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Human Capital and Income Growth in East Asia

Tam Bang Vu*

University of Hawaii.

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Abstract: We examine the effect of human capital on income growth using data for East Asia. The World Bank website provides data on education expenditures and school enrollments per year, which are flow variables. We supplement the data with information from each country's websites and estimate the impact of stock of human capital using a method based on the conventional production function. The results show that the effects of human capital on per capita income growth for the period 2000-2012 are higher than those of period 2012-2024. We also find that the effects are very different for individual economies.

Keywords: Human capital, income, East Asia.

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1. Introduction

The traditional production function in any nation comprises capital and labor. Capital can be divided into physical and human capital.

Previous authors have tried to estimate stocks of physical capital as discussed in Dadkiah and Zahedi (1990), Hulten and Wykoff (1981), Hulten, C.R. (1991), Prucha (1997), Gábor Pula (2003), Ward (1973), and OECD manuals (2001, 2009). However, capital estimates are extremely sensitive due to strong assumptions. Pula (2003) points out that this led to the estimated capital-output ratios fluctuate greatly and therefore, there is no way to guest what is the close estimation. In addition, the above literature only focusses on physical capital, leaving the human capital impact inaccurately addressed in literature.

Authors, who estimate impact of investment in human capital often use education expenditures or school enrollments per year as its proxy. Bils and Klenow (2000) find that this investment only has a weak effect on per capita income. On the reverse causality, this income increase has a direct impact on school enrollments. Hojo (2003) uses the residual from the estimation by Caselli et al. (1996) as a proxy for productivity. Using Arellano and Bond (1991) procedure, he finds that education has a direct relation with productivity.

Among papers on Asia, Demuger (2001) and Chen and Feng 2000) have shown that education has a direct correlation with per capita income. Hua (2006) finds that secondary and primary education has inverse relation with output per worker, but that of university education has a direct relation. Vu (2011) finds that direct relation between vocation school enrollments and provincial development.

Kumar (2003) finds that school enrollments have a direct relation with output per worker, but the reverse relation is negative, but his data set is small. Vu and Hammes (2007) use larger datasets and find that the two-way relations are both direct and significant.

For Vietnam, Henaff (2005) emphasizes that it is tough to estimate the impact of education: Costs of education are too high to give a positive rate of return. Moock *et al* (1998) and Doan (2011) use data for households. Both papers find that returns to education in Vietnam are very weak.

For Pacific region, Turpin (2010) finds that Australian higher education has positive impact on industrial development.

Later papers discuss the different topics. Castelló-Climent and Doménech (2021) the relationship between human capital and income inequality. The authors find that human capital has a direct relationship with income inequality. However, the effects are very different in individual countries. Zhao and Hou (2025) examine the impact of (Artificial Intelligence) AI development on inter-industry income disparity in China. They find that AI also has a direct relationship with income inequality, and the disparity varies greatly across regions.

In brief, none of the above articles focus on human capital and per capita income growth in East Asian economies utilizing the data modifying approach. Our paper aims to fill this gap.

East Asian economies in this paper comprises China, Hong Kong, Japan, South Korea, Macao, and Taiwan. Data on investment in education such as expenditures and school enrollments per year are flow variables. We use our previous method in Im and Vu (2012) for physical capital, which is a stock variable, to estimate human capital per person. We then analyze the effect of human capital growth on per capita income growth in East Asia.

***Corresponding Author**

Tam Bang Vu*

University of Hawaii.

2. Model and Data

We use the Cobb-Douglas production function, focusing on human capital and labor—temporarily eliminating physical capital, which might result in increasing returns to scale. Thus, assuming a constant return to scale function, we have:

$$Y_t = Ae^{\tau t} K_t^{\alpha} L_t^{1-\alpha} \tag{1}$$

where $\theta \equiv (A, \tau, \alpha)'$ is a vector of unknown parameters whose estimations require observations on Y_t as income, K_t as human capital, and L_t as labor. If we can estimate θ in Equation (1) without using K_t, then growth rate of K_t can be deduced from Equation (1) as long as data on Y_t and L_t are available. We then follow a method outlined in Im and Vu (2012) to obtain:

$$G_Y = G_A + \alpha G_K + (1-\alpha) G_L \tag{2}$$

where G_Y is growth of income per person in this paper, G_A is growth of technology, G_K is growth of human capital, and G_L is growth of labor, the parameter α is the growth of human capital that contributes to growth of per capita income. Estimate equation (7) will provide information for calculating human capital growth per person using Equation (9).

Data on income, population, employment, and real interest rates for 2000-2024 are from the World Bank website. We supplement the dataset with information from each country's website. Data with current values are converted into real values using GDP deflation provided by the US Department of Agriculture. We then generate dummies to account for the different effects on individual economies.

3. Results

We perform Hauman tests and find that the fixed effect is the most appropriate method. The modified Hauman tests do not reveal any endogenous variables. We then follow Im and Vu (2012) to obtain parameters to use in Equation (2) for the effects of human capital growth on income per person. The results are similar to Summers-Heston (1991) for physical capital using different methods.

Table 1 reports the aggregate results. They show that human capital growth accounts for 29.42% of value-added growth per person in East Asia during 2000-2012 (Column 1.1) but only 25.57% of this growth during 2012-2024 (Column 1.2).

Table 1. Aggregate Effects of Capital Growth on Growth of Per Capita Income
Dependent variable: Log of income per person.

	Column 1.1. Period 2000-2012		Column 1.2. Period 2012-2024	
Variable	Coefficient	p-value	Coefficient	p-value
Trend	0698**	.033	.0679**	.041
Log of interest rate	-.487**	.019	-.3276**	.037
Growth of human capital	.2942**	.045	.2557***	.006
Sample Size	86		77	
Prob. > F	.003		.002	
Average R-Square	.7425		.7024	
White test: p-value	.3523		.4176	
Autocorrelation coefficient	.4523		.3978	

Note: ** and *** denote statistically significant at 5% and 1% levels, respectively. Coefficients for growth of capital are calculated using Equation (9), and p-values of the Wald tests for the significance of these coefficients are reported.

Using South Korea as the base group, we generate five dummies for other economies. The results for 2000-2012 are reported in Table 2, Column 2.1. They show that the coefficient of South Korea is 4% higher than the East Asian average. The highest economy is Hong Kong, of which the coefficient is 3% higher than that of South Korea and significantly so. The remaining economies have the coefficients lower than the base group and statistically significantly so. The raking of the economies is as follows: Hong Kong, South Korea, Taiwan, Japan, China, Macao.

The results for 2012-2024 are reported in Table 2, Column 2.2. The ranking of the economies is like those in Column 2.1 with one exception: Hong Kong now have coefficient not statistically different from that of South Korea.

Table 2. Individual Effects of Human Capital Growth on Growth of Per Capita Income

Dependent variable: Log of income per person for each economy.

	Column 1.1. Period 2000-2012		Column 1.2. Period 2012-2024	
Variable	Coefficient	p-value	Coefficient	p-value
South Korea				
Log of interest rate	-.6479**	.025	-.4987**	.035
Human capital growth	.3312**	.026	.2895**	.039
Hong Kong				
Log of interest rate	-.3298**	.018	-.5365***	.004
Human capital growth	.3621***	.006	.2902	.213
Taiwan				
Log of interest rate	-.5231**	.018	-.3197**	.037
Human capital growth	.2959**	.034	.2543**	.033
Japan				
Log of interest rate	-.4132**	.026	-.3109**	.041
Human capital growth	.2364***	.008	.2312**	.025
China				
Log of interest rate	-.3109**	.034	-.4657**	.024
Human capital growth	.1978**	.017	.1878**	.046
Macao				
Log of interest rate	-.9807**	.019	-.6387***	.001
Human capital growth	.1865**	.048	.1756**	.027
Sample Size	91		87	
Prob. > F	.000		.000	
Average R-Square	.7542		.7231	
White test: p-value	.3512		.4958	
Autocorrelation coefficient	.2867		.5201	

Note: ** and *** denote statistically significant at 5% and 1% levels, respectively. Coefficients for growth of capital are calculated using Equation (9), and p-values of the Wald tests for the significance of these coefficients are reported.

4. Conclusion

There are several implications. First, COVID-19 might have a long-lasting impact on investment in human capital worldwide. Second, the efficient use of human capital might be a problem in East Asian economies even though investment in education is often high in these countries Third, the empirical results confirm the theory on catching up phenomenon in economics, which suggests that higher development results in lower return to capital, in this case, human capital. Finally, there is needs for education reforms to allow more vocational education instead of university education in these countries so that direct skills can directly contribute to economic development instead of general knowledge.

These comments are only suggestions and require empirical studies to confirm their accuracy in the future.

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