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The Rise in Schooling due to the Economic Development: The Case of East Asia

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Abstract

This paper introduces a theoretical model based on a fairly new viewpoint on education, by which people are informed of their expected outcomes of future education. According to the model, the effect of the recent rapid development in East Asian countries, on the demand of education is examined, using panel data of 10 East Asian countries. We believe that our framework offers the key to an understanding of the interdependent relation between schooling and economic development in recent East Asia. It is also found that the impact of the economic development on educational demand is larger for boys, particularly in tertiary education.

Keywords : Demand for schooling; Economic development; East Asia.

JEL Classification Numbers : I21; O11 ; O53

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1 Introduction

As reported in *the East Asian Miracle: Economic Growth and Public Policy* (World Bank Policy Research Reports), East Asian countries have achieved a miracle economic growth during the recent decades, even though their growth speeds have declined in the latter 1990s. They have increased their real per capita income by about 2-4 times for the past 20 years, which is twice as fast as the growth in average advanced countries, 3 times as fast as the Latin American countries, and an incredible 25 times as fast as the South Sahara African countries.

It is widely believed that the increase in educational attainment or enrollment is one of the most important factors that have led to the achievement of this unprecedented economic growth in East Asia. The aim of this paper is to shed light on this interdependent relation between education and economic growth, in particularly, by examining the effect of economic development on the demand of schooling in recent East Asia.

Generally, it is admitted that education, or human capital accumulation, is essential for the economic development or economic growth in a region. Much research have been carried out, following this viewpoint, in examining the effect of education on economic development both from a theoretical and empirical approach. For example, Lucas (1988) has theoretically described the role of human capital in economic growth in its well-known endogenous growth model. Mankiw, Romer, and Weil (1992) have examined cross-country growth differences using neoclassical growth model where they have included a human capital. Krueger and Lindahl (2001) is an excellent survey on empirical studies concerning the effects of education on economic development. Becker, Murphy, and Tamura (1990) show that an increase in the initial stock of human capital tends to raise physical investment, hence makes it easier for developing countries to catch up with the leading economies. However, surprisingly few studies so far have been made in examining the effect of economic development on education, even though the innovation of new technology or knowledge which stem from the economic development should influence the behavior of individuals on educational demand. One of the reasons for the lack of studies in this direction is due, we believe, to the fact that there has been no theory for education to address this problem.

This paper introduces a fairly new view to education, for the purpose of addressing the problem. While the role of education as an investment¹, a

signal², or a consumption³ are well known, this paper insists that education has another important aspect that, through education, people are informed of their expected outcomes of future education. In the traditional theory for education, it is assumed that the educational outcomes are known in advance. However, in reality, they are unknown since people are not known of their innate abilities or aptitudes in advance, and also due to the fact that educational outcomes may change by accident. Instead, people obtain information about their own abilities or aptitudes through education, which makes it possible for them to predict their outcomes of their future education, and therefore to work in fields in which they can perform best. This paper presents a theoretical model that assumes this property of education, which shows that an educational demand depends not only on what one can expect to acquire by a particular education, but also on the degree of development of region where one belongs. We then apply this theoretical form to explain the effect of recent rapid economic development in East Asian countries on the demand of education using panel data of 10 East Asian countries (i.e., China, Hong Kong, Indonesia, Korea, Japan, Malaysia, Philippines, Singapore, Thailand and Vietnam) for the period 1980-2000. It is shown that the empirical results are consistent to what our theory predicts especially for secondary and tertiary school education. In addition, it is shown that the impact of economic development on educational demand is larger for boys, particularly in tertiary education.

This paper is organized as follows. A model is presented in Section 2, where the theory for the determination of educational demand is described, assuming the role of education as an indicator of one's future educational outcomes. According to the theoretical framework, the empirical results using panel data of 10 East Asian countries are shown in Section 3. Section 4 gives a conclusion.

2 Model

In this section, a theoretical model is presented to describe the effect of economic development on the educational demand, by assuming two types of education. One is an education as an investment, which makes people more productive through the acquisition of information or knowledge concerning the usage of particular skills. This aspect of education is based on *the Human Capital Theory* originated by Becker (1964) and Schultz (1963). We denote

this type of education as **type A education**. The other type of education is a fairly new one. Generally, people do not know their educational outcomes in advance, contrary to traditional literatures where they have been assumed that the return to **type A education** is known in advance. In fact, education seems to have a property of forecasting one's outcomes of future education by providing information about one's innate abilities or talents for several skills. To focus on this aspect of education, we introduce another type of education which we denote as **type B education** whose role is to reduce the uncertainty seen in **type A education**.

A good place to start is by considering an economic model with perfect foresight where people are certain about their educational outcomes. Then, by comparing it to an economy where they are uncertain, we make sure of the function of **type B education**. Finally, the model is extended so that the demand of **type B education** is solved endogenously in the model. The main result of the analysis is that the educational demand depends not only on what one can expect from a particular education but also on the degree of development in the region.

2.1 The Economy with Perfect Foresight

Suppose a country where people (population is normalized to 1) can access n types of productivity-enhancing skills, and can decide whether to learn each of them. (Thus, this is how we define **type A education**.) We assume n to be continuous⁴. Individual can learn as many skills as he wants in exchange for an education cost C_i for each skill i ($i \in n$), and is assumed to maximize one's lifetime income. The education is completed before each of the individual gets a job. We assume for simplicity that there exists only one job in this economy, and that the acquisition of each skill contributes independently to increase one's productivity in the job. Educational outcomes are different among individuals (depending on the difference in abilities, aptitudes, or accidental reasons), where the degree that the skill i contributes to the increase of one's productivity in the job (which we denote as a_i) is supposed to be uniformly distributed in $[0, A_i]$. Thus, the lifetime earnings that each individual obtains are decided according to the outcomes on education. Let us see how an average productivity of a worker in this country can be described when people are certain about their educational outcomes in advance. Suppose that the credit market is perfect, and $0 \leq C_i \leq A_i$. Then, skill i is learned by $\frac{A_i - C_i}{A_i}$ of people whose average increase of productivity

by the skill acquisition is $\frac{A_i - C_i}{2}$. Thus, the average productivity of a worker in this economy can be described as⁵

$$\bar{I}^{PF} = \int_0^n \frac{(A_i - C_i)^2}{2A_i} di. \quad (1)$$

Note that **type B education** is not needed in this perfect foresight economy.

2.2 The Economy with Imperfect Foresight

We now consider a more realistic economy in which people do not know about their educational outcomes in advance. Thus, people can only realize their own values of a_i after they have spent an education cost C_i in learning skill i . In this case, the demand for skill i is 1 if $\frac{A_i}{2} \geq C_i$, and 0 if $\frac{A_i}{2} \leq C_i$. Thus, the average productivity of a worker in this economy can be described as

$$\bar{I}^{IF} \equiv \int_0^n \max\left\{\frac{A_i}{2} - C_i, 0\right\} di. \quad (2)$$

Note that the wage difference between perfect and imperfect foresight economy

$$\bar{I}^{PF} - \bar{I}^{IF} = \int_0^n \min\left\{\frac{C_i^2}{2A_i}, \frac{(A_i - C_i)^2}{2A_i}\right\} di \quad (3)$$

is a social cost caused by an uncertainty of **type A education**.

We are now ready to define the other type of education, whose property is to reduce this uncertainty, consequently, making people more productive. Our interest is to understand the characteristics of the demand seen in this type of education, given the number of accessible skills n . Note that n can be regarded here to represent the degree of development in the country. Thus, our strategy is to examine the effect of economic development on the educational demand by focusing on the relation between n and the demand of **type B education**. Suppose, after having **type B education**, one can choose to learn whichever skill one likes without any uncertainty if only one pays a fixed cost δ . That is, **type B education** is assumed to change the economy an individual faces from an imperfect foresight to the one with perfect foresight. Notice that this type of education should be demanded, if at all, in the primary stage of one's education process, and therefore, **type B education** shows a property to forecast one's outcomes of future education. Clearly, its demand is 1 if

$$\delta \leq \int_0^n \min\left\{\frac{C_i^2}{2A_i}, \frac{(A_i - C_i)^2}{2A_i}\right\} di \quad (4)$$

is satisfied, in which case the differential between both side of the equation expresses the social benefit that **type B education** creates. It is easy to verify that there exists n^* for which the above equation holds for all $n \geq n^*$. Note that the impact of the number of accessible skills on the expected average income ($\Delta I/\Delta n$) increases from $E_n(\max\{\frac{A_n}{2} - C_n, 0\})$ to $E_n(\frac{(A_n - C_n)^2}{2A_n})$ after $n = n^*$. This implies that in less developed countries where few skills or information are available, people have little incentive to have **type B education**, which is a basis of our idea.

2.3 Determination of Educational Demand

The model is extended so that the demand of **type B education** is determined as an endogenous variable e (defined as the cost spent for **type B education**) in the model. An individual who has invested e for **type B education** is supposed to realize one's ability of skill i (i.e. a_i) with a probability $P_i(e)$ ($\forall i, 0 \leq P_i(e) \leq 1, P_i'(e) > 0, P_i''(e) < 0$). In this setting, the equation to give an expected average productivity of a worker in this economy is described as

$$\bar{I} = \int_0^n \left(P_i(e) \frac{(A_i - C_i)^2}{2A_i} + (1 - P_i(e)) \max\{\frac{A_i}{2} - C_i, 0\} \right) di - e. \quad (5)$$

An individual maximizes equation (5) on e to derive the first order condition,

$$\int_0^n P_i'(e) \min\left\{ \frac{C_i^2}{2A_i}, \frac{(A_i - C_i)^2}{2A_i} \right\} di = 1. \quad (6)$$

It is easy to check that the second order condition holds⁶. Next proposition characterizes the effect of economic development on the demand of **type B education** in this model.

Proposition 1.

$$\frac{de}{dn} > 0 \quad (7)$$

$$\frac{d^2\bar{I}}{dn^2} > 0 \quad (8)$$

Proof. In Appendix. □

Equation (7) shows that as the variety of skills that exist in the country increases, the more the value of knowing one's innate ability increases, and therefore the more an individual invests for **type B education**. It also tells us that, since people have more prospects for the outcome of **type A education**, the marginal increase of the variety of skills is more effective in the country with high n . Thus, equation (8) implies that an innovation or introduction of new skill is more effective in more developed countries.

3 Empirical Analysis

3.1 Data

The purpose in this section is to try to account for the rise in schooling by the recent rapid development in East Asia (which is often known as the East Asian Miracle) according to Proposition 1. We use panel data of 10 East Asian countries for the period 1980, 1985, and 1990-2000.⁷ The 10 countries we have chosen are China, Hong Kong, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Thailand, and Vietnam.⁸ These countries and periods have been selected so that the variables needed for our regressions can be easily obtained. The panel data used in this paper is mostly collected from *the World Development Indicators 2003* on CD-ROM (WDI).

Although it is very difficult to find the exact index that reflects the degree of development (the variety of skills) in a region, we use the proportion of employees in the non-agricultural sector for the analysis. An index that represents the degree of development in public traffics is also used for the analysis, since the mobility of workers in a region seems to be important for the future opportunities (i.e., the variety of choices in skills) of children, and hence for educational demand. The ratio of the number of air passengers to population is used for the index⁹. On the other hand, an enrollment rate for primary, secondary, and tertiary school education is used to represent educational demand for each country according to WDI and *Global Education Digest* (2003) published by UNESCO. Although there must be many roles in school education (e.g., investment, signaling, etc.), we believe that schooling surely provides students with prospects for their futures.

3.2 Estimation Results

Table 1, Table 2, and Table 3 show the results of the panel data analysis where the enrollment rates are regressed on 3 variables: NONAGRI, TRAFFIC, and LE. NONAGRI denotes the proportion of employees in the non-agricultural sector. TRAFFIC denotes the ratio of the number of air passengers to population. Life expectancy at birth (labeled as LE) is added since it increases the expected span that workers can engage in a job, and therefore increases the value of **type B education**.

The fixed effect model is used for the regression since explanation variables are likely to be correlated with error term, due to the reverse causation: while the demand of schooling is positively affected by the degree of development, the causation can run the other way as well. Each table describes the regression results for primary, secondary, and tertiary school education respectively. Besides the results for both sexes, those for boys and girls are shown separately in each table. Though statistics for each of the sex are available for the explanation variables NONAGRI and LE, they are not available for TRAFFIC, for which we have used the common values.

Though the effect of economic development does not seem significant when regressed on primary education (Table 1), it shows quite significant results when regressed on secondary and tertiary education (Table 2 and Table 3). Note that the Hausman statistics in these two tables are also significant (except for boys in secondary education), which indicates that the correlation between explanation variables and error term is well absorbed in country dummies for the cases of secondary and tertiary education.

The demand of schooling in primary education is not well explained, presumably, because there are little differences in the enrollment rate of primary education between these countries due to it being compulsory, and therefore does not really reflect the household's opinion of education directly. However, the results for secondary education and tertiary education are significantly favor equation (7) in Proposition 1 to hold. This indicates that people invest more on education if industries are developed in the region, due to the property of education that it provides them with information about the outcome of their future education.

Our analysis also shows the difference in the effect of economic development on education between the sexes. It tells us that the impact of economic development on educational investment is larger for boys in tertiary education, whilst we cannot admit significant differences in secondary education.

It seems to still be regarded that higher skills should be acquired by males, and it is therefore the boys who increase their future possibilities by regional development.

The marginal impact of an industrial development on the average productivity of a worker ($\Delta GDP/\Delta NONAGRI$) is also regressed on the degree of development for both sexes. ΔGDP and $\Delta NONAGRI$ are the increments of GDP and NONAGRI respectively, between each periods. Table 4 shows that $\Delta GDP/\Delta NONAGRI$ is positively related to NONAGRI in both cases, indicating that equation (8) in Proposition 1 also holds. (The random effect model is used this time, since we find no correlation between explanation variable and error term.) This implies that the innovation or introduction of a new skill contributes more to increase one's income, if more skills are already available in the region. Since the demand for **type B education** is larger, and hence people are more informed of their innate traits and abilities in such regions, people are more adaptable to a new technology.

These empirical results are entirely consistent with our theoretical model which regards **type B education** to be important in understanding the effect of recent economic development on educational demand in East Asian countries. While the rich endowment of educational stock is necessary to promote developing countries' economic catching up with the advanced nation, at the same time, the decision for educational demand is affected by the prospects for future that these countries provide to citizens. We believe that this interdependent relation between education and economic development is one of the most important issues in the field of development economics, and that this paper offers the key to understand it.

	Enrollment Rate (Primary Education)		
	Total	Girls	Boys
NONAGRI	-0.20 (-1.27)	-0.19 (-1.65)	-0.16 (-0.98)
TRAFFIC	-6.33 (-2.08*)	-9.46 (-3.90*)	-6.38 (-2.37*)
LE	0.88 (2.45*)	1.32 (4.66*)	0.75 (1.92)
Hausman stat.	5.90	13.2*	4.22
adj.R2	0.468	0.729	0.308
obs.	53	47	47

Table 1. Estimation Result for Primary Education
(Fixed Effect Model, 1980, 1985 and 1990-2000).

Note: t-values are in the parentheses. *: Significant in 5% degree.

	Enrollment Rate (Secondary Education)		
	Total	Girls	Boys
NONAGRI	0.76 (4.79*)	0.56 (4.14*)	0.56 (2.89*)
TRAFFIC	3.56 (1.18)	2.94 (1.09)	2.97 (1.08)
LE	0.96 (2.62*)	1.28 (3.09*)	1.33 (2.75*)
Hausman stat.	10.6*	12.4*	6.55
adj.R2	0.962	0.974	0.972
obs.	86	71	71

Table 2. Estimation Result for Secondary Education.
(Fixed Effect Model, 1980, 1985 and 1990-2000)

Note: t-values are in the parentheses. *: Significant in 5% degree.

	Enrollment Rate (Tertiary Education)		
	Total	Girls	Boys
NONAGRI	0.48 (2.42*)	0.52 (2.87*)	0.85 (2.28*)
TRAFFIC	20.6 (6.03*)	17.7 (3.50*)	23.1 (3.04*)
LE	0.47 (0.80)	1.41 (1.28)	-0.56 (-0.46)
Hausman stat.	18.5*	21.6*	22.9*
adj.R2	0.890	0.853	0.883
obs.	89	54	49

Table 3. Estimation Result for Tertiary Education.
(Fixed Effect Model, 1980, 1985 and 1990-2000)

Note: t-values are in the parentheses. *: Significant in 5% degree.

	$\Delta (\text{GDP})/\Delta \text{NONAGRI}$		
	Total	Girls	Boys
NONAGRI	0.79 (3.67*)	0.71 (2.61*)	0.63 (2.22*)
Hausman stat.	0.20	0.53	0.14
adj.R2	0.322	0.217	0.143
obs.	95	71	76

Table 4. Estimation Result for $\Delta (\text{GDP})/\Delta \text{NONAGRI}$
(Random Effect Model, 1985 and 1990-2000).

Note: t-values are in the parentheses. *: Significant in 5% degree.

4 Conclusion

A model was presented in this paper, where two types of education were assumed: Education as an investment and education that provides people with prospects for their futures. It was shown that the model makes it possible for us to understand the effect of economic development on the demand of education due to the latter aspect of education. While education affects economic development, at the same time, education is also affected by economic development, which is useful in understanding of recent miracle growth in East Asia.

The theoretical framework has shown to be consistent with empirical results, using panel data of 10 East Asian countries. It is also shown that the impact of economic development on educational investment is larger for boys, particularly in tertiary education.

5 Appendix

Proof of Proposition 1

From equation (5),

$$\frac{de}{dn} = -\frac{P'_i(e) \min\left\{\frac{C_i^2}{2A_i}, \frac{(A_i - C_i)^2}{2A_i}\right\}}{\int_0^n P''_i(e) \min\left\{\frac{C_i^2}{2A_i}, \frac{(A_i - C_i)^2}{2A_i}\right\} di} > 0. \quad (9)$$

On the other hand,

$$\begin{aligned} \frac{d\bar{I}}{dn} &= P_n(e(n)) \frac{(A_n - C_n)^2}{2A_n} + (1 - P_n(e(n))) \max\left\{\frac{A_n}{2} - C_n, 0\right\} \\ &+ \left(\int_0^n P'_i(e) \min\left\{\frac{C_i^2}{2A_i}, \frac{(A_i - C_i)^2}{2A_i}\right\} di - 1\right) e'(n) \\ &= P_n(e(n)) \frac{(A_n - C_n)^2}{2A_n} + (1 - P_n(e(n))) \max\left\{\frac{A_n}{2} - C_n, 0\right\} \end{aligned}$$

leads to

$$\frac{d^2\bar{I}}{dn^2} = P'_n(e(n)) \min\left\{\frac{C_n^2}{2A_n}, \frac{(A_n - C_n)^2}{2A_n}\right\} e'(n) > 0. \quad (10)$$

Notes

1 Becker (1964) and Schultz (1963) are famous studies that discuss the role of education as an investment.

2 Spence (1973) and Arrow (1973) point out the signaling aspect of education. Stiglitz (1976) discusses the screening aspect of education which resembles the role of education as a signal.

3 See for example, discussion in Gullason (1989)

4 This is a device for the analysis to be simple. Main results do not change even for a discrete n .

5 The productivity of an individual without any education is assumed to be 0.

6 For simplicity, the existence of inner solution in equation (5) is assumed.

7 However, the data is not available for 1980 for Vietnam, and 1997-2000 for Hong Kong and Singapore.

8 The term *South East Asia* may be a more suitable name for some of these countries. However, we broadly categorize these countries as East Asia in this paper.

9 Statistics for other traffics such as automobiles or trains are difficult to obtain.

References

- [1] Arrow, Kenneth J., 1973, Higher Education as a Filter. *Journal of Public Economics* 2(3) pp.193-216.
- [2] Becker, Gary S., 1964, *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*. New York: Columbia University Press.
- [3] Becker, Gary, S., Murphy, Kevin, M., and Tamura, Robert, F., 1990, Human Capital, Fertility, and Economic Growth. *Journal of Political Economy*. 98(5) pp.12-37.
- [4] Gullason, Edward T., 1989, The Consumption Value of Schooling: An Empirical Estimate of One Aspect. *Journal of Human Resources* 24(2) pp.289-298.

- [5] Krueger, Alan B. and Mikael Lindahl., 2001, Education for Growth. *Journal of Economic Literature* 39 pp.1101-1136.
- [6] Lucas, Robert E., 1988, On the Mechanics .of Economic Development. *Journal of Monetary Economics* 22(1) pp.3-42.
- [7] Mankiw, Gregory N., Romer, David. and Weil, David., 1992, A Contribution to the Emprics of Economic Growth. *Quarterly Journal of Economics* 107(2) pp.407-438.
- [8] Schultz, Theodore W., 1963, *The Economic Value of Education*. New York: Columbia University Press.
- [9] Spence, Michael., 1973, Job Market Signaling. *Quarterly Journal of Economics* 87(3) pp.382-397.
- [10] Stiglitz, Joseph E., 1975, The Theory of “Screening” Education and the Distribution of Income. *American Economic Review* 65(3) pp.283-300.
- [11] UNESCO., 2003, *Global Education Digest: Comparing Education Statistics Across the World*. UIS Global Statistical Reports.
- [12] World Bank., 1993, *The East Asian Miracle: Economic Growth and Public Policy* World Bank Policy Research Reports.