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Human Capital, Production and Growth in East Asia

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Abstract

The present study uses a production function and an alternative empirical strategy to investigate the importance of human capital on the level and growth of output by focusing on a single region, namely East Asia. The finding is that educational attainment (measured by average years of schooling) statistically significantly correlates with subsequent income levels. This in turn implies that a change in educational attainment has a positive effect on this group of countries' income growth. However, the evidence is less clear-cut, and varies when the aggregate measure of educational attainment is decomposed into different school levels; namely primary, secondary and higher level. In all cases the impact of primary education remains positive but only significant in some cases. In all cases, a statistically significant positive effect was found for average years of school at secondary level. The impact of higher school level (than secondary level) in all cases is insignificant and surprisingly tends to have a negative effect on income level and growth.

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I. INTRODUCTION

In this paper the aim is to test whether human capital has an effect on income level and its rate of growth in Asian countries. In order to test this main hypothesis, the Cobb-Douglas production functions, which augment the labour input, are used.

The present study adopts an alternative empirical strategy to investigate the importance of human capital on the **level and growth of output** by focusing on a **single region**, namely East Asia. Another main advantage of this approach is a more careful and in depth examination of region-specific characteristics that are crucial to the region's economic development. In particular, the role of human capital in past experiences (during 1965-90) of East Asian countries is carefully studied.

The outline of the paper is as follows. In the next section, the production function model is developed and explained. Section III explains the econometric methodology and data used. Section IV presents the results obtained. This section discusses these results in some detail and compares them with other East Asian human capital studies. Section V concludes the paper.

II. PRODUCTION FUNCTION SPECIFICATION

The suggestion of Topel (1998) that the production function is a more direct approach to test the connection between human capital and output is followed in this study. Therefore, the approach here is to estimate aggregate production functions from pooled time-series and cross-section data. In this paper, the importance of human capital in one specific region, East Asia is tested. The advantage, as suggested by Temple (1998), is that the correlation between human capital and output is less likely to be hidden in the small cross-country data by unrepresentative observations.

The study hypothesis is that accumulated human capital has a direct impact on the productivity of labour. As a result, the labour input is augmented by the level of human capital, therefore, the production function used in the empirical study is

$$Y_{it} = A_{it} K_{it}^{\alpha} (H_{it} L_{it})^{1-\alpha} \quad (1)$$

where Y is the output level, K is the physical capital stock, L is the raw labour input, A is the productivity level, H is the level of human capital and α and β are parameters. This specification (after many tests which can be obtained from the authors) was reduced to a **constant returns to scale** Cobb-Douglas production function for these Asian countries.

The human capital stock (H) is measured by educational measure (E) and a simple transformation function is employed relating human capital to the education level as

$$H_{it} = e^{\delta E_{it}} \quad (2)$$

where δ is a parameter. Substituting (2) into (1) yields

$$Y_{it} = A_{it} K_{it}^{\alpha} (e^{\delta E_{it}} L_{it})^{1-\alpha} \quad (3)$$

Dividing (3) by L_{it} yields

$$\frac{Y_{it}}{L_{it}} = A_{it} \left(\frac{K_{it}}{L_{it}}\right)^{\alpha} e^{\delta(1-\alpha)E_{it}} \quad (4)$$

Assuming Hicks neutral technical progress and taking natural logs, the following estimatable form is derived:

$$\ln\left(\frac{Y_{it}}{L_{it}}\right) = \ln A_0 + \lambda t + \alpha \ln\left(\frac{K_{it}}{L_{it}}\right) + (1-\alpha)\delta E_{it} \quad (5)$$

Let $\varphi = (1-\alpha)\delta$, leads to

$$\ln\left(\frac{Y_{it}}{L_{it}}\right) = \ln A_0 + \lambda t + \alpha \ln\left(\frac{K_{it}}{L_{it}}\right) + \phi E_{it} \quad (6)$$

where α and φ are the elasticity of output with respect to capital and average education respectively.

Equation (6) is estimated from the data and procedures discussed below but at this stage it is worthwhile to emphasize the key assumptions of the model that will be estimated (and briefly discuss them in the next section).

1. All countries have access to the same technology, that is, they have the same underlying aggregate production functions.
2. The rate of technical progress is the same across countries and takes the form of an exponential time trend.
3. The right-hand side variables, physical capital, human capital, and labour, are uncorrelated with the stochastic error term, ε .
4. Human capital variables refer to current population at working age (explained in more detail below), depend largely on history and are not affected by current output.

III. METHODOLOGY AND DATA

Here the approach is to estimate the aggregate production functions from pooled time-series and cross-section data. Pooled regressions are dealt with where time series and cross-sectional observations are combined or pooled together. As Vinod and Ullah (1981, p. 248) wrote:

When dealing with cross section and time series data, where each individual cross-

section sample is small so that sharp inferences about the coefficients are not possible, it is a common practice in applied work to pool all data together and estimate common regression. The basic motivation for pooling times series and cross-section data is that if the model is properly specified, pooling provides more efficient estimation, inference, and possibly prediction.

If the regression is estimated by the usual OLS procedure, the assumption is that the regression parameters do not change over time (temporal stability) and that they do not differ between various countries (cross-sectional stability). Implicitly also, the assumption in such a

procedure is that the error variance of various countries' production functions is homoscedastic and the error term in a country's production function at time t is uncorrelated with the error term in those of the other countries in the sample at time t . These are obviously unrealistic assumptions. Fortunately, there are various ways of relaxing these assumptions and incorporating them in the estimating procedure.

One is by assuming that the intercept values in the various countries' production functions are different (question of cross-sectional stability) by using the dummy variables. A second is by relaxing homoscedasticity of the error variance of various countries' production functions. Then GLS procedure is used for estimation. A third is by letting the error term in a country's production function at time t be correlated with the error term in those of the other countries in the sample at time t . Also, the error term in a country's production function at time t can be correlated with the error term at time $t-1$. Then GLS procedure is used for estimation.

For the first, because the countries in this sample are quite homogeneous¹, the regression parameters do not differ much and, therefore, the problem of cross-section instability is less likely. For the relaxation and testing of the other assumptions is done by using appropriate GLS procedures for estimation in SHAZAM.

The OLS and the three GLS ('pool') commands available in SHAZAM programme, which are used here, are described below.

1. OLS: By using the usual OLS procedure, the assumptions are that $E(\varepsilon) = 0$ and the stochastic error terms, ε , have identical variances and are uncorrelated across time and countries.
2. POOL (SAME): By using POOL (SAME), the error term in a country's production function at time t is correlated with the error term at time $t-1$ but still force the autoregressive parameters of the error terms to be the same for each of the cross-sectional units. If this option is specified then the model assumptions are autoregressive, and cross-sectional homoskedasticity
3. POOL (CORCOEF): By using POOL (CORCOEF), the error term in a country's production function at time t is correlated with the error term at time $t-1$. The estimation of the autoregressive parameters of the error terms is not the same for each country. If this option is specified then the model assumptions are cross-sectional heteroskedasticity with cross-sectional independence.
4. POOL (FULL): By using POOL (FULL), the error term in each country's production function is cross-sectionally correlated and time-wise autoregressive. If this option is specified then the model assumptions are cross-sectional heteroskedasticity with cross-sectional dependence.

Among these four commands, the FULL option is the least restricted one and therefore its estimated results are preferable. However, in this study this procedure always fails. This is because the FULL type estimation requires a large number of observations in order to fulfil its assumptions of cross-sectional heteroskedasticity with cross-sectional dependence but the sample in this study is not large enough for this estimation. The second best estimated result is from the CORCOEF command model. The estimated parameters from the CORCOEF command are therefore preferred to those from the SAME and OLS. However, it will be clear from the results presented that these three different commands always lead to very similar, if not identical parameter estimates.

¹Japan and the Philippines are different countries (for example, different economic structure). However, since the sample size in this study is small, using dummy variables is difficult. This problem is, hopefully, not serious and, at least partially, be resolved when the extended model which capture differences in human capital is estimated.

Turning to the data, the data of GDP, physical capital and labour used for estimation are from the Summers and Heston Penn World Table (Mark 5.6a). The output measure is real GDP per worker (1985 international prices). The labour force is derived from the reported data on real GDP per capita, real GDP per worker and population. This study covers the 1965 to 1990 time period for a sample of six countries, which all the data required are available – Hong Kong, Japan, Korea, the Philippines, Taiwan and Thailand. For the data on human capital variable, as the educational attainment ratio has always been the most preferable and widely used direct proxy of human capital in the literature, it is also used in this study.

The data of human capital, provided by Barro and Lee (1996), were presented in five-yearly blocks for the year 1960-1990, i.e. 1960, 1965, 1970, 1975, 1980, 1985, and 1990. For estimation in this study all data, also in five-yearly blocks for the year 1965-1990 and for six countries, are used. It is also worthwhile to note that the average years of attainment variables are called XY# in this study, where X is either t (total), p (primary), s (secondary) or h (higher), Y is either blank (aggregate), m (males) or f (females) and # is either 2 (adults aged 25 and over) or 1 (adults aged 15 and over).

IV. RESULTS

The estimation results from equation (6) are presented in Table 1.#, where # is either 0,1, 2, 3. Table 1.0 presents the results where E_{it} denotes the aggregate measure of educational attainment (measured by average years of attainment of schooling). Table 1.1 presents the results where E_{it} denotes primary educational attainment. Table 1.2 presents the results where E_{it} denotes secondary educational attainment. Table 1.3 presents the results where E_{it} denotes higher educational attainment.

All results obtained from the OLS, SAME and CORCOEF are qualitatively identical (see the previous section). The quantitative results are only slightly different, if not identical. However, the estimated parameters from the CORCOEF command are used for the reference because this is less restrictive and as a result the estimates are more preferable.

From Table 1.0 the estimate of the production elasticity of capital is between 0.47 and 0.56. The estimates of technical progress are not statistically significant. The estimated effects of average years of schooling, applying to persons aged 15 and above and 25 and above, are both equal to 0.09 and statistically significant at the conventional test level. This implies that a one year increase in the average years of schooling will lead to a 0.09 percent increase in output per unit of labour. For females, this estimated effect of average years of schooling applying to persons aged 15 and above and 25 and above are 0.07 and 0.06 respectively and both are statistically significant at the conventional test level. This implies that a one year increase in the average years of schooling of females will lead to a 0.06-0.07 percent increase in output per unit of labour which is slightly lower than that of the aggregate impact. For males, this estimated effect of average years of schooling applying to persons aged 15 and above and 25 and above are 0.06 and 0.10 respectively and both are statistically significant at the conventional test level. This implies that a one year increase in the average years of schooling of males will lead to 0.06-0.10 percent increase in output per unit of labour which is slightly higher than that of the aggregate and female impact. Overall the results are basically similar, when the years of attainment applying to persons aged 15 and above and 25 and above, except for the case applying to males. The impact of the years of attainment applying to male aged 15 and above on income is lower than that applying to males aged 25 and above.

From Table 1.1 the estimate of the production elasticity of capital is between 0.56 and 0.62. The estimates of technical progress are not statistically significant. The estimated effect of average years of schooling at primary level applying to persons aged 15 and above is statistically insignificant while that of 25 and above is 0.11 and statistically significant at the conventional test level. This implies that a one year increase in schooling at primary level will lead to 0.11 percent increase in output per unit of labour. For females, the estimated effects of average years of schooling, applying to persons aged 15 and above and 25 and above, are both statistically insignificant at the conventional test level. For males, this estimated effect of average years of schooling applying to persons aged 15 and above is statistically insignificant while that of 25 and above is 0.18 and statistically significant at the conventional test level. This implies that a one year increase in the average years of schooling of males at primary level will lead to a 0.18 percent increase in output per unit of labour which is higher than that of the aggregate and female impact. Unlike that applying to those aged 25 and above, the impact of the years of attainment applying to aged 15 and above on income is always insignificant. Unlike that applying to males, the impact of the years of attainment applying to females on income is always insignificant. This implies that the years of attainment of females at primary school has no impact on income level. Overall, the aggregate effect on output of an additional year of schooling at primary level is equal to that in Table 1.0. In the case of males, it is higher than that in Table 1.0.

From Table 1.2 the estimate of the production elasticity of capital is between 0.43 and 0.50. The estimate of technical progress is statistically significant only in the case of average years of schooling at secondary level applying to males and equals 0.04. The estimated effect of average years of schooling at secondary level applying to persons aged 15 and above and 25 and above are 0.18 and 0.25 respectively and statistically significant at the conventional test level. This implies that a one year increase in the average years of schooling at secondary level will lead to a 0.18-0.25 percent increase in output per unit of labour. For females, the estimated effects of average years of schooling applying to persons aged 15 and above and 25 and above are identical and equal to 0.21 and statistically significant at the conventional test level. This implies that a one year increase in the average years of schooling of females at secondary level will lead to 0.21 percent increase in output per unit of labour. For males, the estimated effects of average years of schooling applying to persons aged 15 and above and 25 and above are 0.12 and 0.17 respectively and are statistically significant at the conventional test level. This implies that a one year increase in the average years of schooling of males at secondary level will lead to 0.12-0.17 percent increase in output per unit of labour which is lower than that of the aggregate and females effect. The impact of the years of attainment at secondary level applying to males on income is lower than that applying to females. Overall, the effect of an additional year on output of schooling at secondary level is higher than those in Tables.1.0 and 1.1.

From Table 1.3 the estimate of the production elasticity of capital is between 0.62 and 0.67. The estimate of technical progress is statistically insignificant. The estimated effects of average years of schooling at a higher school level applying to persons aged 15 and above and 25 and above are -0.25 and -0.26 respectively and are statistically insignificant at the conventional test level. For females, the estimated effects of average years of schooling applying to persons aged 15 and above and 25 and above are -0.28 and -0.34 respectively and are statistically insignificant at the conventional test level. For males, the estimated effects of average years of schooling applying to persons aged 15 and above and 25 and above are -0.09 and -0.05 respectively and are statistically insignificant at the conventional test level. This implies that an increase in the average years of schooling at a higher school level has no effect on output and tends to be a negative effect.

Therefore, summing up, the results clearly show:

1. A insignificant positive effect of the average years at primary school (in most cases)
2. A significant positive effect of the average years at secondary school (in all cases)
3. A insignificant negative effect of the average years at higher school (in all cases).

Nelson and Phelps (1966) suggested that the composition of level of education of workers is very important to a country's income growth. To sustain growth, a country has to manage its resources in a way to achieve the optimal level of higher and lower education. Different levels of education are complements and not perfect substitutes. They are required inputs for education production. Higher education is for innovation while lower education is for developing or utilising new innovation. Training some workers to very high standards but ignoring the rest may be inefficient because the poorly trained workers are unable to fully develop or even utilise new innovation. This may slow down the return to innovators and the growth rate. On the other hand, only emphasising basic knowledge and ignoring higher education may reduce a country's ability to innovate and hence the growth rate will be low. Thus, the design of education policy needs to take account the complementary nature of different forms of human capital and not concentrate too heavily on one form alone.

The countries in this study lie below the international leading-edge. They are now developing and learning by doing, rather than innovating or doing their own fundamental research. Imitation is more accessible especially when free trade is allowed. These countries now enjoy the benefits from learning by doing and imitation but once they reach the technical frontier, increased investment in research becomes necessary in order to sustain their growth. Applying Nelson and Phelps's hypothesis to the above statement, the ability of a country to innovate is now not necessary (in this case it is not because countries invest too heavily on higher education but because they can borrow or utilise technology from other countries). Now they can benefit by training workers to utilise this available technology and hence, secondary school is necessary for these countries. Primary school education may not be enough for workers to know how to develop or even utilise technology, which is consistent with the fact that these countries' products are not labour intensive anymore but tend to be medium technology intensive. Higher school education is not necessary for the countries right now and tends to have a negative effect on income levels and growth². But, once they cannot enjoy the benefit from other countries' innovation, higher education will be required and has a positive effect on income levels and growth. The countries with secondary-educated workers therefore can enjoy static welfare gains from imitation and learning by doing but may end up with dynamic losses if they cannot adjust their education stock, once that enjoyable period ends. The recent economic down turn may imply that these countries are near to or have even reached the technical frontier. Labour intensive and low/medium technology intensive products in the world market which used to belong to these countries are now replaced by products from less developed countries. The countries cannot however shift to high technology products because of the shortage of their stock of knowledge.

The learning by doing model of Young (1991) can also be used to explain the study results. Under free trade, more developed countries will produce and export more sophisticated goods while the less developed countries will produce and export less sophisticated goods. Less sophisticated goods use a lower stock of technological knowledge. Under free trade considerations of comparative advantage, the countries in our sample tend to produce medium sophisticated goods, while the less and more developed countries produce less and more sophisticated goods respectively. As a result, secondary education is necessary for producing

²This is possibly because higher education takes resources away from lower education. This argument can be tested by putting all education measures in together to control for each in interpreting others but the estimation is very likely to face multicollinearity problem.

the medium sophisticated goods and hence it has a significant positive effect on the countries' income levels and growth.

An alternative explanation for the insignificant negative impact on output of average years at higher school is that costs of educational investment are significant at the macroeconomic level. The opportunity costs of resources in term of earnings foregone by enrolled students may be relatively large compared to the gains from highly educated individuals who work as teachers rather than in private industry. Also, short term the opportunity costs of resources occur when scarce government finance is devoted to investment in education structures and equipment (particularly in higher school) rather than in other types of productive infrastructure.

Next turning the relative roles of total factor productivity (TFP) and inputs in output growth, the estimates of input elasticity of output from Table 1.0-1.3 and the growth rates of output and input are used to calculate the contribution to growth and TFP for each country.³ Table 2.# provides these calculations, where # is either 0, 1, or 2. The estimated parameters obtained from the CORCOEF command model were used these calculations. Table 2.0 presents the results where E denotes the aggregate measure of educational attainment (measured by average years of attainment of schooling). Table.2.1 presents the results where E denotes primary educational attainment. Table 2.2 presents the results where E denotes secondary educational attainment.

Among all the countries in the study, the contribution of average years of attainment to output growth is very small. The positive contribution of average years of attainment to output growth (total, primary and secondary level) is largest for the Philippines economy and smallest for Japan. The Philippines is less developed compared to other countries in this sample so primary and secondary education will allow it to learn more from existing technology. Japan is more developed compared to other countries in this sample so it enjoys less benefit from existing technology. This is also consistent with features of the Nelson and Phelps (1966) model.

The average years of attainment at secondary level has the largest impact on output growth compared to other levels. The increase in the average years in schooling, taking into account every school level, accounted for between 1.74 and 5.02 percent of income growth in this sample. The increase in the average years in schooling at primary level accounted for between 0.70 and 4.59 percent of income growth. The increase in the average years in schooling at secondary level accounted for between 9.72 and 22.94 percent of income growth.

Therefore summing all up in all countries, except Hong Kong, capital accumulation plays the most important role.

Finally, if one compares the results presented and discussed here with results from other studies, overall, the main finding in this study is similar to that of Barro-Martin (1995). They found that education attainment was significantly correlated with growth but the impact of primary education attainment was insignificant. However, in this study the impact of female schooling at every school level on output is qualitatively identical to that of male schooling, which is different from that of Barro-Martin (1995) who found negative coefficients for the average years of schooling of females but positive coefficients of males. This study was also

³Once the growth of each input weighted by the estimated output elasticity is subtracted from the growth of output, the residual is considered the TFP. The contribution of each input to growth is calculated as the percentage ratio of the growth of each input, weighted by its output elasticity to the growth rate of output and the contribution of TFP is the percentage ratio of the residual to the growth rate of output.

compared with Collins and Bosworth (1996). The results were extremely different from this study in the case of the Philippines. Education had a negative effect on its economic growth while in this study education makes a very impressive contribution to its economic growth as explained above.

V. CONCLUSION

It was found that education contributes a small amount in output growth in East Asian countries. Factor accumulation played the most important role in drive growth of these countries during the period 1965-1990. The regression results show that the average years of schooling, taking into account every school level, have a statistically significant positive impact on output levels of these countries. In this case, human capital contributed between 2 and 5 percent on growth. However, the results are different when the aggregate measure of educational attainment is decomposed into primary, secondary, and higher levels. The estimated regression shows that while the average years of school attainment at primary and secondary levels have positive impacts, the average years of school attainment at a higher level has a statistically insignificant and negative impact on output levels of these countries. In the case of primary level, human capital contributed only between 1 and 5 percent while in the case of higher level, human capital contributed between 10 and 23 percent. It was found that the impact, of female schooling at every school level, on output is qualitatively identical to that of male schooling. The impact on output of female schooling in aggregate and primary school levels is lower than that of male schooling. The impact on output of females schooling at secondary school levels is, however, higher than that of male schooling. The results are slightly different if the years of attainment apply to persons aged either 15 and above or 25 and above.

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Table 1.0 $\ln Y/L = \text{Constant} + \lambda t + \alpha \ln K/L + \phi(\text{Total}) + \varepsilon$

Regression	Constant	λ	α	$\phi(t1)$	$\phi(t2)$	$\phi(tf1)$	$\phi(tf2)$	$\phi(tm1)$	$\phi(tm2)$	R ²	LLF
1. OLS	3.52 (8.59)	0.002 (0.12)**	0.53 (7.90)	0.10 (2.76)	-	-	-	-	-	0.93	16.0
2. SAME	4.35 (7.43)	0.06 (1.84)*	0.45 (5.53)	0.06 (1.83)*	-	-	-	-	-		27.5
3. CORCOEF	3.80 (11.52)	0.008 (0.49)**	0.52 (9.14)	0.09 (2.98)	-	-	-	-	-		31.1
1. OLS	3.34 (7.96)	0.0007 (0.03)**	0.58 (8.89)	-	0.08 (2.08)	-	-	-	-	0.93	14.5
2. SAME	4.67 (7.23)	0.06 (1.60)**	0.40 (4.72)	-	0.08 (1.99)*	-	-	-	-		27.7
3. CORCOEF	3.95 (12.47)	0.007 (0.45)**	0.50 (9.75)	-	0.09 (3.48)	-	-	-	-		33.2
1. OLS	3.23 (8.58)	-0.003 (-0.14)**	0.60 (10.68)	-	-	0.07 (2.28)	-	-	-	0.93	14.9
2. SAME	4.48 (7.13)	0.06 (1.73)*	0.44 (5.33)	-	-	0.06 (1.64)**	-	-	-		27.1
3. CORCOEF	3.70 (12.58)	0.003 (0.20)**	0.54 (11.74)	-	-	0.07 (3.04)	-	-	-		31.7
1. OLS	3.02 (8.04)	0.004 (0.16)**	0.65 (12.44)	-	-	-	0.04 (1.40)**	-	-	0.92	13.2
2. SAME	4.56 (7.22)	0.06 (1.33)**	0.43 (5.23)	-	-	-	0.07 (2.03)*	-	-		28.0
3. CORCOEF	3.67 (11.57)	0.004 (0.21)**	0.56 (11.80)	-	-	-	0.06 (2.81)	-	-		31.7
1. OLS	3.47 (8.12)	0.02 (0.90)**	0.54 (7.46)	-	-	-	-	0.08 (2.40)	-	0.93	15.2
2. SAME	4.28 (7.50)	0.06 (2.13)	0.46 (5.61)	-	-	-	-	0.06 (1.76)*	-		27.5
3. CORCOEF	3.60 (10.15)	0.02 (1.08)**	0.55 (9.04)	-	-	-	-	0.06 (2.00)*	-		30.1
1. OLS	3.48 (7.73)	0.01 (0.62)**	0.55 (7.22)	-	-	-	-	-	0.08 (2.21)	0.93	14.7
2. SAME	4.53 (7.32)	0.07 (1.90)*	0.41 (4.76)	-	-	-	-	-	0.08 (1.94)*		27.8
3. CORCOEF	4.01 (11.5)	0.02 (1.15)**	0.47 (7.80)	-	-	-	-	-	0.10 (3.14)		32.8

Data Sources (Tables 1.0-1.3): Barro and Lee (1996) and Summers and Heston (1991) Penn World Table (Mark 5.6a).

Notes (Tables 1.0-1.3): The t-statistics are shown in parentheses. (* and ** denote a coefficient not significantly different from zero at the 5% and 1% test levels, respectively).

Table 1.1 $\ln Y/L = \text{Constant} + \lambda t + \alpha \ln K/L + \phi(\text{Primary School}) + \varepsilon$

Regression	Constant	λ	α	$\phi(p1)$	$\phi(p2)$	$\phi(pf1)$	$\phi(pf2)$	$\phi(pm1)$	$\phi(pm2)$	R ²	LLF
1. OLS	2.79 (8.07)	0.01 (0.52)**	0.65 (11.46)	0.07 (0.84)**	-	-	-	-	-	0.92	12.6
2. SAME	4.46 (6.58)	0.09 (2.42)	0.47 (5.33)	0.02 (0.32)**	-	-	-	-	-		25.9
3. CORCOEF	3.13 (11.22)	0.006 (0.30)**	0.61 (13.09)	0.08 (1.54)**	-	-	-	-	-		29.5
1. OLS	2.84 (8.06)	0.01 (0.54)**	0.66 (12.05)	-	0.05 (0.74)**	-	-	-	-	0.92	12.5
2. SAME	4.41 (6.67)	0.08 (2.06)	0.45 (5.18)	-	0.07 (0.99)**	-	-	-	-		26.5
3. CORCOEF	3.27 (11.19)_	0.004 (0.23)**	0.58 (11.65)	-	0.11 (2.10)	-	-	-	-		30.4
1. OLS	2.80 (8.01)	0.02 (0.64)**	0.68 (13.7)	-	-	0.02 (0.41)**	-	-	-	0.92	12.3
2. SAME	4.31 (6.63)	0.08 (2.16)	0.49 (5.75)	-	-	0.02 (0.37)**	-	-	-		26.1
3. CORCOEF	3.16 (10.20)	0.008 (0.41)**	0.62 (13.27)	-	-	0.05 (1.13)**	-	-	-		29.1
1. OLS	2.81 (7.95)	0.02 (0.70)**	0.68 (14.21)	-	-	-	0.01 (0.30)**	-	-	0.92	12.2
2. SAME	4.29 (6.84)	0.07 (1.76)*	0.48 (5.69)	-	-	-	0.06 (1.13)**	-	-		26.8
3. CORCOEF	3.25 (10.0)	0.007 (0.34)**	0.61 (12.5)	-	-	-	0.06 (1.47)**	-	-		29.5
1. OLS	2.76 (8.07)	0.01 (0.69)**	0.62 (9.15)	-	-	-	-	0.14 (1.36)**	-	0.92	13.2
2. SAME	4.28 (6.52)	0.08 (2.35)	0.49 (5.75)	-	-	-	-	0.02 (0.35)**	-		26.2
3. CORCOEF	3.02 (12.2)	0.005 (0.29)**	0.61 (13.58)	-	-	-	-	0.11 (1.85)*	-		29.9
1. OLS	2.88 (8.43)	0.01 (0.54)**	0.60 (8.54)	-	-	-	-	-	0.16 (1.57)**	0.92	13.5
2. SAME	4.43 (6.49)	0.09 (2.37)	0.45 (5.02)	-	-	-	-	-	0.06 (0.78)**		26.2
3. CORCOEF	3.14 (15.40)	-0.0009 (-0.07)**	0.56 (12.33)	-	-	-	-	-	0.18 (3.05)		32.2

Table 1.2 $\ln Y/L = \text{Constant} + \lambda t + \alpha \ln K/L + \phi(\text{Secondary School}) + \varepsilon$

Regression	Constant	λ	α	$\phi(s1)$	$\phi(s2)$	$\phi(sf1)$	$\phi(sf2)$	$\phi(sm1)$	$\phi(sm2)$	R ²	LLF
1. OLS	4.14 (9.50)	0.02 (1.05)**	0.49 (8.28)	0.19 (4.07)	-	-	-	-	-	0.95	19.7
2. SAME	4.92 (9.11)	0.06 (2.43)	0.39 (5.30)	0.21 (3.67)	-	-	-	-	-		30.7
3. CORCOEF	4.34 (9.83)	0.03 (1.70)*	0.47 (7.59)	0.18 (3.16)	-	-	-	-	-		32.0
1. OLS	4.13 (9.12)	0.01 (0.60)**	0.50 (8.15)	-	0.22 (3.84)	-	-	-	-	0.94	19.0
2. SAME	4.83 (8.94)	0.05 (1.84)*	0.40 (5.58)	-	0.22 (3.55)	-	-	-	-		31.2
3. CORCOEF	4.61 (13.21)	0.02 (0.93)**	0.44 (9.32)	-	0.25 (4.70)	-	-	-	-		36.1
1. OLS	4.27 (10.93)	0.005 (0.27)**	0.48 (9.25)	-	-	0.24 (5.07)	-	-	-	0.95	22.78
2. SAME	4.68 (9.28)	0.04 (1.75)*	0.43 (6.40)	-	-	0.21 (3.90)	-	-	-		30.91
3. CORCOEF	4.46 (12.3)	0.01 (0.87)**	0.46 (9.63)	-	-	0.21 (4.78)	-	-	-		34.5
1. OLS	4.02 (9.89)	-0.003 (-0.17)**	0.52 (9.90)	-	-	-	0.24 (4.18)	-	-	0.95	20.0
2. SAME	4.64 (9.05)	0.04 (1.25)**	0.44 (6.50)	-	-	-	0.23 (3.84)	-	-		32.2
3. CORCOEF	4.27 (12.7)	0.02 (0.90)**	0.49 (11.22)	-	-	-	0.21 (4.43)	-	-		35.2
1. OLS	3.73 (8.22)	0.03 (1.32)**	0.55 (8.72)	-	-	-	-	0.12 (2.85)	-	0.93	16.2
2. SAME	4.79 (8.25)	0.07 (2.71)	0.40 (5.07)	-	-	-	-	0.15 (2.79)	-		29.1
3. CORCOEF	4.09 (8.55)	0.04 (1.83)*	0.50 (7.33)	-	-	-	-	0.12 (2.42)	-		30.6
1. OLS	3.72 (7.89)	0.02 (1.11)**	0.55 (8.52)	-	-	-	-	-	0.13 (2.65)	0.93	15.7
2. SAME	4.78 (8.14)	0.07 (2.40)	0.40 (5.04)	-	-	-	-	-	0.17 (2.76)		29.3
3. CORCOEF	4.42 (9.78)	0.04 (2.07)	0.46 (7.16)	-	-	-	-	-	0.17 (3.24)		32.6

Table 1.3 $\ln Y/L = \text{Constant} + \lambda t + \alpha \ln K/L + \phi(\text{Higher School}) + \varepsilon$

Regression	Constant	λ	α	$\phi(h1)$	$\phi(h2)$	$\phi(hf1)$	$\phi(hf2)$	$\phi(hm1)$	$\phi(hm2)$	R^2	LLF
1. OLS	2.71 (7.93)	0.04 (1.60)**	0.70 (16.16)	-0.39 (-1.53)**	-	-	-	-	-	0.92	13.4
2. SAME	3.81 (6.97)	0.05 (1.38)**	0.56 (7.75)	0.16 (0.41)**	-	-	-	-	-		26.8
3. CORCOEF	2.99 (8.71)	0.03 (1.33)**	0.66 (14.77)	-0.25 (-1.15)**	-	-	-	-	-		29.0
1. OLS	2.75 (8.22)	0.05 (1.82)*	0.69 (16.47)	-	-0.42 (-1.79)*	-	-	-	-	0.93	13.9
2. SAME	3.69 (6.99)	0.05 (1.36)**	0.57 (8.32)	-	0.06 (0.19)**	-	-	-	-		26.7
3. CORCOEF	2.97 (8.63)	0.03 (1.39)**	0.66 (14.93)	-	-0.26 (-1.28)**	-	-	-	-		28.9
1. OLS	2.90 (8.27)	0.04 (1.52)**	0.67 (15.2)	-	-	-0.31 (-1.30)**	-	-	-	0.92	13.1
2. SAME	3.95 (6.49)	0.07 (1.56)**	0.54 (6.76)	-	-	0.05 (0.12)**	-	-	-		26.49
3. CORCOEF	3.17 (8.51)	0.04 (1.64)**	0.64 (13.2)	-	-	-0.28 (-1.57)**	-	-	-		29.4
1. OLS	2.97 (8.28)	0.05 (1.67)**	0.66 (14.66)	-	-	-	-0.33 (-1.48)**	-	-	0.93	13.4
2. SAME	4.03 (6.51)	0.08 (1.81)*	0.53 (6.54)	-	-	-	-0.11 (-0.31)**	-	-		26.5
3. CORCOEF	3.29 (8.43)	0.05 (1.97)*	0.62 (12.38)	-	-	-	-0.34 (-1.98)*	-	-		29.9
1. OLS	2.50 (6.53)	0.03 (1.47)**	0.73 (14.61)	-	-	-	-	-0.39 (-1.61)**	-	0.92	13.6
2. SAME	3.72 (7.11)	0.05 (1.49)**	0.57 (8.07)	-	-	-	-	0.15 (0.51)**	-		27.0
3. CORCOEF	2.90 (8.63)	0.02 (0.86)**	0.67 (14.7)	-	-	-	-	-0.09 (-0.38)**	-		28.6
1. OLS	2.52 (6.81)	0.04 (1.64)**	0.73 (15.2)	-	-	-	-	-	-0.38 (-1.77)*	0.93	13.9
2. SAME	3.62 (7.26)	0.04 (1.24)**	0.58 (8.70)	-	-	-	-	-	0.15 (0.58)**		27.0
3. CORCOEF	2.88 (8.55)	0.02 (0.77)**	0.67 (14.68)	-	-	-	-	-	-0.05 (-0.26)**		28.5

Table 2.0 Contribution of capital, labour, average years in school and TFP to growth

Countries	GDP Growth	Contribution			
		Capital	Labour	Education	TFP
Hong Kong	8.03	2.70	1.34	0.21	3.79
(%)		(33.62)	(16.67)	(2.56)	(47.15)
Japan	5.74	4.61	0.52	0.10	0.51
(%)		(80.41)	(8.99)	(1.74)	(8.86)
Korea	9.52	5.84	1.21	0.29	2.18
(%)		(61.40)	(12.68)	(3.02)	(22.91)
Philippines	4.12	2.04	1.27	0.21	0.60
(%)		(49.60)	(30.88)	(5.02)	(14.50)
Taiwan	8.62	5.92	1.27	0.26	1.18
(%)		(68.60)	(14.70)	(3.04)	(13.65)
Thailand	7.34	4.81	1.37	0.20	0.96
(%)		(65.59)	(18.62)	(2.76)	(13.04)

Table 2.1 Contribution of capital, labour, average years in school at primary level and TFP to Growth

Countries	GDP Growth	Contribution			
		Capital	Labour	Education	TFP
Hong Kong	8.03	3.13	1.12	0.16	3.61
(%)		(39.00)	(14.01)	(2.02)	(44.97)
Japan	5.74	5.35	0.43	0.04	-0.09
(%)		(93.28)	(7.55)	(0.70)	(-1.53)
Korea	9.52	6.78	1.01	0.22	1.50
(%)		(71.22)	(10.65)	(2.31)	(15.81)
Philippines	4.12	2.37	1.07	0.19	0.49
(%)		(57.54)	(25.94)	(4.59)	(11.93)
Taiwan	8.62	6.86	1.06	0.24	0.45
(%)		(79.58)	(12.35)	(2.81)	(5.26)
Thailand	7.34	5.58	1.15	0.19	0.42
(%)		(76.08)	(15.64)	(2.60)	(5.68)

Table 2.2 Contribution of capital, labour, average years in school at secondary level and TFP to growth

Countries	GDP Growth	Contribution			
		Capital	Labour	Education	TFP
Hong Kong	8.03	2.38	1.50	0.91	3.24
(%)		(29.59)	(18.68)	(11.38)	(40.36)
Japan	5.74	4.06	0.58	0.56	0.54
(%)		(70.76)	(10.07)	(9.72)	(9.45)
Korea	9.52	5.14	1.35	1.45	1.57
(%)		(54.03)	(14.20)	(15.28)	(16.49)
Philippines	4.12	1.80	1.42	0.94	-0.05
(%)		(43.65)	(34.59)	(22.94)	(-1.18)
Taiwan	8.62	5.21	1.42	1.11	0.89
(%)		(60.37)	(16.46)	(12.89)	(10.27)
Thailand	7.34	4.23	1.53	1.23	0.34
(%)		(57.72)	(20.85)	(16.80)	(4.63)

Sources and Notes: Tables 1.0-1.3 and see text Section IV.

