Schooling Levels and the Growth of the Four Asian Tigers

Christian Perez

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Changes Made Since First Draft

Following Jonathan's suggestions, I made several changes to my first draft. I included a comparison of the point estimates from my regression model (regressing the Solow residuals g on growth in human capital levels ($\frac{\dot{H}}{H}$)) to the corresponding estimates in Acevedo (2008). I also included some possible explanations for the difference in our estimates.

There were several typos in the introductory paragraph spotted by Jonathan; I made sure these were addressed. Finally, I added a paragraph describing my reaction to the results for the g and R Solow residual series, discussing why the results did not match my expectations, and comparing my results to another author's analysis of similar Solow residual series.

1. Introduction

In the second half of the twentieth century, the "Four Asian Tigers" (Hong Kong, Singapore, South Korea, and Taiwan) experienced rapid growth and industrialization. These countries transformed from relatively poor, backwater countries in the 1960s to highly developed societies by the beginning of the 21st century. Their growth and rise to prominence has inspired much study of this phenomenon, with even President Obama urging education reform towards the South Korean model. Despite the recent financial crisis, their output growth is still positive, though it is significantly less than in previous years. Naturally, one wonders which factors have contributed to their remarkable growth.

Researchers claim "economic freedom", cultural mores, human capital, and many other factors have played a role in growth, along with the standard factors of capital and labor. Indeed, each Asian Tiger possesses a relatively "free market" economy and a renowned educated workforce. In this paper, I investigate how schooling levels have contributed to the economic growth of these countries. The main vessel through which I conduct my analysis is the Solow model, both augmented with human capital and without it.

To this end, I employ two empirical strategies to unravel schooling levels' effects on growth. First, I use the technique of "growth accounting" to calculate Solow residuals for each country. These residuals measure the growth of factors not explicitly modeled in the production function (called total factor productivity or TFP): technology, human capital (in the un-augmented model), and other unmeasured sources. I calculate Solow residuals in both versions of the Solow model and compare them. Since the augmented Solow model removes human capital from the Solow residuals, a significant difference between the two types of residuals would indicate that human capital plays a large role in TFP growth. Assuming TFP growth has a large effect on output growth, we can then link these two causal chains together and conclude that schooling levels have a large effect on output growth.

Next, I implement Acevedo (2008)'s approach to decompose Solow residuals into human capital and other technological productivity growth. Acevedo employs a standard ordinary least squares regression model with the residuals as the left-hand-side variable and schooling levels as the right-hand-side variable. Acevedo's goal is to determine how human capital plays a role in the growth of South Korea; I extend some of his results and methodologies to the other Asian Tigers.

The paper is organized as follows. Section 2 reviews the history of the Four Asian Tigers during their period of rapid growth, Section 3 describes, compares, and contrasts the schooling systems and policies of the Asian Tigers, Section 4 presents some criticisms and doubts of the Asian Tigers' remarkable growth, Section 5 outlines the empirical strategies in detail, Section 6 describes the data used to estimate the empirical models, Section 7 presents the results from the estimations, and Section 8 concludes.

2. Historical Outline

Following World War II, all four Asian Tiger countries existed in a state of relative poverty. They each emerged from imperial Japanese occupation, which imposed radical changes to their existing sociopolitical systems. Foreign influence and aid in these countries continued in the years following the war.

Some fared better than others in the postwar period. South Korea endured the Korean War and faced several revolutions following it. Taiwan, on the other hand, was blessed with the entire gold reserves of mainland China and experienced professionals brought by the Kuomintang government. By 1965, Taiwan no longer required American aid as it had established a solid financial base. Singapore's postwar period consisted of a slowly emerging separation from the British rule and increased racial tensions among its citizens of Chinese and Malaysian descent. Hong Kong experienced a large inflow of immigrants from mainland China and businesses from Shanghai, and remained under British rule until 1997. This vast pool of cheap labor and economic resources is credited to have aided Hong Kong's growth. In all, the nations could be ranked by economic and political success in the postwar period (roughly up to 1965) as follows: Taiwan, Hong Kong, Singapore, and South Korea.

From 1965 onwards, all nations grew in global stature and economy. South Korea emphasized an export-oriented economy, particularly in industries where it could gain a competitive advantage such as electronics, ship building, textiles, cars, and steel. Taiwan remained successful, though it focused on medium-scale businesses whereas its fellow Tigers developed large conglomerates. Hong Kong continued to "rise upwards" as new skyscrapers and businesses emerged in its harbor. Singapore focused on developing high-technology industries and established large oil refineries that attracted oil companies.

High growth continued for these economies into the '90s until the 1997 Asian Financial Crisis (Liu 2008). In 1998, Hong Kong's GDP growth rate fell to -8.7%, Singapore's growth rate fell to -6.7%, South Korea's growth rate fell to -9%, and Taiwan's growth rate fell to 3% (from 5%) (PWT 6.3). Following this, some cast doubt on the validity of these economies' rapid growth and argued that "the Asian miracle was always a sham". That the Asian Tigers' ascendance was real and stable was confirmed in the following years as their economies bounced back and relatively high growth continued

(Kim 2007).

In recent years, attention has shifted to the rise of the BRIC economies, in particular, China. The Asian Tigers nevertheless continue to grow with Hong Kong, Singapore, South Korea, and Taiwan having GDP growth rates of 7.2%, 8.9%, 4.7%, and 4.9%, respectively, in 2004 (PWT 6.3). Their influence in global markets today is undoubted; global brands such as Hong Kong's Star Cruises and Taiwan's Acer are becoming more commonplace around the world. South Korea's Hyundai recently came in 87th in Fortune's "Global 500", a ranking of the world's 500 largest companies (Fortune 2009).

3. Schooling Systems and Policies

We wish to determine what role schooling levels have in production; however, schooling is not likely to be homogenous across countries. Perhaps additional years of schooling in , say, the South Korean system would be more beneficial than a similar level of schooling in, say, the Taiwanese system. To get a better sense of the variation in schooling quality across countries (if any significant variation exists), I examine the history and structure of their schooling systems during the second half of the twentieth century.

3.1 Colonial Influence

As previously mentioned, each Asian Tiger was under Japanese colonial rule during World War II. In some ways, this was a blessing in terms of the evolution of education systems in these countries. The Japanese are generally regarded to have established excellent, modern educational facilities and systems for their colonies (Sorensen 1994). The Japanese, in turn, sought to emulate the Western educational system and instilled the American "six-three-three-four" system into their colonies: six years of elementary school, three years of middle school, three years of high school, and four years of college (Taiwan Government Information Office 2010). The Kuomintang government of Taiwan embraced the Japanese educational system and proceeded to build a hybrid system that combined traditional mainland Confucian education with the more modern Japanese style (Clark 2002). Compulsory education laws in Taiwan were slowly enacted in the remainder of the century with nine years of educations required for children starting in 1968 and twelve years required starting in 1990 (Clark 2002).

The Japanese influence on education took a less favorable tone in South Korea. Though the Japanese did instill their modern schooling system in Korea (not yet North and South), they did so with the goal of keeping Koreans "...subordinate in all ways to ethnic Japanese" (Sorensen 1994). In 1942, 40 percent of Koreans were enrolled in elementary school while the institutions for higher learning in Korea mostly enrolled Japanese. After independence and formation in 1948, school enrollment for South Koreans began to rapidly increase, with elementary enrollment past 90% by 1964 and high school enrollment past 90% by 1979. Compulsory enrollment up to ninth grade was enacted in 1990 (Sorensen 1994).

Though Hong Kong and Singapore were also Japanese colonies, their schooling systems were more influenced by the British education system (NLB 2010, Chan 2008). Since these two countries were British colonies before Japan's imperial campaign and had British educational systems in place, perhaps the Japanese colonialists did not feel the need to install Western-influenced Japanese schooling systems. They followed the British "six-three-two" system: six years of elementary, three years of secondary education, and two years of senior secondary (Chan 2008). To the extent that they differ, Singapore struggled to accommodate its racially diverse population (NLB 2010) while Hong Kong divided its educational system into Anglo-Chinese schools (taught in English and Chinese), Chinese schools (taught only in Chinese), and National schools (expensive international schools were foreign children are taught in English) (Chan 2008). Compulsory schooling laws came into effect for Singapore in 2003; children of ages 6-15 are required to attend a national primary school (Ministry of Education, Singapore 2010). In Hong Kong, nine years of education were made mandatory in 1997 (Hong Kong Education Bureau 2007).

In conclusion, the Four Asian Tigers seem to have had modern, Westernized schooling systems during their periods of rapid growth. From their World War II colonial rulers they directly (as in the case of Hong Kong and Singapore) or indirectly (as in the case of Taiwan and Korea) inherited attributes of Western schooling systems such as the tiered structure. Perhaps it's that they had these modern systems, as opposed to the more traditional ones found in African countries such as Nigeria, where compulsory schooling has yet to be established (Maps of the World 2009), that allowed them to grow faster than comparable countries following World War II.

3.2 Regulation, then Decentralization

A comprehensive study of the history of education systems of the Asian Tigers, Mok (2006) describes how these countries had highly regulated systems. Hong Kong would stress (and still stresses) "quality assurance" inspections: schools are randomly selected and then are rigorously inspected for the fulfillment of criteria such as organization and support for pupils. Singapore conducted similar inspections, following a European-based model of quality assurance. In Taiwan, modifications in teaching materials or curricula needed to be first approved by the education ministry. Sorensen (1994) notes that, during the period 1963-1979, South Korea became a "testocracy" where centralized state exams influenced all facets of education.

Later in the century, however, the Tigers' education systems became more and more decentralized. Referring again to Mok (2006), in South Korea, the government's grip on schools relaxed in 1994 when control of student quotas were handed over to schools and funding criteria became much less stringent. Taiwan began to introduce market competition among schools: researchers at universities now competed for research funds and other incentive mechanisms were designed for teachers. Singapore granted more autonomy to schools in order to promote transparency in school performance. Finally, Hong Kong chose to maintain some control from local school leaders, but worked to encourage their development as managers.

The Four Asian Tigers followed authoritarian rule over their education systems during most of their rapid growth. If such policies were successful, then why did they discontinue them towards the end of the century? Perhaps they had gauged that the education sector had matured by the late twentieth century; local provincial or municipal schooling systems were no longer dependent on the government. A relaxing of control during the earlier fragile years could have led to a deterioration or collapse of the education system. It would be plausible to think that the aforementioned commitment and responsibility of these countries to their citizens' education are the roots of their current highly educated workforces.

4. Counterarguments to Growth

The controversial paper Young (1993) reduces the growth of the Four Asian Tigers to higher quantities of traditional observables: higher investment, labor, and capital (both physical and human capital). Young's findings suggest that their growth was driven through factors other than advances in technology, contrary to popular belief. As Krugman (1994) puts it, "...Asian growth has so far been mainly a matter of perspiration rather than inspiration–of working harder, not smarter." Appealing to neoclassical growth theory, since the Solow model posits a production function with decreasing marginal productivities in its arguments, we'd expect a slowdown in the Asian Tigers' economies.

In relation to this paper's goal, de la Fuente and Domenech (2000) tell of the increasing skepticism to the role of human capital in growth. Researchers find that human capital variables are insignificant or have the "wrong sign" in their growth regressions, leading them to doubt that it human capital actually has an effect on growth. Thankfully, de la Fuente and

Domenech provide an explanation for this phenomenon: the human capital data are fraught with error. They revise the Barro and Lee (1996) dataset on human capital and go on to show that the contribution of TFP to output is significant. In this paper, I use the Barro and Lee (2001) dataset. Though Barro and Lee (2001) do not reference de la Fuente and Domenech (2000)'s methods, they do employ new techniques (since 1996) to address measurement error. A more recent project, Cohen and Soto (2007), further addresses measurement error in schooling levels, proposing an alternative dataset to Barro and Lee (2001). Cohen and Soto then go on to find significant and positive coefficients in their growth regressions.

5. Empirical Strategies

To investigate the role of schooling levels on growth, I take two principal empirical paths; both utilize the technique of growth accounting. Growth accounting is technique to decompose the determinants of output growth as determined by the researcher's production function. For example, Acemoglu (2009) decomposes the production function $F(K, AL)$ into $\frac{\dot{y}}{y} = g + \alpha_k \frac{\dot{k}}{k}$ where y is output per worker, k is capital per worker, α_k is capital's share of output, and g is called the Solow residual. The Solow residual is meant to capture the contribution to output growth of factors not explicitly expressed in the production function such as technological growth, cultural changes, and human capital accumulation, that is, factors in A (called total factor productivity (TFP)). Calculating a series of Solow residuals across time allows us to make conjectures about the role of technology or human capital in production: consistent high TFP growth rate supports a hypothesis that these factors can explain a large portion of overall growth.

For our purposes, we can create these series for the Asian Tigers and then attempt to extrapolate information about schooling levels, but we can do one better. Suppose we modify the production function to include human capital, as in Acemoglu (2009): $Y(t) = K(t)^{\alpha} H(t)^{\beta} (A(t)L(t))^{1-\alpha-\beta}$ where H denotes human capital. In per worker terms, we then have $y(t) = k(t)^{\alpha} h(t)^{\beta} A^{1-\alpha-\beta}$. The growth accounting formula can then be written as $\frac{\dot{y}}{y} = R + \alpha \frac{\dot{k}}{k} + \beta \frac{\dot{h}}{h}$, where R is our new Solow residual. As we've included human capital in the production function, the Solow residual no longer captures the effects of human capital on growth in output. My first strategy is then the following: I compute the Solow residuals in the original production function presented above, henceforth g, and then compare them with the new Solow residuals calculated from this new production function, henceforth R. Significant differences in the Solow residual trends then illustrates the effects of human capital on growth.

To calculate the g series, I use the parameter value $\alpha_k = .35$, a value consistently observed in historical data. To calculate the R series, I use the parameter values from Mankiw, Romer, and Weil (1992). There, the authors posit our same augmented production function, $F(K,H,AL)=K^{\alpha}H^{\beta}(AL)^{1-\alpha-\beta}$, and transform it as follows: $log(y_j^*) = constant - \frac{\alpha+\beta}{1-\alpha-\beta}log(n_j+g+\delta) + \frac{\alpha}{1-\alpha-\beta}log(s_k) + \frac{\beta}{1-\alpha-\beta}log(s_h)$ where s_k is the fraction of income invested in physical capital, s_h is the fraction invested in human capital, n_j is population growth, g is the growth rate of TFP, and δ is the depreciation rate, for country j . The authors assume that $g+\delta=0.05$ noting that "...changes in this assumption have little effect on the estimates." They estimate this equation using $log(y_j^*) = \beta_0 + \beta_1 log(\frac{I}{GDP}_j) + \beta_2 log(n_j+g+\delta) + \beta_3 log(SCHOOL_j) + \epsilon_j$, where $\frac{I}{GDP}$ is the average share of gross investment in GDP meant to measure s_k (averaged across the years 1960-1985), $SCHOOL$ is a constructed measure to proxy for s_h (also averaged across 1960-1985), and n_j is the population growth rate (again, averaged across 1960-1985). The coefficients β_1, β_2, and β_3 estimate $\frac{\alpha}{1-\alpha-\beta}$, $-\frac{\alpha+\beta}{1-\alpha-\beta}$, and $\frac{\beta}{1-\alpha-\beta}$, respectively; their estimates can be used to derive implied values of α and β . From Table II of the paper, their estimates are $\hat{\alpha}=.31$ and $\hat{\beta}=.28$.

As previously mentioned, my second strategy also uses growth accounting. In order to extract the contribution of human capital to TFP, Acevedo (2008) estimates the following regression model: $g_{j,t} = \beta_0 + \beta_1(\frac{\dot{H}}{H})_{j,t} + \epsilon_{j,t}$ where $g_{j,t}$ and $(\frac{\dot{H}}{H})_{j,t}$ are the Solow residuals and growth rate of human capital for country j at time t . He then interprets the estimate of the coefficient β_1 as the effect of human capital growth on TFP growth. This gives us another way to illustrate the effects of human capital: if β_1 is found to be significantly positive, and since TFP growth contributes to overall increased production, we can link the two causal chains together and infer that increases in human capital are causally linked to increases in overall production. Following Acevedo, I estimate his model using the Barro and Lee (2001) dataset, which contains schooling levels from 1955-2000 in five-year intervals.

6. Data

After an extensive search for data on output per worker, capital per worker, and schooling levels, I could only find data on these variables from 1962-1990 for all four countries. The variable for which data was most difficult to find was capital per worker. Some sources such as Hall and Jones (1998) suggested using the perpetual inventory method to create the capital per worker data, but due to lack of expertise and time, I abstained from this path.

That said, I used the Penn World Table 5.6 (PWT 5.6) dataset to obtain data on output per worker and capital per worker. I considered using the more recent 6.3 release of the Penn World Table data, but it did not contain the capital per worker series. It should be noted that sources such as Johnson, Larson, Papageorgiou, and Subramanian (2009) raise the issue of measurement error in the Penn World Table data releases. Unfortunately, the 5.6 release does not contain capital per worker series for Singapore; I extract this series from the Easterly and Levine (2001) data, which measures capital per work for Singapore using aggregate investment figures and the aforementioned perpetual inventory method.

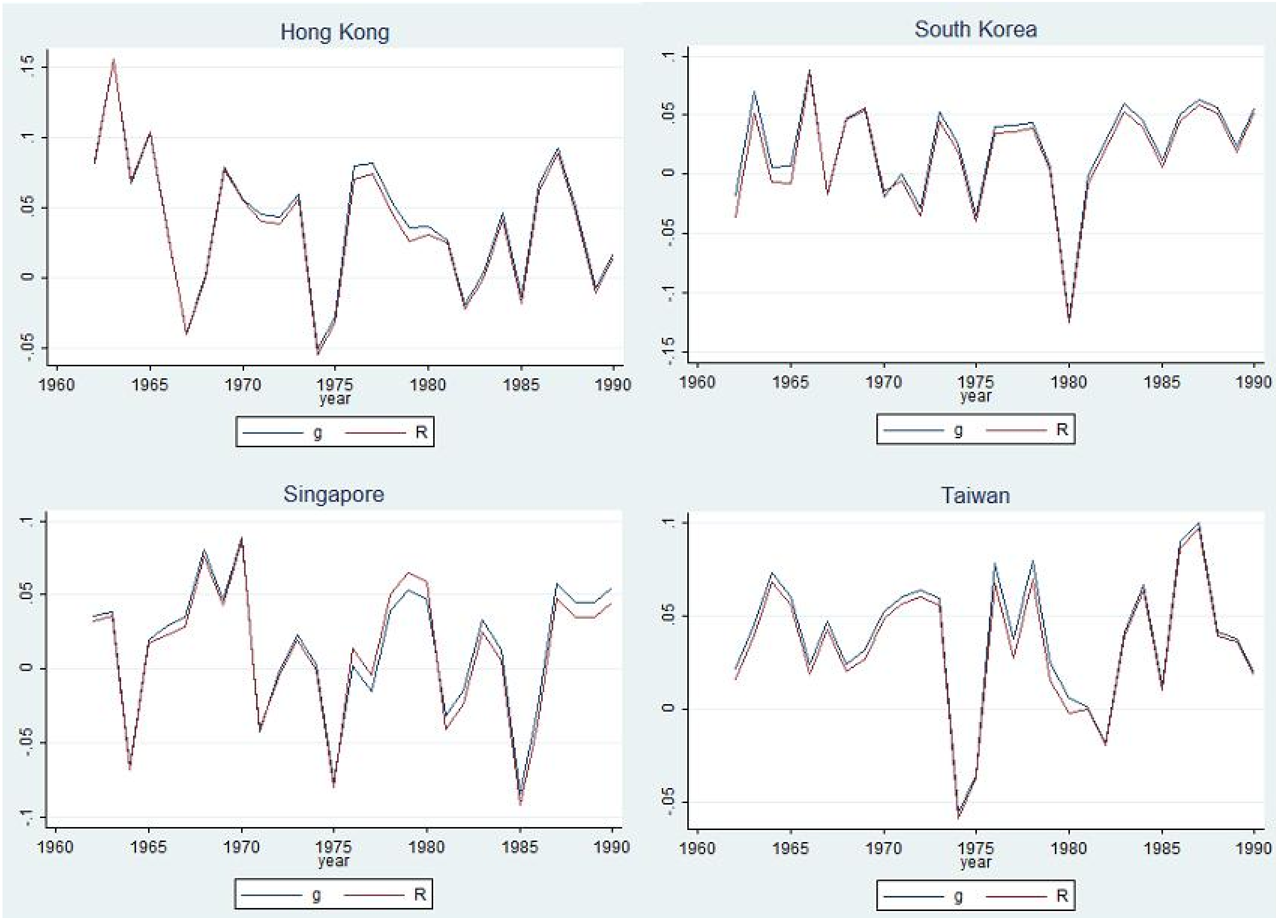
A brief comparison of the calculated values of capital per worker for Hong Kong, South Korea, and Taiwan by Easterly and Levine (2001) and the Penn World Table data demonstrates that the Easterly and Levine (2001) figures are almost always about 1,000 to 1,500 points higher. Theoretically, since I use the growth rate of capital per worker, this difference in levels shouldn't matter in calculating Solow residuals. Furthermore, since the specifications that do use the level of capital per worker transform K into logs, I apply the same argument as Mankiw, Romer, and Weil (1992) do to their human capital variable: any proportional gain in capital per worker will be allocated to the constant term in the regression.

The schooling level data is obtained from the Barro and Lee (2001) data set. Following Acevedo (2008), I use their Average Years of Schooling variable to account for schooling levels. This variable is compiled in Barro and Lee (2001) from various sources including the UNESCO data used in Mankiw, Romer, and Weil (1992). It comes in five-year intervals from 1960 – 2000 for all four countries and in two categories: as a percentage of the total population over 15 years and as a percentage of the total population over 25 years. Following Acevedo (2008), I use the data of the total population over 15 years of age.

Data on output per worker and capital per worker is annual while the schooling level data comes in five-year intervals. Acevedo (2008) imputes the average years of schooling data for years between the five-year measurements by "...assuming linear growth rates". He does not specify his procedure, but I follow his intentions by a "connect-the-dots" algorithm: I connect the values of two adjacent measurement years, say, 1950 and 1955, with a line and impute the values for the in-between years, 1951, 1952, 1953, and 1954, with their corresponding values on the line. A more formal procedure is described in the appendix.

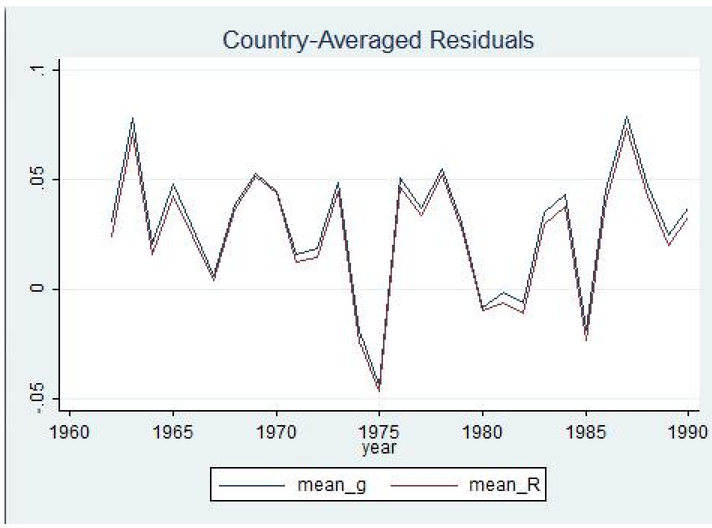
7. Results

The Solow residual series for each country are shown below.



As the two types of residuals hardly differ for each country, these series show mild evidence for the importance of human capital in TFP growth. As expected, the R residual series are mostly near or below the g residual series; only Singapore deviates from this trend in the years 1975-1980. South Korea and Taiwan are the only countries where the R residuals are consistently below the g residual series. Hong Kong and Singapore show little notable separation of the R and g series with the exception of the years 1976-1982 for Hong Kong and 1981-1990 for Singapore (and the aforementioned 'pathological' interval 1975-1980 for Singapore). The residuals taken as a whole mostly positive, another result to at least confirm the correctness of our specifications. The major deviants to this trend are South Korea and Taiwan, whom have eight or more years in which the residuals are zero or negative. These results support Young (1993)'s finding that South Korea and Taiwan are the Tigers with the second lowest and lowest TFP growth over the years 1970-1985, respectively. Young also finds that Hong Kong is the Tiger with the highest TFP growth rate; given that Taiwan only has four years with negative TFP growth as opposed to Hong Kong's six, the results seem to suggest that Taiwan had the highest TFP growth rate. There are notable spikes in the residual series: South Korea in 1979-1981, Hong Kong in 1965-1967, and Taiwan in 1973-1974. South Korea's spike can be explained by the oil shock of 1979, which caused crop failure, and the assasination of President Park Chung-Hee in October 1979 (Lee 1996). Lee notes that "...for the first time since 1957, [South] Korea faced a negative GDP growth rate of -2.7 percent..." I have yet to find possible sources of explanation for the Hong Kong and Taiwan spikes.

We can consider the region as a whole by averaging residuals across countries in each year. The country-averaged residuals are shown below.



Again, the R and g residual series hardly differ. The R series is now always below the g series; unless we believe that H does not enter the production function, as opposed to Mankiw, Romer, and Weil (1992), this result at least confirms that our specifications were correct. We now turn to statistical t-tests to compare the means of the residuals across time for each country. The results are shown below.

Hong Kong	(1)
R - g	-0.00345
	(-0.28)
N	58

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.0 > 01$

South Korea	(1)
R - g	-0.00581
	(-0.52)
N	58

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.0 > 01$

Singapore	(1)
R - g	-0.00274
	(-0.23)
N	58

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.0 > 01$

Taiwan	(1)
R - g	-0.00433
	(-0.46)
N	58

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.0 > 01$

In each t-test, the null hypothesis is $H_0 : \overline{g}_j = \overline{R}_j$ where $\overline{g}_j$ is the average of the g residuals across the years 1962-1990 for country j. Each t-statistic is below 1.645 in absolute value; thus we can't reject the null hypothesis at the 10% significance level, much less at the standard 5% significance level. There is again no evidence to support the claim that the R and g residuals differ, which is evidence against the hypothesis that schooling levels have a significant contribution to TFP growth. As previously mentioned, we can link the causal chains connecting schooling levels to growth in output and conclude that schooling levels do not have a significant contribution to overall output growth *assuming TFP growth has a significant contribution to output growth.* This assumption is questioned in Young (1993) whose findings are in turn questioned by Hsieh (2002).

That the R and g series do not differ by much was surprising to me. After augmenting the Solow model with human capital, Mankiw, Romer, Weil (1992) obtain better estimates of their structural parameters. This suggests that the augmentation significantly changes any estimates (for better or worse) derived from the original Solow model. Yet my results suggest that this augmentation does not cause any notable changes. Valdes (1999) mentions that the size of the Solow residuals "...would diminish if we used the "broad concept" of capital, thus including under K [capital] human as well as physical capital." Thus, in this context, we should have that the R series be notably smaller than the g series. Alas, they hardly deviate from each other.

My estimation of Acevedo (2008)'s regression yields the following results.

	(1)
VARIABLES	g
$\frac{\dot{H}}{H}$	-0.214
	(0.199)
Constant	0.0339***
	(0.00659)
Observations	116
R-squared	0.008

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

I get $\hat{\beta}_1 = -.214$ as the coefficient on $(\frac{\dot{H}}{H})$. Normally this would indicate the paradoxical finding that increased growth in schooling levels leads to lower TFP growth. Alas, the heteroscedasticity-robust standard error on the coefficient is .199 giving us a p-value of .284. Thus we cannot reject the null hypothesis $H_0 : \beta_1 = 0$ at the 10% significance level, much less at the standard 5% significance level. These results are in stark contrast to Acevedo (2008)'s estimate of $\hat{\beta}_1 = .5383$, which is statistically significant at the 5% level. Recall, however, that he only looks at South Korea and compiles his final dataset from several different sources.

The regression results are similar to the results from the comparison of the g and R series: schooling levels do not seem to have a significant contribution to TFP growth, and, assuming TFP growth plays a major role in output growth, on overall production.

8. Conclusion

Despite the setback during the 1997 Asian Financial Crisis, the Four Asian Tigers continue to grow. In the past couple of years, their growth has slowed, but this seems to be due to the recent global financial crisis rather than idiosyncratic reasons. Their emergence from the current slowdown will be intriguing; will Young (1993)'s claim of factor accumulation catch up with some of the Tigers and stifle their growth? We should take Young's results with a grain a salt as Barro (1998) has indicated. There, Barro analyzes Young (1993)'s arguments and calculations, concluding that most approaches to measure the contribution TFP growth to output growth, including Young's, systematically yield estimates that are biased downwards. Updated approaches such as Hsieh (2002)'s aim to remove this systematic bias.

I've presented evidence against the hypothesis that schooling levels explain a considerable fraction of growth in output. This result goes against those found in de la Fuente and Domenech (2000) and Cohen and Soto (2007). Seeing as I've employed reasonable empirical strategies, this seems to suggest that measurement error in schooling levels still persists in Barro and Lee (2001)'s dataset. An extension to this paper would utilize alternative datasets, such as de la Fuente and Domenech (2000)'s and Cohen and Soto (2007)'s, that correct for this error. Furthermore, I would also attempt to acquire and use an updated series on capital per worker seeing as that variable is also known to be measured with error.

Appendix

This section explains the "connect the dots procedure" for calculating the Average Years of Schooling values for years in between the five-year intervals in which the data from Barro and Lee (2001) come in. If s_{t_0} and s_{t_5} denote two adjacent values of Average Years of Schooling, and t_1, t_2, t_3, and t_4 denote the in-between years, then $s_{t_1} = s_{t_0} + (1/5)(s_{t_5} - s_{t_0})$, $s_{t_2} = s_{t_0} + (2/5)(s_{t_5} - s_{t_0})$, $s_{t_3} = s_{t_0} + (3/5)(s_{t_5} - s_{t_0})$, and $s_{t_4} = s_{t_0} + (4/5)(s_{t_5} - s_{t_0})$. As an example, if s_{1950} and s_{1955} denote the values for Average Years of Schooling in 1950 and 1955, I assign to 1951 $s_{1951} = s_{1950} + \frac{s_{1955} - s_{1950}}{5}$, $s_{1952} = s_{1950} + \frac{s_{1955} - s_{1950}}{5}$ to 1952, and so on.

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