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

Educational loan and human capital accumulation in a small open economy

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Abstract

Cartiglia (1997) shows that trade increases human capital investment in developing countries unless there are credit markets for individuals. In this paper, when households can borrow the education cost from a market, a trade−induced decrease in the skilled wage leads to less human capital investment in developing countries.

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1 Introduction

It is widely discussed how international trade affects human capital accumulation in each country. Findlay and Kiertzkowski (1983) show that skill-scarce economies result in less investment in human capital by trade. Their result is supported by other researchers such as Grossman and Helpman (1991) and Stokey (1991). On the contrary, Cartiglia (1997) shows that trade increases human capital levels in developing countries. One of the two key assumptions is that the education sector uses skilled labor and the school fee depends on the skilled labor wage. So a decrease in the price of skilled-intensive goods reduces education cost and increases the incentive to go to school. The second assumption is that individual borrowing is not allowed. In this paper, even under the same setting for education sector as Cartiglia (1997), if individuals can borrow the education cost from a market, a trade-induced decrease in the skilled wage reduces the human capital investment.[1]

It is worthwhile to consider the case that there are credit markets for individuals, because people can actually borrow the educational cost in many countries. For instance, student loan programs have been developed in various forms in over 50 countries throughout the world, which includes many developing countries, such as Kenya, Indonesia, Thailand and so on (Ziderman;2002).[2] In addition, it is known that the informal credit market is available in developing economies.[3] Therefore, we can consider that people are able to make a loan in several ways even when the credit markets are not complete.

The rest of this paper is organized as follows. Section 2 presents the model where individuals can borrow from an imperfect credit market. In Section 3, we show an effect of world price change. Concluding remarks appear in Section 4.

2 The model

We consider an overlapping generations model where members of each generation live for two periods; “ young” and “ old” periods. There is no population growth

[1]Eicher (1999), as Cartiglia (1997), shows the convergence result with domestic credit markets. A decrease in skilled wages eases the credit constraint and then increases an incentive to go to school in developing economies. Ranjan (2001) shows the ambiguous effect of trade on human capital investment by allowing for heterogeneity in ability as well as in initial capital.

[2]The educational cost actually includes not only the direct cost of tuition or text books, but also the living costs or the opportunity cost while individuals attend school indirectly. Student loan programs are established to cover such costs. Ziderman (2002) notes that student loan programs almost exclusively relate to tertiary education throughout the world. So the Japanese Scholarship Foundation (*Nihon Ikueikai*), which covers both the tertiary education and the upper secondary schooling, is a notable exception.

[3]Besly (1995) states that it is popular for people to borrow and lend money among their family, friends and community members in developing countries.

and the population of each generation is normalized to unity. By the assumption of a small open economy, firms and individuals take a world interest rate as given. However, individuals must borrow at a higher interest rate than the world rate because there is a capital market imperfection where lenders need positive costs to keep track of each individual borrower.

2.1 The production structure

The economy can produce two final goods; High-Tech goods H and Low-Tech goods L, with three factors of production; skilled labor S_H, unskilled labor U, and physical capital K. Capital K is mobile across sectors and is used in the production of both types of goods, while labor inputs are specific factors. Skilled workers S_H are solely employed in the High-Tech sector, and unskilled workers U are employed only in the Low-Tech sector. Each labor supply is endogenously determined through the occupational choices of individuals. The production functions exhibit constant returns to scale and denoted by

$$H = F_H(K_H, S_H), \quad L = F_L(K_L, U).$$

K_H and K_L denote physical capital levels allocated to the High-Tech and to the Low-Tech sectors respectively. The Low-Tech good is the numeraire and the relative price of the High-Tech good, p (> 1), is given in the world market. In equilibrium, the value of the marginal product of capital employed in the two sectors must be equal to the world interest rate r^w as

$$r^w = p\frac{\partial F_H}{\partial K_H} = \frac{\partial F_L}{\partial K_L}.$$

The returns to skilled workers and unskilled workers are denoted by w_s and w_u. Both of which only depend on the world prices and the technology as

$$w_s = p\frac{\partial F_H}{\partial S_H} = w_s(p, r^w), \quad w_u = \frac{\partial F_L}{\partial U} = w_u(r^w),$$

where $\frac{\partial w_s}{\partial p} > 0$, $\frac{\partial w_s}{\partial r^w} < 0$, and $\frac{\partial w_u}{\partial r^w} < 0$.

2.2 The education sector

In the education sector, students of the young generation are educated and/or trained by skilled workers of the old-age generation and become skilled workers in the next period.[4] In time t, the education sector employs some skilled workers

[4]This framework that the new human capital is produced in the education-service industry by using human capital not within the household or through on-the-job trainings has been presented by Mino (1996) among others.

as teachers from generation $t-1$. All students in time t are required to pay the education fee, ε_t, which is determined endogenously to cover teachers' wages. It is indifferent for skilled workers to work either in the High-Tech sector or in the education sector; hence the teachers' wage is equal to the skilled labor wage which is determined in the production sector. When the number of students is e_t $(0 < e_t < 1)$ and the number of teachers required by the students is S_{Et}, the education fee, ε_t, is then denoted by

$$\varepsilon_t = (\frac{S_{Et}}{e_t}) w_{st} \equiv \gamma w_{st},$$

where γ $(0 < \gamma < 1)$ is the ratio of the number of teachers to that of students.[5] This ratio which expresses the quality of schools or the efficiency of educational systems in the economy has been determined exogenously and is constant over time.

The total amount of labor in time t is allocated between production and education sectors as

$$S_{Ht} + S_{Et} + U_t = 1.$$

2.3 Households

Individuals differ in the ownership of initial capital within each generation. According to Cartiglia (1997), we suppose that the allocation of initial capital is described by a uniform distribution;

$$n(k_m) = \frac{1}{\bar{k}} I_{[0,\bar{k}]}(k_m),$$

where $\bar{k} > 0$ is the maximum level of initial capital, and $I_{[0,\bar{k}]}$ means the indicator function. The distribution of capital within each generation is exogenously set to be the same in every period.

Individual i is given her/his initial capital, k_t^i, at the beginning of the first period of the life and decides whether or not to go to school.[6] In the young period, they devote their all time to either schooling or leisure. Individuals who choose to go to school can then be engaged as skilled workers in the old period. If individuals do not go to school when young, they are forced to work as unskilled

[5]The same setting that education fee is based on the skilled labor wage is employed by Cartiglia (1997), Eicher (1999), and Ranjan (2001). In World Bank (2002), 67.5 % of the public expenditures for education is actually teachers' wages in developing countries. World Bank (2002) reports that the average " student-teacher ratio" (Class scale) in 1998 is 42 to 1 in developing countries and 25 to 1 on the world average.

[6]There are some young people who have no initial capital exactly, because the minimum level of initial capital is assumed to be zero.

workers in the old period. Skilled workers work either in the High-Tech sector or in the education sector, and receive the equal skilled wage, $w_{s,t+1}$. Unskilled workers who work in the Low-Tech sector receive the unskilled wage, $w_{u,t+1}$. Students must pay the education fee, ε_t, from their initial capital. At the time, students may borrow from the credit market against their future earnings to finance their education cost if their initial capital does not cover the education fee. Individuals consume goods only in the old period.[7] Students, if some part of their initial capital remains, save the rest of the income until the end of the old period. Young individuals who do not go to school save all initial capital. Labor income is given at a time during the old age period. Those individuals who have borrowed from the capital market when young, reimburse their loans including the interest with their labor income, and consume the rest of their income during the old period. Individuals, who did not borrow, have their savings, obtain the principal and the interest from their savings, and together with their labor income, consume all of the income.

We assume capital market imperfection as follows.[8]

Assumption 1
The interest rate for borrowers, d_{t+1}, is higher than the world market interest rate, that is,

$$d_{t+1} = r^w_{t+1} + \pi > r^w_{t+1},$$

where π $(0 < \pi \leq 1)$ is the exogenous probability that the loan cannot be returned. It expresses the degree of credit market imperfection in the economy.[9]

To compare our result with that of Cartiglia (1997), we also assume that the individuals have the incentive to go to school as a result of the following assumption.

Assumption 2
The present value of skilled labor wage is higher than the current school fee,

$$\frac{w_{s,t+1}}{(1 + r^w_{t+1} + \pi)} > \varepsilon_t = \gamma w_{s,t} \ .$$

That is, the present value of returns from the educational investment is higher than the cost, even if they borrow from the imperfect credit market to finance the education fee.

All individuals have identical preferences over the consumptions. A simple form of utility function is assumed to be $U^i_t = (C^i_{H,t+1})^\theta (C^i_{L,t+1})^{1-\theta}$, where $C^i_{H,t+1}$,

[7] Even if individuals consume in the young period as well, the main result of this paper is never changed. To show our result clearly, people do not consume when young.

[8] A similar assumption is used by Galor and Zeira (1993).

[9] Because lenders are assumed to be risk neutral, the value of π has no effects on the lenders' behaviors. There is no default by succeeding in keeping track of borrowers.

$C^i_{L,t+1}$ is the consumption levels of the High-Tech and Low-Tech goods. This specification of the utility function makes the indirect utility linear in life-time income, Y^i_{t+1}. The indirect utility function is denoted by

$$IU^i_t = U(p, Y^i_{t+1}). \tag{1}$$

Individuals intend to maximize their life-time income, Y^i_{t+1}. When there is the capital market imperfection, the decisions of young individuals are divided into the three cases depending on their initial capital.[10] In each case, individuals come to receive different life-time income. Life-time income measured by the second period is respectively as follows.[11]

Case 1: Individual i goes to school without a loan, saves, and works as a skilled worker in the old.

$$Y^i_{1,t+1} = (1 + r^w_{t+1})(k^i_t - \varepsilon_t) + w_{s,t+1} \tag{2}$$

Case 2: Individual i goes to school with a loan and works as a skilled worker in the old.

$$Y^i_{2,t+1} = -(1 + d_{t+1})(\varepsilon_t - k^i_t) + w_{s,t+1} \tag{3}$$

Case 3: Individual i does not go to school, saves, and works as an unskilled worker in the old.

$$Y^i_{3,t+1} = (1 + r^w_{t+1})k^i_t + w_{u,t+1} \tag{4}$$

Let's look into the behavior of individual i whose initial capital is k^i_t. Firstly, if individuals have initial capital $k^i_t \in [\tilde{k_{1,t}}, \bar{k}]$, where $\tilde{k_{1,t}}$ is equal to the education fee, ε_t, they can afford to pay the education cost by themselves. The condition that the rich individuals, whose initial capital is $k^i_t \in [\tilde{k_{1,t}}, \bar{k}]$, certainly go to school in the young period is the utility of *Case 1* exceeds that of *Case 3* as $IU^i_{1,t} > IU^i_{3,t}$. With Eqs. (1), (2), and (4), this condition is denoted by

$$\frac{w_{s,t+1} - \gamma(1 + r^w_{t+1})w_{s,t}}{w_{u,t+1}} > 1.$$

So when the education returns are large enough, rich individuals hope to go to school and belong to *Case 1*.[12]

[10] If individual borrowers can make a loan in a " perfect" credit market at the world interest rate, r^w_{t+1}, the decisions of young individuals are only divided into *Case 1* or *Case 2* and all young people go to school in the economy. At that time, human capital level becomes constant and is not affected by the change of the world price, p.

[11] Galor and Zeira (1993) and Galor and Zang (1997) also analyze the models that individuals have different life-time income by their choices of receiving education or not. See Appendix A for the loan-amount determination.

[12] This wage condition ensures that the relation of thresholds is satisfied with $\tilde{k_{2,t}} < \tilde{k_{1,t}}$. If $\tilde{k_{1,t}} < \tilde{k_{2,t}}$, the utility of *Case 3* is larger for all people and no one hopes to go to school. But as we set two production sectors, we exclude this case.

When the initial capital is less than $\tilde{k_{1,t}}$, individuals have to choose whether or not to go to school with a loan. As long as they can take the same or larger utility by receiving education, they borrow from the credit market to finance the education cost. This condition is given by $IU^i_{2,t} \geq IU^i_{3,t}$. With Eqs. (1), (3), and (4), the threshold of initial capital in this situation is expressed as

$$k^i_t \geq \frac{-\{w_{s,t+1} - \gamma(1+d_{t+1})w_{s,t}\} + w_{u,t+1}}{\pi}.$$

We shall define the value which satisfies this equality by $\tilde{k_{2,t}}$. Individuals whose initial capital is $k^i_t \in [\tilde{k_{2,t}}, \tilde{k_{1,t}})$ belong to *Case 2* and $k^i_t \in [0, \tilde{k_{2,t}}]$ belong to *Case 3*.[13] Thus, the middle-class individuals whose initial capital is $k^i_t \in [\tilde{k_{2,t}}, \tilde{k_{1,t}})$ go to school with a loan and have no savings. Poor individuals whose initial capital is smaller than $\tilde{k_{2,t}}$ do not go to school when young and save all initial capital.

2.4 Equilibrium

As mentioned before, γ expresses the number of teachers required by a student, so the number of skilled labor who are employed in the education sector in time t is denoted by $S_{Et} = \gamma e_t$, where e_t is the number of students in time t. The total skilled workers in time t is given by S_t, and they are divided into the High-Tech sector and the education sector as $S_t = S_{Ht} + S_{Et}$. The size of skilled labor in time t is equal to that of students in time $t-1$; $S_t = e_{t-1}$. Therefore, skilled labor who are working in the High-Tech sector is described by $S_{Ht} = e_{t-1} - \gamma e_t$. Unskilled labor in time t, on the other hand, is equal to the number of young-age people who did not go to school in time $t-1$; $U_t = 1 - e_{t-1}$. In the steady state, as both the number of skilled labor and the number of students are constant over time, we get $e_t = e^*$ for all t. With this notation, labor supply in the steady state are respectively given by $S_E = \gamma e^*$, $S = e^*$, $S_H = (1-\gamma)e^*$, and $U = 1 - e^*$.

In equilibrium, demand for teachers and supply of teachers are equalized in the education sector. Demand for teachers is determined by the size of young individuals who hope to go to school. When human capital level is given by the educated population in the economy, the human capital level is determined by the number of young individuals whose initial capital is $k^i \in [\tilde{k_2}, \bar{k}]$. Consequently, human capital level in the steady state is given by

$$e^* = \int_{\tilde{k_2}}^{\bar{k}} \frac{1}{\bar{k}} dk_m = \frac{\bar{k}\pi + \{1 - \gamma(1 + r^w + \pi)\}w_s - w_u}{\bar{k}\pi}.$$

[13] See Appendix B for more details.

3 The trade-induced decrease in human capital level

When the price of High-Tech good changes, the effect on the human capital level is expressed by

$$\frac{de^*}{dp} = \frac{\{1-\gamma(1+r^w+\pi)\}}{\bar{k}\pi}\frac{dw_s}{dp} > 0.$$

The sign of this derivative is due to Assumption 2. An increase (decrease) in the price of High-Tech good, p, increases (decreases) human capital level.

When the world price of skilled-labor-intensive good decreases in developing economies, the skilled labor wage also decreases through the Stolper-Samuelson effect. Because the school fee depends on the skilled labor wage, a trade-induced fall in the skilled wage reduces the education cost and hence increases the demand for schooling as Cartiglia (1997). But if we allow individuals to borrow from the credit market against their future's labor income, the decrease in the skilled wage reduces the educational returns and then decreases the incentive to go to school with a loan as well. In this paper, it is shown that as long as the present value of skilled labor wage is higher than the current school fee, the effect of smaller returns is larger for the middle-class people whose initial capital does not cover the school fee.

We can see the mechanism of this result with the initial capital distribution. The decrease in the skilled wage pushes down the level of $\tilde{k_1}$ and, on the other hand, pushes up the level of $\tilde{k_2}$. That is, the size of *Case 1* becomes larger and the size of *Case 2* becomes smaller. However, because the human capital level is just given by the educated population, the effect of higher threshold $\tilde{k_2}$ is only effective. Therefore, the decrease in the world price leads to less human capital investment in developing countries.

4 Concluding remarks

This paper has analyzed implications of educational loans based on the model by Cartiglia (1997). Effects of trade on human capital accumulation of the present model differ from his analysis where individuals are assumed to be unable to borrow from the market. The result of this paper ensures that the standard results of Findlay and Kierzkowski (1983) where capital market is perfect are still supported even when there is a credit market imperfection such as risk premium.

Appendix A

The loan amount of *Case 2* is determined as follows.
When individual i borrows, b_t^i, from the credit market and goes to school with savings, the life-time income measured by the second period is given by

$$\begin{aligned} Y_{t+1}^s &= (1+r_{t+1}^w)\{(k_t^i + b_t^i) - \varepsilon_t\} - (1+d_{t+1})b_t^i + w_{s,t+1} \\ &= -\pi b_t^i + (1+r_{t+1}^w)(k_t^i - \varepsilon_t) + w_{s,t+1}. \end{aligned}$$

This means that the lesser amount borrowed, b_t^i, results in a lager life-time income, Y_{t+1}^s. Therefore, only people whose initial capital is less than the education fee borrow the minimum amount which can finance the fee. If people can afford to pay the education cost by themselves, they never borrow from the market to maximize their life-time income.

When individual i does not go to school although she/he borrows from the market, the life-time income measured by the second period is given by

$$\begin{aligned} Y_{t+1}^u &= (1+r_{t+1}^w)(k_t^i + b_t^i) - (1+d_{t+1})b_t^i + w_{u,t+1} \\ &= -\pi b_t^i + (1+r_{t+1}^w)k_t^i + w_{u,t+1}. \end{aligned}$$

This also means that less borrowing amount brings larger life-time income. Therefore, we can exclude a case that unskilled workers have a loan.

Appendix B

When $\tilde{k_{2,t}} \leq 0$, going to school with a loan always brings larger utility for any young people whose initial capital is less than $\tilde{k_{1,t}}$. At the time, only *Case 1* and *Case 2* exist and there are no uneducated people in this economy. But as we set two production sectors, we can exclude this case and treat $\tilde{k_{2,t}}$ as positive. The condition of $\tilde{k_{2,t}} > 0$ is given by

$$\frac{w_{s,t+1} - \gamma(1+d_{t+1})w_{s,t}}{w_{u,t+1}} < 1.$$

To have these three cases, we analyze under the wage difference;

$$\{w_{s,t+1} - \gamma(1+d_{t+1})w_{s,t}\} < w_{u,t+1} < \{w_{s,t+1} - \gamma(1+r_{t+1}^w)w_{s,t}\}.$$

If the wage difference is proportionate within this formula relationship, the human capital level in the economy is not affected by the world price change.

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