of recipient countries receives foreign aid, F_t , and allocates it between public education and cash transfer. Denoting education aid and cash transfer in period t by A_t and TR_t , respectively, the following equality holds:

$$F_t = A_t + TR_t .$$

This system is assumed to be balanced in each period. Denoting the share of foreign aid allocation as λ , we have:

$$A_t = (1-\lambda)F_t , \tag{1}$$

$$TR_t = \lambda F_t , \tag{2}$$

respectively. It is assumed that the flow of aid is implemented in a co-financing manner, i.e., $F_t = \varphi \overline{E}_t$ [6] where it is a fraction of that country's level of public expenditure on education, and the public expenditure on education is assumed to be financed by the labor income tax of adult in period t, $\overline{E}_t \equiv \tau y_t^a$.

Public education, financed by both domestic tax and flow aid from abroad, is given as:

$$E_t = \overline{E}_t + A_t = \left[1 + (1-\lambda)\varphi\right]\tau y_t^a . \tag{3}$$

2.2 Individuals

[6] There are many specifications of foreign aid flow. Chatterjee et al. (2003), among others assumed that foreign aid flow is a fraction of that country's level of income. They pointed out that it does characterize the temporal transfers occurring in EU and Eastern Europe (Chatterjee et al., 2003; Chatterjee and Turnovsky, 2005, 2006). Our specification derives from the Education for All (EFA)-Fast Track Initiative (FTI) introduced in 2002. Many FTI-endorsed countries received Education ODA which is a fraction of government financing of education. See World Bank (2004).

Consider a child born at $t-1$ (called generation t), with human capital inherited from his/her parents. He/She attends school to acquire more human capital. The human capital of the children, h_{t+1}, depends on schooling time, e_t, the quality of public education, E_t, and the human capital of the parent. The production function of human capital is given as

$$h_{t+1} = \delta(e_t E_t)^{\eta} h_t^{1-\eta}, \qquad \delta > 0, \quad 0 < \eta < 1 \tag{4}$$

where δ is the productivity parameter.

The lifetime utility of the individual is assumed to be log-linear: [7] $U_t = (1-\beta)\ln c_{t+1} + \beta \ln n_t h_{t+1}$, where β is the preference parameter for children. Parent allocates the time endowment of children between schooling and working. Let θ be the ability of the children. They supply $(1-e_t)\theta h_t$ units of efficient labor as child labor in the first period. They devote zn_t units of time to rearing n_t children and the remaining $1-zn_t$ units of time to working in the second period. Thus, their second-period budget equation, composed of the sum of child labor, adult labor and cash transfer by the foreign aid, can be written as[8]

$$s_t = n_t(1-e_t)\theta h_t + (1-zn_t)h_t(1-\tau) + TR_t \tag{5}$$

where s_t is the individual's savings for retirement; n_t is the number of children; z is the rearing time per child; and τ is the tax rate on labor income of adult. Since production is linear in human capital, the wage per unit of human capital is normalized to one. In the last period, their consumption, c_{t+1}, is given as

$$c_{t+1} = (1+\bar{r})s_t \tag{6}$$

where $\bar{r}$ is the world interest rate.

2.3 Optimization

The problem for the individual is to choose consumption, c_{t+1}, the number of children, n_t, and their schooling time, e_t, so as to maximize the lifetime utility.

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[7] See Azarneat (2006) for the interpretation of this specification.

[8] This setting is similar to that of Hazan and Berdugo (2002), Chakraborty and Das (2005), and Contreras (2007), among others.

Taking (1) into account, the first-order conditions for utility maximization are given as:

$$c_{t+1} \quad : \quad \frac{1-\beta}{c_{t+1}} = \frac{\mu_t}{1+r} \tag{7}$$

$$n_t \quad : \quad \frac{\beta}{n_t} = \mu_t [z(1-\tau+\lambda\varphi\tau)h_t - (1-e_t)\theta h_t] \tag{8}$$

$$e_t \quad : \quad \frac{\beta\eta}{e_t} = \mu_t \theta n_t h_t \tag{9}$$

where μ_t is the Lagrange multiplier. Equation (8) means that the marginal utility of having an additional child is equal to the net marginal costs of children, which are the cost of rearing a child minus child labor income. Equation (9) means that the marginal utility of schooling is equal to the marginal costs, which is the marginal return on child labor.

From (7)-(9), we have the optimal plans of the individual:

$$n_t = \frac{\beta(1-\eta)(1-\tau+\lambda\varphi\tau)}{z(1-\tau+\lambda\varphi\tau)-\theta} \tag{10}$$

$$e_t = \frac{\eta[z(1-\tau+\lambda\varphi\tau)-\theta]}{\theta(1-\eta)} \tag{11}$$

It should be noted that an increase in the share of cash transfers decreases the fertility rate, i.e. $dn_t / d\lambda < 0$. In addition, as can be seen from (11), the higher the share of cash transfer is, the longer the schooling time is. Therefore, the individual faces a trade-off between his/her schooling time and fertility through the cash transfers. On the other hand, from (10) and (11), we can show that $de_t / d\tau < 0$ and $dn_t / d\tau > 0$. An increase in tax rate induces individuals to send their children to work so as to compensate for the reduction in adult income, thus reducing their schooling time.

3. Equilibrium Growth

In this section we characterize the steady-state growth path. Defining the

balanced-growth path on which all per capita variables grow at the same rate, and the balanced-growth rate is given as: $1+\gamma = g = Y_{t+1}/Y_t = h_{t+1}/h_t$. Making use of (3), (4), (10) and (11), we have

$$g = \delta\left(\frac{\eta}{\theta(1+\beta)(1-\eta)}\right)^{\eta}\{[(1+\beta\eta)z(1-\tau+\lambda\varphi\tau)-(1+\beta)\theta][\tau+(1-\lambda)\varphi\tau]\}^{\eta} \tag{12}$$

There are no transitional dynamics in our model, and all variables jump immediately to their steady state values. The equilibrium growth rate depends on the preference parameter, β, the technological parameter in human capital production, η, the physical ability of the children, θ, and the time-cost of child-rearing, z. The greater the spillover from accumulated human capital is, the higher the growth rate; the greater the rearing time-cost of children is, the higher the growth rate. On the contrary, the greater the preference factor is, the lower the growth rate; the greater the physical ability of the children is, the lower the growth rate.

Since our objective in this paper is to examine the effects of policy change in foreign aid allocation and the tax rate on the economic growth, we focus on the two policy variables, i.e. the allocation of foreign aid between public education and cash transfer, and the tax rate. To obtain a set of policies, we assume that the determination of the policies is achieved in two steps: the recipient government determines the balanced-growth maximizing foreign aid allocation between public education and cash transfer for any level of taxation, and then derives the balanced-growth maximizing taxation level at the given allocation ratio.

4. Growth effects of foreign aid allocation

In this section and hereafter, while restricting our concern to the steady-state path, we analyze the effects of foreign aid allocation on the growth rate. We assume that initially the recipient government chooses the policy variable, λ, so as to maximize the

balanced-growth rate for a given τ. From (11), we have the following proposition:

Proposition 1. *Suppose that there exist an interior growth-maximizing foreign aid allocation,* $\hat{\lambda}$. *Then it is given as:*

$$\hat{\lambda} = \frac{(1+\beta)\theta - (1+\beta\eta)z(1-2\tau-\varphi\tau)}{2(1+\beta\eta)z\tau}. \tag{13}$$

It is increasing in τ.

Proof. Differentiating (12) with respect to λ, we have:

$$\frac{dg}{d\lambda} = \delta\left(\frac{\eta}{\theta(1+\beta)(1-\eta)}\right)^{\eta}\left\{\left[(1+\beta\eta)z(1-\tau+\lambda\varphi\tau)-(1+\beta)\theta\right]\left[\tau+(1-\lambda)\varphi\tau\right]\right\}^{\eta-1}$$
$$\times\tau\varphi\left\{-2(1+\beta\eta)z\varphi\tau\lambda+\left[(1+\beta)\theta-(1+\beta\eta)z(1-2\tau-\varphi\tau)\right]\right\} \tag{14}$$

Solving $dg/d\lambda = 0$ leads to

$$\hat{\lambda} = \frac{(1+\beta)\theta - (1+\beta\eta)z(1-2\tau-\varphi\tau)}{2(1+\beta\eta)z\tau}.$$

Total differentiating $\hat{\lambda}$ with respect to τ yields:

$$\frac{d\hat{\lambda}}{d\tau} > 0 \quad \square$$

This proposition shows that the share of cash transfer is crucial for the long-run growth rate of the economy. The relationship between the allocation ratio and the growth rate is an inverted-U shaped. An increase in λ affects the growth rate in the following two ways. From (10) and (11), we can show that $dn_t/d\lambda < 0$ and $de_t/d\lambda > 0$. In this case, as the allocation ratio of cash transfer is raised, individuals increase their schooling time, and reduce the fertility rate. Hence, the per capita labor income of adult increases. However, when the allocation ratio of cash transfer is greater than $\hat{\lambda}$, the growth rate decreases as the tax rate is increased. Since the allocation ratio of education aid, $1-\lambda$, is raised, the quality of public education is

improved, and hence the growth rate is increased.

The second part of this proposition also reveals the importance of cash transfer to reduce the child labor. From (10) and (11), we can also show that $dn_t / d\tau > 0$ and $de_t / d\tau < 0$. An increase in the tax rate encourages parents to have many children and provide little education to each child. This implies that child labor becomes abundant when the recipient government increases the tax rate. The second part of this proposition shows that an increased cash transfer must be available to compensate for family income.

5. Welfare effects of foreign aid allocation

In this section we consider the effect of foreign aid allocation on the individual's welfare. The steady-state equilibrium level of utility whose childhood is period $t-1$ is written as:

$$\begin{aligned} U_t^* &= (1-\beta)\ln c_{t+1}^* + \beta \ln n_t^* h_{t+1}^* \\ &= \ln(1-\tau+\lambda\varphi\tau) - \beta\ln[z(1-\tau+\lambda\varphi\tau)-\theta] + \beta \ln h_o g^t, \end{aligned} \tag{15}$$

Differentiating (14) with respect to λ, we have:

$$\frac{dU_t^*}{d\lambda} = \varphi \frac{(1-\beta)z(1-\tau+\lambda\varphi\tau)-\theta}{(1-\tau+\lambda\varphi\tau)\left[z(1-\tau+\lambda\varphi\tau)-\theta\right]} + t\beta\frac{1}{g}\frac{dg}{d\lambda}. \tag{16}$$

The first term on the RHS of (16) is the effect caused by the increased consumption and the reduced fertility rate due to increasing the share of cash transfer. The second term represents the growth effect, which is given by (14). The welfare effect is expressed by the sum of the above terms. While the first term is constant, the second one is non-stationary. From (16), we have the following proposition:

Proposition 2. *1. If parents are sufficiently altruistic toward their children, the optimal allocation, λ^*, is lower than the growth-maximizing allocation, $\hat{\lambda}$.*

2. If parents are not sufficiently altruistic toward their children, the optimal allocation, λ^*, is higher than the growth-maximizing allocation, $\hat{\lambda}$.

Proof. Evaluating (16) at $\lambda = \hat{\lambda}$, we obtain

$$\left.\frac{dU_t^*}{d\lambda}\right|_{\lambda=\hat{\lambda}} = \varphi \frac{(1-\beta)z(1-\tau+\hat{\lambda}\varphi\tau)-\theta}{(1-\tau+\hat{\lambda}\varphi\tau)\left[z(1-\tau+\hat{\lambda}\varphi\tau)-\theta\right]}. \tag{17}$$

Define $\Gamma(\beta) = \left[(1-\tau+\hat{\lambda}\varphi)z-\theta\right]-\beta(1-\tau+\hat{\lambda}\varphi)z$. $\Gamma(0)>0$, and $\Gamma(1)<0$ for all $0<\beta<1$. Since $\Gamma(\beta)$ is continuous, there exists $\overline{\beta}\in(0,1)$ such that $\Gamma(\overline{\beta})=0$.

Hence, $\left.\frac{dU_t^*}{d\lambda}\right|_{\lambda=\hat{\lambda}} \begin{matrix}<\\=\\>\end{matrix} 0$ if $\beta \begin{matrix}>\\<\end{matrix} \overline{\beta}$. □

The intuition behind this proposition is as follows. If the recipient government chooses an allocation ratio smaller than the growth-maximizing allocation ratio, it reduces the maximized-balanced-growth rate, and hence tends to lower welfare. However, since parents are sufficiently altruistic toward their children, they prefer to have many children and a decrease in the level of consumption. In this case, even if the allocation ratio of cash transfer decreases, household income raises since many children work in the form of child labor. This positive effect dominates the negative welfare effect of a lower growth rate if the allocation ratio is lower than the growth maximizing value of that parameter.

On the other hand, if the recipient government chooses an allocation ratio larger than the growth-maximizing allocation ratio, it reduces the maximized balanced-growth rate, and hence tends to lower welfare. However, since parents are not sufficiently altruistic toward their children, they prefer to have few children and an increase in the level of consumption. An increase in the allocation ratio is paid back to the household in the form of cash transfers which has a positive wealth effect. As a consequence, a higher allocation ratio of cash transfer leads to an increase in the level of total income. This effect dominates the negative welfare effect of a lower growth rate if the allocation

ratio is higher than the growth-maximizing value of that parameter.

Proposition 2 has policy implications for foreign aid allocation on welfare. The optimal foreign aid allocation is not necessarily achieved even if the recipient government chooses the allocation between public education and cash transfer so as to maximize the growth rate. In our economy, the degree of altruism parameter plays an important role when the recipient government chooses an optimal allocation.

6. Effects of taxation

So far we have focused on the growth and welfare effects of foreign aid allocation. Garcia Penasola and Turnovsky (2005) pointed out that as developing countries grow, they need to generate larger tax revenue to finance public services. In this section, we consider whether providing education is welfare-improving in the economy where child labor exists. This problem has been discussed by many authors as one of the most important issues in a developing economy (See, for example, Baland and Robinson (2000), Hazan and Berdugo (2002), among others). However, these studies crucially depend on an intergenerational contract that has to be enforced, where a parent allows all of his children to study, and, in exchange, the children promise to compensate their parent in the next period.[9] Our analysis and its focus differ from such studies in that we allow a government policy without such a contract in order to examine the effectiveness of taxation of the growth and welfare so as to finance public education. For our purpose, we assume here that the economy is initially on the growth-maximized balanced-growth path, and then consider an increase in income tax from generation t. We first analyze the income tax that maximizes the balanced-growth rate. The problem for the recipient government is to choose τ so as to maximize g, for a given λ. Differentiating (12) with respect to τ, we have the following proposition:

[9] In reality, Baland and Robinson (2000) pointed out that it is difficult to enforce such intergenerational contracts.

Proposition 3. *Suppose that there exist an interior growth-maximizing tax rate,* $\hat{\tau}$. *Then it is given as:*

$$\hat{\tau} = \frac{(1+\beta\eta)z - (1+\beta)\theta}{2(1-\lambda\varphi)(1+\beta\eta)z}. \tag{18}$$

Proof. Differentiating (12) with respect to τ, we have:

$$\frac{dg}{d\tau} = \delta\left(\frac{\eta}{\theta(1+\beta)(1-\eta)}\right)^{\eta}\left\{\left[(1+\beta\eta)z(1-\tau+\lambda\varphi\tau) - (1+\beta)\theta\right]\left[\tau+(1-\lambda)\varphi\tau\right]\right\}^{\eta-1}$$

$$\times\left[1+(1-\lambda)\varphi\right]\left\{-2(1-\lambda\varphi)(1+\beta\eta)z\tau + \left[(1+\beta\eta)z - (1+\beta)\theta\right]\right\} \tag{19}$$

Solving $dg/d\tau = 0$ leads to

$$\hat{\tau} = \frac{(1+\beta\eta)z - (1+\beta)\theta}{2(1-\lambda\varphi)(1+\beta\eta)z}. \quad \square$$

An increase in τ affects the growth rate in the following two ways. First, a higher τ serves to improve the quality of public education. This is a positive effect of τ on growth rate. Second, a higher τ has a negative effect on income, which decreases the growth rate. This proposition is different from those of Dessy (2000) and Krueger and Donohue (2005), who showed that introduction of compulsory education is growth-enhancing if compulsory education legislation exists and is enforceable.

Next, we examine the welfare effects of an increase in the income tax rate. Since we assume a small open economy, the world interest rate and the wage rate are constant over time. In addition, the policy change does not affect the human-capital stocks of the two generations that are in their first and second adulthood (i.e., parenthood and old age), called generations t and $t-1$, respectively. In our model, there are no transitional dynamics, and all variables jump immediately to their steady state values. Thus, we can see that two generations are not affected by an increase in the income tax rate. Then, we try to analyze the effects on future generations,

restricting our attention to the balanced-growth paths. Differentiating (15) with respect to τ gives in the following proposition:

Proposition 4. *An increase in the tax to finance public education is Pareto-improving when parents are not sufficiently altruistic toward their children.*

Proof. See Appendix A. □

The intuition is as follows. If the recipient government chooses a tax rate smaller than the growth-maximizing tax rate, it reduces the maximized balanced-growth rate. However, a lower tax rate leads parents to have few children and provide much education to each child. Thus, they prefer to raise the quality of education. This effect dominates the negative welfare effect if the tax rate is lower than the growth-maximizing value of that parameter. This proposition reflects a different interpretation from that of Baland and Robinson (2000) who showed that introducing compulsory schooling could be Pareto-improving. In their model, were the children able to enter into a contract with their parents for the transfer of their future income in exchange for a reduction in their present child labor, the problem of compensating parents for the introduction of compulsory schooling (i.e., redistributive taxation) would be resolved. In our economy, an increase in the tax rate to finance public education is Pareto-improving even if this policy is not enforceable or an intergenerational contract.

As for the efficiency of child labor, foreign aid allocation can reduce child labor. The effect of child labor is still controversial in the existing theoretical literature.[10] Basu and Van (1998)[11], for example, pointed out that child labor is efficient in contrast to the results of Baland and Robinson (2000) and Hazan and Berdugo (2002). Our

[10] Empirically some controversy is also remained. See, for example, Grooteart and Kamber (1995).
[11] Basu and Van (1998) consider a model of labor market-derived multiple stable quilibria.

result can be interpreted as follows. If there is no foreign aid allocation, our model is in line with that of Basu and Van (1998). However, from Proposition 1, under the growth-maximizing policy, a change in the tax rate tends to raise the allocation ratio of cash transfer to compensate for family income. This implies that the policy option considered by Baland and Robinson (2000) and Hazan and Berdugo (2002) depends on the intergenerational contract, while our result depends on the foreign aid allocation of cash transfer.

6. Conclusion

In this paper, we focus on the policy implications of the foreign aid allocation between public education and cash transfer for economic development. Most of the literature concerned with the foreign aid adopts a numerical approach to study the policy implications. Our purpose in this paper is to present a simple OLG model with the growth engine of human capital which children are potential workers and then individuals face the tradeoff between education and child labor. It is shown that the relationship between the allocation ratio and growth rate is an inverted-U shaped. In addition, under the growth-maximizing policy, a change in the tax rate tends to raise the allocation ratio of cash transfer to compensate for family income. We also show that there exists an optimal foreign aid allocation which depends on the degree of parents' altruism toward their children. Finally, we demonstrate that an increase in the tax to finance public education is not Pareto-improving but also eliminates child labor.

Two remarks are in order. First, so far we have assumed that each generation is homogenous in our economy, so the income distribution is not reflected. Since the quality of education is financed by income tax, the tax impact on income distribution is an important issue. Second, we assume that only the recipient countries decide on the aid allocation. Empirically, Schraeder et al. (1998) and Alesina and Dollar (2000)

observed that the direction of foreign aid is dictated by political and strategic considerations. In any case, the incorporation of a relationship of mutual interdependence between donor and recipient is of interest and deserves future study.

Appendix.

From (15), the steady-state equilibrium level of utility whose childhood is period $t-1$ is written as:

$$\begin{aligned} U_t^* &= (1-\beta)\ln c_{t+1}^* + \beta \ln n_t^* h_{t+1}^* \\ &= \ln(1-\tau+\lambda\varphi\tau) - \beta\ln[z(1-\tau+\lambda\varphi\tau)-\theta] + \beta \ln h_o g^t, \end{aligned}$$

Differentiating (14) with respect to τ, we have:

$$\frac{dU_t^*}{d\tau} = \frac{-(1-\beta)z(1-\tau+\lambda\varphi)+\theta}{(1-\tau+\lambda\varphi)\left[z(1-\tau+\lambda\varphi)-\theta\right]} + t\beta\frac{1}{g}\frac{dg}{d\tau} \qquad \text{(A1)}$$

Evaluating (A1) at $\tau = \hat{\tau}$, we obtain

$$\left.\frac{dU_t^*}{d\tau}\right|_{\tau=\hat{\tau}} = \frac{-(1-\beta)z(1-\hat{\tau}+\lambda\varphi)+\theta}{(1-\hat{\tau}+\lambda\varphi)\left[z(1-\hat{\tau}+\lambda\varphi)-\theta\right]} \qquad \text{(A2)}$$

Define $\Omega(\beta) = -(1-\beta)z(1-\hat{\tau}+\lambda\varphi)+\theta$. $\Omega(0)<0$, and $\Omega(1)>0$ for all $0<\beta<1$. Since $\Omega(\beta)$ is continuous, there exists $\overline{\beta}\in(0,1)$ such that $\Omega(\overline{\beta})=0$. Hence,

$$\left.\frac{dU_t^*}{d\tau}\right|_{\tau=\hat{\tau}} \gtreqless 0 \quad \text{if} \quad \Omega(\beta) \gtreqless 0.$$

Thus, an increase in the tax to finance public education can bring about Pareto-improving when parents are not sufficiently altruistic toward their children. □

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