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Contents

Abstract

Emerging Asian economies have made strong progress in improving educational capital in the past 40 years. High educational attainment, especially at the secondary level, has significantly improved emerging Asia's educational achievement. Regressions show that better parental education and income, lower income inequality, declining fertility, and higher public educational expenditures account for higher educational enrollment. But Asia's average years of schooling are forecast to increase to 7.6 years by 2030, from 7.0 in 2010, significantly slower than the increase of 4.1 years from 1970 to 2010. That would put emerging Asia's educational capital in 2030 at only the 1970 level of the advanced countries, or still 3.5 years behind the level of advanced countries in 2010. For sustained human development, Asian economies must invest in improving educational quality and raising enrollment rates at the secondary and tertiary levels.

I. Introduction

Well-known for its remarkable economic achievements, emerging Asia[1] has grown by over 6.7% a year since the 1970s, making it the world's fastest-growing region. Numerous studies have explored this remarkable growth record. They point to several primary explanations, including high saving and investment ratios, a well-educated labor force, macroeconomic stability, and export-oriented development strategies.

Among these factors, there has been considerable focus on high savings and the region's emphasis on exports. By contrast, even though the role of emerging Asia's notable educational achievements in economic growth has often been emphasized, there has been little investigation into how this was achieved in the last 5 decades. Of the limited literature, Friedrickson and Tan (2008) attribute the success to several factors including (i) high rates of economic growth, (ii) an emphasis on the policies needed to promote high economic growth, (iii) the rapid transition from high to low fertility rates, and (iv) strong public institutions. Lee (2001) discusses the measures Asian countries adopted to expand the quantity and quality of education and emphasizes the role of government in setting educational priorities to meet changing demands, and improve the efficiency of resource utilization. Meanwhile, a number of papers have recognized the positive impact of cultural and religious features in East Asia on educational outcomes. Indeed, studies on Asian-American students' educational expectations and school performance also suggest that family orientation or training, which generally embody Asian culture and values, play an active role in their high expectations and outstanding performance in schools in the United States (US) (Leung 2001, Goyette and Xie 1999, Chen and Stevenson 1995, Peng and Wright 1994). That is, their parents tend to have high educational expectations of their children and provide strong support (Lee and Barro 2001).

This paper investigates how emerging Asia achieved its rapid human development from 1970 to 2010, and projects educational progress in the next 20 years.[2] Section II presents a brief overview of the region's educational progress in the past 40 years. Section III reviews the empirical literature on the determinants of educational investment, and examines the empirical relationship between school enrollment rates and income and nonincome factors. Section IV discusses the estimation methodology for generating educational projections and

[1] Emerging Asia includes the People's Republic of China; Hong Kong, China; India; Indonesia; the Republic of Korea; Malaysia; Pakistan; the Philippines; Singapore; Taipei,China; Thailand; and Viet Nam. Accounting for about 95% of developing Asia's gross domestic product (GDP) and 86% of its population, they represent regional trends well.

[2] We focus on educational capital as a main component of human capital. However, human development can be more broadly defined as comprising other factors such as health and skills.

presents our projections of educational attainment of estimates for 2015–2030. The final section provides concluding remarks.

II. Educational Progress in Emerging Asia, 1970–2010

This section provides a brief overview of the record of human capital accumulation in emerging Asia from 1970 to 2010 compared to other regions. We use Barro and Lee's (2010) estimates of educational attainment of the adult population as a measure of human capital. The data provide estimates of population distribution by educational level and average years of schooling, disaggregated by sex and by 5-year age groups among the population aged 15 years and over for 146 countries at 5-year intervals from 1950 to 2010.

Let us denote $h^a_{j,t}$ as the proportion in age group *a*, for whom *j* is the highest level of schooling attained, i.e., *j* = 0 for no school, 1 for primary, 2 for secondary, and 3 for higher at time *t*. There are 13 5-year age groups ranging from *a* = 1 (15–19 years) to *a* = 13 (75 years and over). For those aged 15 years and above, this proportion of population (h^{15+}_j) is simply the average of h^a_j across all age groups, weighted by the corresponding population share by age group, l^a:

$$h^{15+}_t = \sum_{a=1}^{13} l^a_t h^a_t \tag{1}$$

From this, the numbers of years of schooling by age group and for the population aged 15 and above are computed, respectively, as follows:

$$s^a_t = \sum_j h^a_{j,t} Dur^a_{j,t} \tag{2}$$

$$s^{15+}_t = \sum_{a=1}^{13} l^a_t s^a_t = \sum_j h^{15+}_{j,t} Dur^{15+}_{j,t} \ . \tag{3}$$

where Dur_j indicates the duration by educational level.

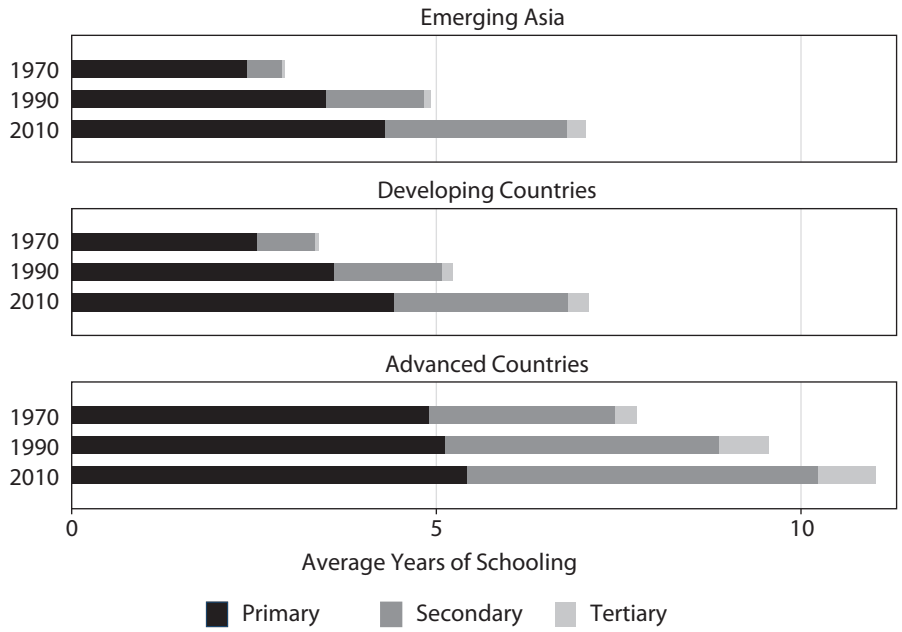
A. Educational Attainment Trend

As can be seen in Figure 1, compared to other regions, emerging Asia has shown strong growth in educational attainment in the past 4 decades. In 2010, its population aged 15 and over had an average 7 years of schooling, up by 4.1 years from just 2.9 years in 1970. By contrast, in the same period, the high-income countries raised their average years of schooling by 3.3 years (from 7.7 to 11.0), while developing countries (including emerging Asia) generally added 3.7 years (from 3.4 to 7.1).

Emerging Asia's strong progress is due mainly to a big leap in average years of primary and secondary schooling, which accounts for almost 90% of its overall increase. Average

years of primary and secondary schooling increased 1.9 and 2.0 years, respectively. In particular, average secondary schooling increased from less than 0.5 year in 1970 to almost 2.5 years in 2010. Tertiary education has grown rapidly, increasing from almost zero in 1970 to 0.3 in 2010. Nonetheless, this still falls a bit short of that in all developing countries. It is interesting to note that the educational progress in emerging countries in the past 40 years has brought them to almost the same educational level as the advanced countries 50 years ago. Educational level and distribution for 2010 in emerging Asia are comparable to those of the advanced countries in the late 1960s, and 4 years behind the current level of educational capital in advanced countries (11 years of education).

Figure 1: Educational Attainment of Total Population 15 Years and Above: Emerging Asia, Developing Countries, and Advanced Countries



Note: Graphs by region.
Source: Barro and Lee (2010).

Yet there are substantial educational gaps among emerging Asian countries, as seen in Table 1. The levels of educational attainment in Taipei,China (11.4) and the Republic of Korea (11.7) in 2010 are higher than the average in the advanced economies (11). By contrast, in India and Pakistan, although educational progress has been rapid in the past 40 years, the average remains below 6 years—or the average educational attainment of the advanced countries more than 6 decades ago. Average attainment in both Viet Nam (6.5) and Indonesia (6.3) also remain low in 2010.

Table 1: Educational Attainment Trends of the Total Population, 15 Years and over*

Economy	Year	Population Aged 15+ (million)	No Schooling	Percentage of Population Aged 15 and over									
				Primary		Secondary		Tertiary		Average Years of Schooling			
				Total	Full	Total	Full	Total	Full	Total	Pri	Sec	Ter
Emerging Asia													
	1970	1,035.9	49.5	34.7	17.2	14.6	3.4	1.2	0.7	2.93	2.41	0.48	0.04
	1990	1,732.1	33.2	30.1	18.1	33.2	16.2	3.5	2.0	4.93	3.49	1.33	0.11
	2010	2,473.4	17.4	25.9	18.3	48.0	28.0	8.6	4.5	7.05	4.30	2.49	0.26
	2020	2,818.7	14.6	23.9	17.6	51.0	29.5	10.5	5.2	7.50	4.48	2.70	0.32
	2030	3,102.1	15.0	22.2	15.8	51.8	29.9	11.1	6.1	7.56	4.48	2.74	0.34
China, People's Rep. of													
	1970	500.6	41.9	36.9	19.2	20.3	4.4	0.8	0.5	3.50	2.95	0.53	0.03
	1990	835.4	22.2	34.5	20.4	41.3	26.5	1.9	1.1	5.74	4.24	1.43	0.06
	2010	1,090.7	6.5	24.1	14.4	60.4	51.0	9.0	4.3	8.36	4.95	3.15	0.27
	2020	1,162.9	4.1	20.6	12.5	63.7	55.9	11.5	5.0	8.89	5.16	3.40	0.33
	2030	1,215.9	3.1	19.7	10.7	65.8	58.8	11.5	5.1	9.00	5.26	3.41	0.33
Hong Kong, China													
	1970	2.5	24.1	41.1	24.2	32.3	18.3	2.6	1.5	6.30	4.05	2.16	0.08
	1990	4.5	12.6	24.9	16.6	51.2	32.0	11.3	5.1	9.31	4.99	3.99	0.33
	2010	6.4	12.5	14.8	11.8	56.8	41.8	15.9	6.4	10.37	5.16	4.76	0.45
	2020	6.8	8.8	12.3	10.0	58.4	45.6	20.4	8.0	11.22	5.40	5.25	0.57
	2030	7.2	6.2	10.5	7.0	60.6	48.8	22.7	9.3	11.75	5.53	5.58	0.64
India													
	1970	330.6	66.2	27.1	12.7	5.6	0.1	1.1	0.6	1.60	1.33	0.24	0.03
	1990	538.7	51.6	19.1	14.2	25.4	0.5	3.9	2.2	3.43	2.30	1.01	0.12
	2010	829.1	32.7	20.9	19.1	40.7	0.8	5.8	3.2	5.13	3.32	1.63	0.18
	2020	1,002.8	26.9	21.0	18.9	44.9	1.0	7.1	3.7	5.66	3.60	1.85	0.22
	2030	1,146.3	27.6	18.4	15.6	46.0	1.0	8.1	4.7	5.76	3.55	1.95	0.26
Indonesia													
	1970	69.4	45.4	46.5	21.6	7.8	2.3	0.4	0.2	2.87	2.53	0.32	0.01
	1990	116.4	43.4	30.4	15.2	24.4	17.1	1.8	1.1	4.35	2.94	1.35	0.06
	2010	172.6	17.3	52.6	37.7	27.6	24.0	2.5	1.4	6.29	4.51	1.70	0.08
	2020	196.0	17.4	49.4	37.0	29.5	26.2	3.8	2.4	6.61	4.59	1.90	0.12
	2030	217.2	17.9	48.1	37.3	28.8	25.5	5.2	4.2	6.73	4.60	1.94	0.19
Korea, Rep. of													
	1970	18.5	24.3	39.1	37.6	30.8	14.3	5.8	3.3	6.38	4.50	1.70	0.18
	1990	31.8	12.2	22.1	21.2	46.8	32.9	18.8	9.1	9.32	5.24	3.52	0.56
	2010	40.9	3.6	9.4	9.0	46.8	37.1	40.1	12.0	11.74	5.77	4.93	1.04
	2020	42.9	2.5	6.0	5.4	45.3	36.5	46.2	12.1	12.23	5.83	5.23	1.17
	2030	43.0	1.7	3.4	3.1	46.6	37.3	48.3	12.3	12.51	5.89	5.41	1.21
Malaysia													
	1970	6.0	36.5	42.5	21.3	19.2	7.0	1.7	0.6	4.19	3.17	0.97	0.05
	1990	11.3	17.5	29.5	17.7	44.2	22.6	8.8	2.7	7.67	4.60	2.85	0.23
	2010	19.4	8.5	15.2	9.7	61.4	39.9	14.9	4.5	10.19	5.32	4.48	0.39
	2020	23.9	7.1	11.8	6.7	63.6	41.9	17.5	5.1	10.68	5.42	4.81	0.45
	2030	27.6	6.3	10.5	4.1	64.2	42.0	19.0	5.9	10.86	5.43	4.93	0.50

continued.

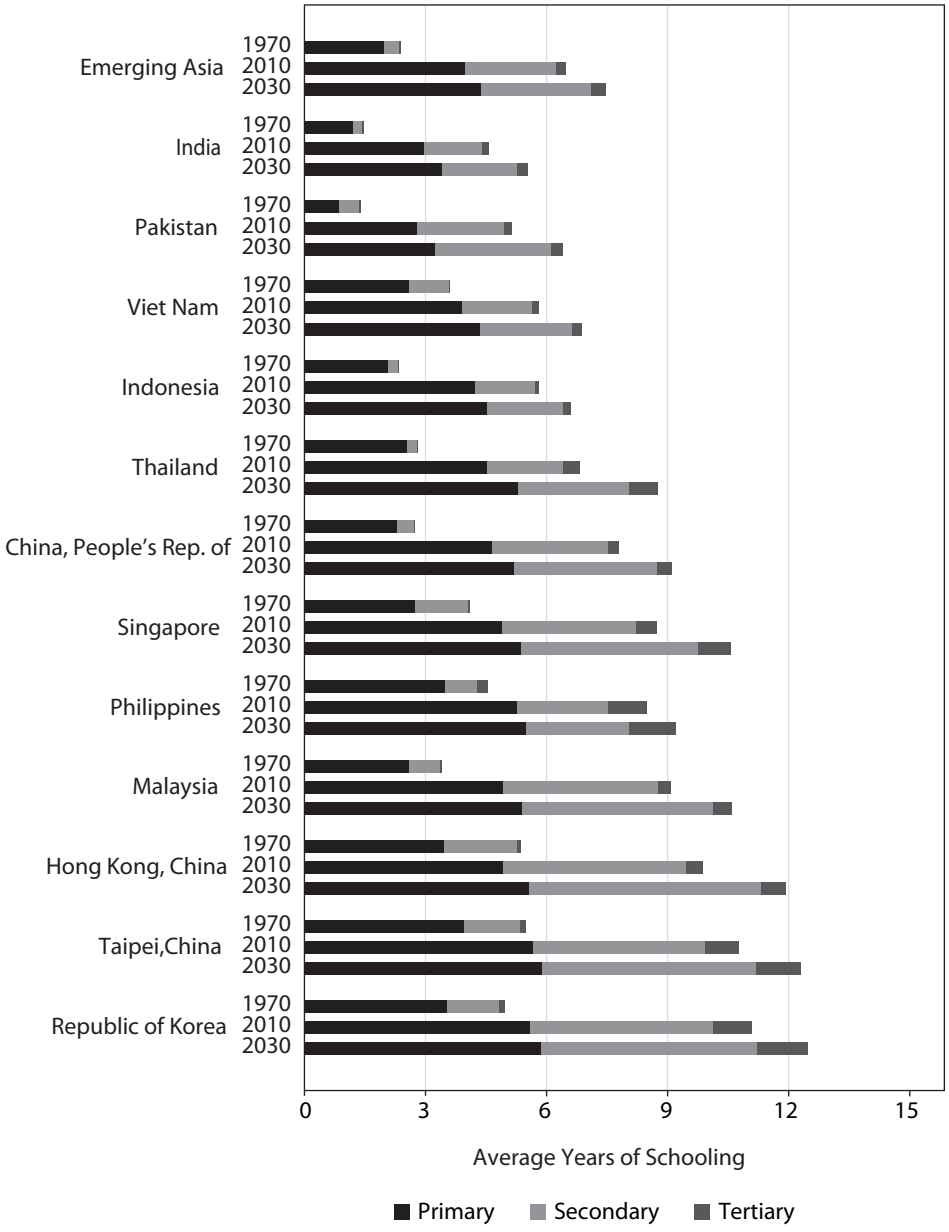
Table 1: *continued.*

Economy	Year	Population Aged 15+ (million)	No Schooling	Percentage of Population Aged 15 and over									
				Primary		Secondary		Tertiary		Average Years of Schooling			
				Total	Full	Total	Full	Total	Full	Total	Pri	Sec	Ter
Pakistan													
	1970	34.2	80.0	8.7	6.5	9.9	4.8	1.4	1.1	1.58	0.94	0.58	0.05
	1990	63.0	66.2	12.0	9.9	19.4	11.1	2.4	2.1	2.92	1.64	1.19	0.09
	2010	112.5	38.0	21.8	19.8	34.6	22.3	5.5	4.5	5.65	3.05	2.40	0.20
	2020	150.3	29.3	25.9	23.9	38.0	28.4	6.8	5.7	6.54	3.48	2.80	0.25
	2030	187.9	30.2	22.4	20.7	39.0	33.2	8.4	7.2	6.87	3.45	3.11	0.31
Philippines													
	1970	20.0	14.9	55.7	20.0	18.8	9.1	10.7	6.0	5.36	4.04	0.98	0.33
	1990	36.1	5.2	41.3	21.0	34.4	15.6	18.8	12.8	7.44	5.06	1.75	0.63
	2010	60.8	4.2	24.8	14.5	42.1	20.2	29.0	22.6	8.95	5.44	2.48	1.03
	2020	76.9	3.3	19.1	11.4	47.4	20.1	30.2	25.4	9.32	5.57	2.63	1.11
	2030	91.4	3.1	17.1	10.1	47.7	17.3	32.2	28.6	9.49	5.61	2.66	1.22
Singapore													
	1970	1.3	34.3	29.6	12.5	34.2	11.5	1.9	1.0	5.20	3.43	1.71	0.06
	1990	2.4	10.2	49.7	25.3	36.7	9.1	3.3	1.9	6.60	4.65	1.85	0.10
	2010	3.9	8.2	27.2	14.5	46.3	26.6	18.3	11.0	9.19	5.12	3.48	0.59
	2020	4.6	7.3	22.7	11.7	47.1	29.6	23.0	12.8	9.80	5.23	3.85	0.72
	2030	4.8	5.5	20.0	10.3	47.7	32.2	26.8	14.5	10.36	5.38	4.16	0.83
Taipei,China													
	1970	8.9	23.6	43.8	36.9	27.1	14.1	5.6	2.0	6.10	4.38	1.57	0.15
	1990	14.9	9.5	28.7	22.4	46.7	27.9	15.2	4.7	8.80	5.25	3.15	0.40
	2010	19.0	2.4	13.4	11.7	46.1	32.4	38.2	7.8	11.37	5.81	4.65	0.92
	2020	20.3	1.5	9.6	8.0	45.3	33.2	43.7	8.5	11.88	5.87	4.97	1.04
	2030	20.2	0.9	6.0	4.6	48.3	37.2	44.8	8.7	12.23	5.90	5.25	1.07
Thailand													
	1970	20.0	24.9	67.2	11.6	6.9	2.1	1.0	0.7	3.65	3.31	0.30	0.03
	1990	37.2	11.6	68.5	16.3	15.1	7.8	4.8	4.4	5.42	4.36	0.87	0.18
	2010	51.9	11.7	48.0	19.5	27.9	15.6	12.3	10.5	7.25	4.81	1.99	0.46
	2020	54.7	11.5	41.1	21.5	30.4	21.2	17.0	14.9	8.30	5.19	2.48	0.64
	2030	56.1	11.2	38.5	26.1	31.7	24.9	18.6	17.3	8.89	5.48	2.70	0.72
Viet Nam													
	1970	24.0	31.1	40.9	16.2	27.2	9.3	0.8	0.4	4.00	2.83	1.14	0.02
	1990	40.4	13.2	73.7	40.2	11.2	5.3	1.9	1.2	4.17	3.50	0.61	0.06
	2010	66.1	4.2	58.0	34.6	31.6	15.3	6.1	2.9	6.45	4.20	2.06	0.18
	2020	76.6	3.6	53.7	33.5	35.3	17.9	7.3	3.3	6.87	4.31	2.35	0.21
	2030	84.6	3.3	55.4	37.3	34.1	17.1	7.2	4.1	6.85	4.38	2.24	0.23

*1970, 1990, and 2010 figures are estimates; 2020 and 2030 figures are projections.
Pri = primary; Sec = secondary; Ter = tertiary.
Sources: Barro and Lee (2010) and authors' estimates.

In terms of the increase in educational attainment since 1970, Malaysia is on top (6 years); followed by the Republic of Korea (5.4); and Taipei,China (5.3) (see Figure 2). By contrast, Viet Nam increased only 2.4 years; Indonesia, India, the Philippines, and Thailand added around 3.5 years; and Hong Kong, China and Pakistan added 4 years.

Figure 2: Educational Attainment of Total Population 15 Years and Above: Emerging Asia, Developing Countries, and Advanced Countries



Note: 1970 and 2010 figures are estimates; 2030 figures are projections.
Sources: Barro and Lee (2010) and authors' estimates.

B. The Role of Population Structure and Enrollment Rates for Educational Progress

The continuous high educational attainment of the younger cohorts has been the major factor behind emerging Asia's significant educational progress.

If we distinguish the population between two major age groups (15–24 and 25 and above), we can express equation (1) as follows:

$$h_{t,j}^{15+} = l_t^{15-24} h_{t,j}^{15-24} + (1 - l_t^{15-24}) h_{t,j}^{25+} \quad (4)$$

Differencing equation (4) between time *t* and *t-5*, while assuming that population structure is stable over time, we get:

$$\Delta h_{t,j}^{15+} = l_t^{15-24} \Delta h_{t,j}^{15-24} + (1 - l_t^{15-24}) \Delta h_{t,j}^{25+} \quad (5)$$

Therefore, the increase in average years of schooling for the population aged 15 and above is mainly determined by the increase in average years of schooling for the young population aged 15–24, because the educational attainment for the population aged 25 and above is relatively stable over time. The change in educational attainment for the young population is determined by the change in school enrollment rates.[3]

Equation (5) highlights two important factors in educational growth over time: (i) the role of population structure and (ii) the role of high enrollment rates.

1. Young Population Structure and Educational Capital Growth

Equation (5) implies that, holding all else constant, educational capital in countries with a greater proportion of young people will grow faster than in countries with an older population structure. To illustrate, consider two countries (say, A and B) with the same distribution of attainment among those aged 15 years and over, but one with relatively a greater proportion of young people than the other (i.e., $l_A^{15-24} > l_B^{15-24}$). Holding all else constant, for the same increase in enrollment, the change in the aggregate educational capital in country A will be greater than in country B.[4]

In emerging Asian countries, a relatively young population structure was indeed an important factor in its rapid educational capital growth in the past 40 years. Those aged 15–24 years represented 31.2% of the total population in 1970, the same as the

[3] Note that estimating $h_{t,j}^{a}$ by forward extrapolation implies that $h_{t,j}^{15-24} = h_{t-5,j}^{15-24} + \Delta enrol_j$. See Barro and Lee (2010).

[4] It is important to note that a young population structure could be considered as both an opportunity and a constraint for a nation in building its educational capital. On one hand, it is a good opportunity because given the same improvements in enrollment and completion rates, a nation with a greater proportion of young people could increase its educational capital at a faster rate than a nation with lesser young people. On the other hand, to improve the quantity and quality of education, a younger population structure requires more resources.

average of developing countries generally, but well above the 23.7% of the advanced countries. This implies that a 1 percentage point increase in the proportion of 15–24-year-olds achieving a particular level translates to a 0.31 percentage point increase in the proportion of the population 15 and above reaching that level in both emerging Asia and developing countries. Meanwhile, in advanced countries, the same increase among the 15–24-year-olds translates to a 0.24 percentage increase among the population aged 15 years and over. However, this population dividend for educational growth has declined significantly in emerging Asia, as the share of its population aged 15–24 decreased to 23.7 % in 2010. It has similarly declined, albeit at a more limited pace, to 25.8% in 2010 in developing countries. Meanwhile, in advanced countries, it has further declined to 17.1% in 2010.

In India, Malaysia, and Pakistan, population structure remains an important factor in the relatively rapid educational progress beyond 2010. In 2010, the population aged 15–24 years was a third of the total aged 15 years and above in Pakistan; 27% in India; and 26% in Malaysia (see Table 2). This means that across all levels, every percentage point increase in the proportion of 15–24-year-olds achieving that level translates to a 0.33 percentage point increase in the proportion of 15 years and above achieving that level (but 0.26 in India and 0.26 in Malaysia). For Singapore, which has the lowest proportion of young adults (13%), every 1 percentage point increase in young adults' educational attainment translates to only a 0.13 percentage point increase in the total population's average educational attainment.

Table 2: Trends of Educational Attainment of Population Aged 15–24 Years Old

Economy and Year	Population (million)	Percent of Population, 15+	Percentage of Population							Average Years of Schooling
			No Schooling	Primary		Secondary		Tertiary		
				Total	Full	Total	Full	Total	Full	
Emerging Asia										
1970	323.5	31.2	29.1	43	27.4	26.8	5.6	1.1	0.4	4.5
2010	585.5	23.7	4.1	16.9	16.0	64.8	39.1	14.2	4.7	9.2
China, People's Rep. of										
1970	158.2	31.6	16.3	44.8	30.5	38.4	7.4	0.5	0.1	5.5
2010	218.6	20.0	0.1	3.5	2.3	75.9	72.8	20.5	6.1	10.9
Hong Kong, China										
1970	0.8	31.3	3.9	40.3	29.9	54.3	29.3	1.6	0.5	8.9
2010	0.9	13.2	0.6	2.7	2.7	82.6	70.0	14.1	4.3	12.6
India										
1970	100.4	30.4	52.3	37	24.3	9.6	0.2	1.1	0.4	2.5
2010	224.7	27.1	7.1	25.6	25.6	61.8	0.9	5.5	1.8	7.1
Indonesia										
1970	21.2	30.6	21	64.8	32.5	13.9	3.7	0.3	0.1	4.3
2010	41.4	24.0	6.8	55.4	55.4	35.4	27.4	2.4	0.8	7.7

continued.

Table 2: *continued.*

Economy and Year	Population (million)	Percent of Population, 15+	Percentage of Population							Average Years of Schooling
			No Schooling	Primary		Secondary		Tertiary		
				Total	Full	Total	Full	Total	Full	
Malaysia										
1970	2.1	34.8	14.5	47.9	31.7	35.1	12.5	2.2	0.3	6.4
2010	5.0	26.0	3.5	0.6	0.3	78.3	54.7	17.7	3.8	12.0
Pakistan										
1970	10.8	31.4	73.7	10.4	7.8	14.1	7.0	1.8	1.6	2.2
2010	37.5	33.3	19.4	30.9	30.8	45.8	28.8	3.8	3.1	7.2
Philippines										
1970	7.2	36.0	5.9	54.5	23.4	27	10.4	12.6	4.2	6.3
2010	18.2	29.9	2.6	11.5	8.3	58.3	21.4	27.5	23.4	9.7
Korea, Rep. of										
1970	5.7	30.7	2	41.4	40.1	50.7	24.3	5.8	0.8	8.6
2010	6.6	16.2	1.2	3.9	3.9	39.1	35.2	55.7	6.3	12.7
Singapore										
1970	0.5	35.5	9.7	29.9	14.8	58.5	19.4	1.7	0.6	7.8
2010	0.7	16.9	7.4	10.3	8.1	66.4	66.4	15.9	5.1	10.8
Taipei,China										
1970	3.0	33.3	3.8	44.4	38.8	44.6	23.9	7.3	0.7	8.3
2010	3.1	16.5	0.1	0	0.0	45.5	39.2	54.4	6.5	13.0
Thailand										
1970	6.8	34.1	6.9	80.6	17.1	11.6	3.7	0.9	0.4	4.8
2010	10.6	20.4	8.3	9.8	9.8	57	34.7	24.9	16.9	10.6
Viet Nam										
1970	6.9	28.9	10.8	31.5	15.6	57.1	17.2	0.8	0.3	6.4
2010	18.2	27.6	0.1	32	24.6	57.5	24.3	10.4	3.2	8.8

Source: Barro and Lee (2010).

2. Higher Enrollment Rates and Educational Capital Growth

Equation (5) also implies that the continuous inflow of a better-educated young population could drive the rapid growth of the educational stock among the population aged 15 years and over. That is, between two countries (A and C) with initially the same population structure ($I_A^a = I_C^a$) and educational attainment, the change in educational capital in A will be greater if the inflow of the better educated young population in A is greater than in B. Aside from having a young population structure, improvements in emerging Asia's enrollment rates were also significant in the past 40 years. In emerging Asia as a whole, the proportion of the young population with no schooling declined by 25 percentage points from 1970 to 2010 as enrollment rates increased at all levels (see Table 2). The proportion of the more educated young population increased from less than 28% in 1970 to 79% in 2010. With the lower illiteracy rate and greater enrollment rates at the higher levels of education (see Table 3), education among the population 15–25 years old has increased by 4.7 years in the past 40 years.

Table 3: Trends in Enrollment Rates (percent)

Economy	Primary (adjusted)		Secondary (adjusted)		Tertiary (gross)	
	1970	2005	1970	2005	1970	2005
China, People's Rep. of	68.2	100.0	23.5	76.0	0.9	22.0
Hong Kong, China	87.0	97.0	33.0	81.6	7.3	32.0
India	57.0	100.0	20.0	51.3	8.2	9.1
Indonesia	67.0	100.0	13.6	62.0	2.8	15.5
Malaysia	87.0	100.0	33.0	69.0	1.7	29.0
Pakistan	33.0	83.4	10.4	28.4	2.5	4.0
Philippines	95.7	100.0	32.3	83.3	19.9	28.0
Korea, Rep. of	94.0	100.0	38.0	93.0	8.0	71.3
Singapore	95.0	79.2	44.0	68.1	6.8	63.9
Taipei,China	96.0	98.0	71.6	93.0	16.9	82.0
Thailand	75.6	100.0	10.9	71.0	3.3	46.0
Viet Nam	81.1	100.0	7.6	82.7	0.1	13.8

Note: Primary and secondary enrollment rates were "adjusted" for the proportion of population in each age group that should be enrolled in a particular level of education.
Source: UNESCO reports (various years) as compiled by Barro and Lee (2010).

The proportion of those who have no schooling has declined significantly in both Pakistan (from 73.7% in 1970 to 19.4% in 2010) and India (from 52.3% to 7.1%), where illiteracy rates were highest among emerging Asian countries in 1970. The proportion of 15–24-year-olds reaching at least the primary and secondary levels in Pakistan has increased more than threefold (to 30.9% and 45.8%), and the tertiary level from 1.8% to 3.8%. In India in the same period, these figures have increased more than sixfold and fivefold, respectively. But while India's primary enrollment rate is now at par with most emerging countries, its secondary enrollment rate is still very low compared with other emerging countries in Asia.

In the People's Republic of China (PRC) and Hong Kong, China, progress among the young population has largely been due to improvement in secondary education. Hong Kong, China posted the highest proportion of the population of 15–24-years-old to reach the secondary level (82.6% in 2010 from 54.3% in 1970), followed by Malaysia with 78.3%, and the PRC with 75.9%.

In the Republic of Korea and Taipei,China, gains at the tertiary levels have been huge among 15–24-year-olds: in the Republic of Korea, 55.7% of the population now reaches the tertiary level from 5.8% in 1970; and in Taipei,China, 54.4% from 7.3%.

Table 2 also implies that completion rates among emerging Asia's young population have improved significantly, especially at the primary and secondary levels, contributing to increasing average years of schooling. Nonetheless, these improvements vary across countries: secondary completion rates in the PRC; Hong Kong, China; and the Republic of Korea were 85% and above in 2010, compared to India's secondary completion rate in India below 2% in 2010.

III. Determinants of Educational Investment

As explained in the previous section, the rapid growth of educational stock among the adult population in the emerging Asian economies is driven by higher school enrollment levels in the young population. We now review the empirical literature on what determines educational capital growth across countries.

A. Determinants of Educational Capital Growth: What does the Literature Say?

1. Parents' Income and Education

Household characteristics such as income, parental education, and household size affect the probability that a child will enroll in, attend, and complete school. Household income determines whether a household can afford to send children to school. Poor households are often unable to provide even a daily allowance to the studying child, let alone pay for tuition fees and school supplies. Often, they cannot forego the income from their children's employment, spare the child's help with the household chores, or the assistance the child provides in caring for younger siblings, especially when both parents are at work.

The educational level of the parents also affects the desire to see their children in school and influences the child's achievement once there. More educated parents may have a stronger desire to provide education for their children, and therefore provide more materials and school-related activities. A more educated adult population may also be more capable of training and producing more educated students. That is, there will be more competent teachers available for instruction, especially at the higher levels of education, who are capable of using new technologies that enhance the quality of learning.

Past empirical studies provide evidence that family background does indeed affect investment in children's education. Focusing on basic schooling outcomes, such as dropout and enrollment rates and educational attainment, earlier studies find that parental income and education have significant impact (for example, see Masters 1969 and Flug et al. 1998). Masters finds that children of less educated parents in the US are 20 times more likely to drop out than children of parents who are both high school graduates. Flug et al. emphasize that parental education and income account for more than 70% of the total variance in enrollment across countries. According to Haveman and Wolfe (1995), every 10% increase in family income is associated with a 0.2%–2% increase in school attainment among children.

Cross-country education production function analysis by Lee and Barro (2001) also indicates that family characteristics, such as income and the education of parents, are strongly related to different school outcomes (that is, internationally comparable test scores, repetition rates, and dropout rates).

A more recent study by Hanushek and Luque (2003) finds that access to more school-related resources at home, direct "parental guidance", and parental education improve school outcomes across countries. Children belonging to families with access to complementary school resources—such as more books at home, a calculator, a computer, a study desk, or a dictionary—consistently perform better. In addition, a child living with his/her mother and belonging to parents who are at least high school graduates will also improve his/her achievement. Currie (2009), meanwhile, provides evidence that health plays an important role in transmitting economic status from generation to generation, specifically that parental socioeconomic status strongly affects child health and, in turn, future educational outcomes.

2. Income Distribution

More equal income distribution implies that more families can afford to send their children to school and invest in their education, as in the case of most countries in emerging Asia. Flug et al. (1998) confirm this. They found that income inequality has a significant negative effect on secondary enrollment rates, in that it represents a lack of resources and access to credit to finance education.

3. Number of Children

The literature also suggests that families face a trade-off between having more children or having less but more educated children who are more likely to succeed (that is, there is a quantity–quality tradeoff) (see Becker and Lewis 1973, Becker 1981, Becker and Barro 1988 for examples). Becker and Lewis (1973) explain that the shadow price of quality education increases with having more children, and vice versa. Becker et al. (1990) suggest that investment in human capital rises with the stock of human capital, as its rate of return continues to increase. But demand for children falls as they become more expensive. This implies that societies with limited human capital choose large families and invest little in each member, while those with abundant human capital do the opposite.

Kalemli-Ozcan et al. (2000) find that schooling increases with child survival rates. In economies with low life expectancy, schooling increases by 1% for every 1% increase in life expectancy. In high life expectancy economies, schooling increases by only 0.7% for every 1% increase in life expectancy. Kalemli-Ozcan (2003) argues that the quantity–quality tradeoff could be empirically observed if uncertainty about the number of surviving children (child mortality) is considered. Kalemli-Ozcan recognizes that there is a precautionary demand for children and that, as empirical studies show, there is a positive relationship between child survival and human capital investment.

Lee and Mason (2010) examine the quantity–quality tradeoff associated with lower fertility. They find that although total spending per child falls with fertility, human capital expenditures per child are inversely related to fertility. Their estimates show that a

constant proportion of parents' lifetime labor income goes to human capital investment, regardless of fertility rates. About one twelfth of parental lifetime labor income is invested in children's education in countries where the total fertility rate (TFR) is near 1, such as Austria, Hungary, Japan, and Slovenia; as well as in countries with higher TFR (e.g., the Philippines with 3.6 and Uruguay with 2.5). This implies that the additional resource per child that is generated as fertility declines is invested in human capital. Therefore, over time, low fertility and an aging population will not be a burden for sustained growth if the greater human capital investments replace the decline in labor force growth.

4. Government Policy

A cross-country study by Heyneman and Loxley (1983) concludes that while both school resources and family background improve a student's academic achievement, school resources are more important to academic achievement, especially in poor countries. But later studies criticize their methodology (i.e., Coleman 1968). Hanushek and Luque (2003) show that the results do not support Heyneman and Loxley.

Several other empirical studies have also found that social spending on education has a positive and significant impact on outcome (Baldacci et al. 2003, Gupta et al. 2002, Psacharopoulos and Patrinos 2004, Bidani and Ravallion 1997, Anand and Martin 1993). Baldacci et al. (2003) and Gupta et al. (2002) also find that the effect of spending in education is greater than in health. A number of other studies, nonetheless, have found a limited education spending effect on outcomes (see Flug et al. 1998, Mingat and Tan 1998, Mingat and Tan 1992, Noss 1991).

Baldacci et al.'s (2008) cross-country assessment indicates that education spending improves the accumulation of education capital, through both a contemporaneous effect and a lagged effect. They suggest that for every additional percentage point of gross domestic product (GDP) in education spending, enrollment rates increase 6 percentage points in the current 5-year period, and by another 3 percentage points in the next period. But it is important to note that the impact of education spending is sensitive to governance; it is around 50% less effective at improving the educational outcome in poor governance environments.

Some studies point out that specific, rather than overall, public education spending is more effective in increasing the quantity and quality of education. Mingat and Tan (1998) found that greater public spending on education, as well as lighter demographic burdens, contribute only a little to rich countries' educational resource advantages. Their analysis indicates that the decline in teacher salaries to per capita GDP is the most important factor. This allows countries to use extra financial resources arising out of income growth to expand enrollments and improve the pupil–teacher ratio.

5. Culture and Ethics

Lee and Barro (2001) recognize the positive impact of features in East Asia on educational outcomes, as may be captured by the East Asian dummy in their cross-country regression analysis of various educational outcome measures.

Comparative studies of Asian students and their western counterparts provide evidence that the East Asian culture has a significant positive impact on educational expectations and performance (Stevenson et al. 2008, Leung 2006). Similar findings were also found in studies on educational expectations and school performance among Asian-American students (Leung 2001, Goyette and Xie 1999, Chen and Stevenson 1995).

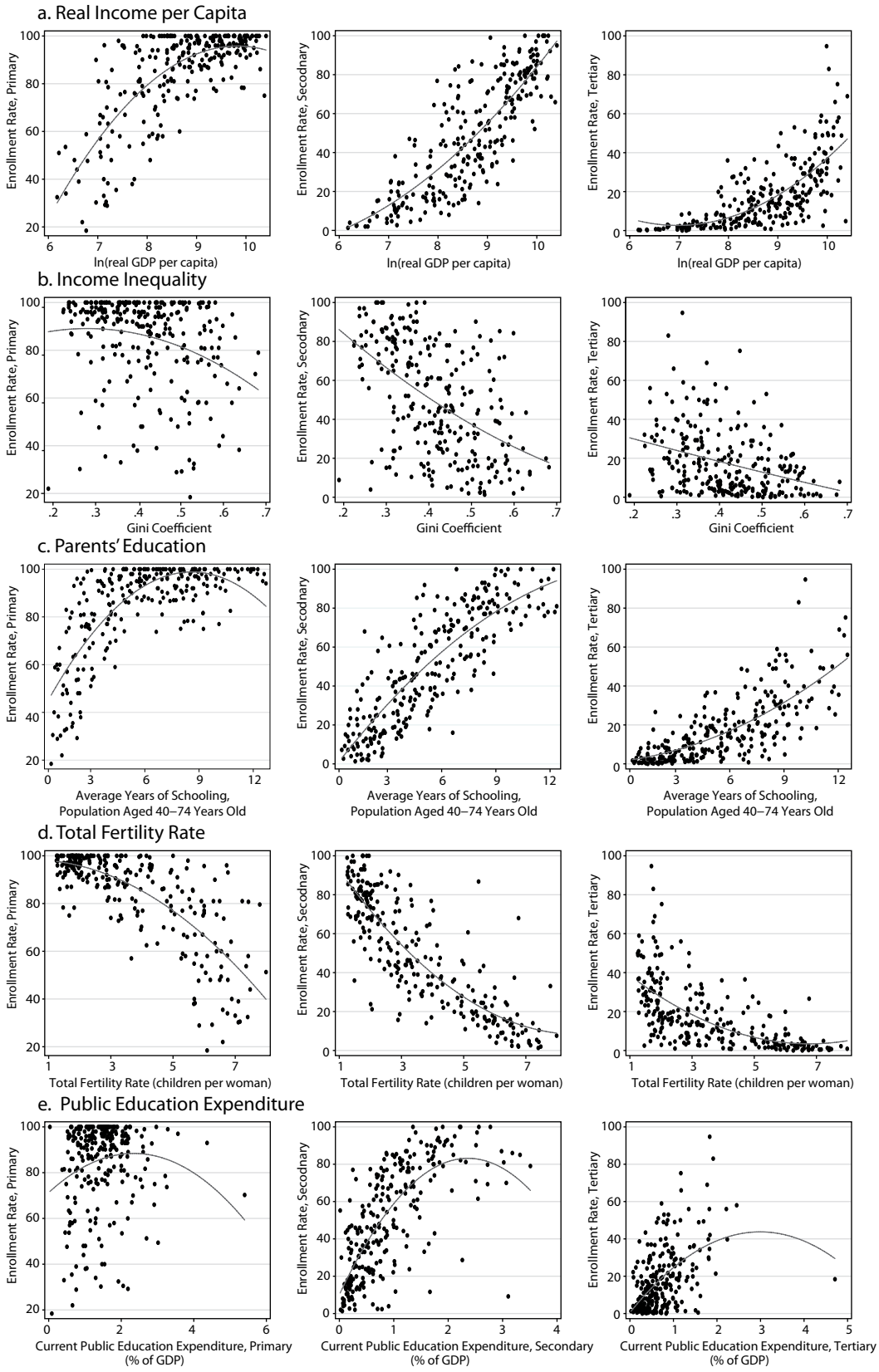
Leung (2006) concludes that differences in resources and the education system fail to explain the superior performance of East Asian students in internationally comparable mathematics achievement tests. In fact, most East Asian countries examined spend less time on mathematics instruction inside the classroom than their western counterparts. Leung suggests that the exceptional performance of East Asian students could be due to cultural factors that are common among them, as well as among their teachers.

Peng and Wright's (1994) analysis of the 1988 National Education Longitudinal Study data in the US indicated that a large part of the difference in achievement between Asian-American and other minority students is due to differences in home environments and educational activities. They found that Asian-American students are more likely to live with both parents, spend more time doing homework, and attend more lessons and activities outside of regular school. Peng and Wright (1994) and Goyette and Xie (1999) also found that Asian-American parents tend to have higher educational expectations and stronger support for their children, which, aside from favorable socioeconomic background and higher parental education, creates higher educational expectations and success among their children.

B. Empirical Estimation of Educational Investment

We use recently available data to estimate the relationship between educational investment—as measured by enrollment rates by level of education—and income and nonincome factors identified in the existing literature. These include real income per capita, income distribution, parental education, fertility, and current public education expenditures. Figure 3a indicates a positive relationship between income and enrollment rates, which is strong at the primary and secondary levels. Figure 3b shows a negative relationship between enrollment rates and income inequality. Figure 3c shows that enrollment rates increase with parental education, while Figure 3d indicates that they decline with higher fertility. Finally, enrollment rates increase with current public education expenditure.

Figure 3: Relationship between Enrollment Rates, Income, Income Inequality, Parents' Education, Fertility Rate, and Public Education Expenditure, 1960–2000



Sources: World Income Inequality Database (United Nations 2008); Barro and Lee (2010); UNdata (United Nations 2010); UNESCO (1971, 1972, 1983, 1989); *Statistical Yearbook of [Taipei,China] 2008* **(**United Nations 2009a**)**.

Specifically, we test and estimate these relationships using both random effects and fixed effects specifications with the following equation:

$$enroll_{j,t} = \alpha + \beta_{1j,t} \ln(\text{GDP per capita}) + \beta_{2j,t} \ln(\text{GDP per capita})^2 + \beta_{3j,t} \text{Gini} + \beta_{4j,t} \text{Ave. Yrs Sch}_{40\text{-}74} + \beta_{5j,t} \text{TFR} + \beta_{6j,t} \text{Public education expenditure}_j + \mu_{j,t} \quad (6)$$

Our dataset is an unbalanced panel consisting of data from 1960 to 2000 for 80 countries at 10-year intervals.[5] We use data on income from the Penn World Table (Version 6.3) and income inequality data, as measured by the Gini coefficient, compiled by the United Nations (UN) in the World Income Inequality Database (WIID) (United Nations 2008).[6] For parental education, we obtain average years of schooling among 40–74-year-olds from the Barro and Lee (2010) educational attainment dataset. Data on fertility (children per woman) and current public education expenditures by educational level (as a percentage of GDP) are sourced from the UN's consolidated online database UNdata (United Nations 2010); UNESCO statistical yearbooks (UNESCO 1971, 1972, 1983, 1989); and the *Statistical Yearbook of [Taipei,China] 2008* (United Nations 2009a).

Table 4 presents our regression results for both random effects (columns 1–3) and fixed country effects (columns 4–6) specifications. As expected, we found a significant positive relationship between per capita income and investment in education. This positive relationship is nonlinear for both primary and secondary enrollment rates, as shown by the significant coefficient of the squared per capita income. That is, holding all else constant, primary and secondary enrollment rates increase with average per capita income, but at a decreasing rate. However, the coefficient of the squared per capita income is statistically significant only for primary enrollment rates (both in random and fixed effects specifications). The relationship between investment in tertiary education and per capita income is also positive and nonlinear. As per capita income increases, the demand for tertiary education increases at an increasing rate.[7]

[5] For each economy included in our dataset there are at least two observations for each educational level.

[6] The income Gini data from WIID are classified into four quality grades: 1 (best), 2, 3, 4 (poor). We use quality grades 1–3 data only in our analysis.

[7] Tertiary enrollment is decreasing in per capita income when ln(per capita income) is lower than 7.1, or per capita income is lower than US$1,231.6 (in constant 2000 prices). This however applies to very limited cases only. In our sample, the lowest per capita income in 2000 is greater than that level ($1,793.5).

Table 4: Regression Results for Enrollment Rate Determinants

Dependent Variable: Enrollment Rate	Random Effects			Fixed Effects		
	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary
	(1)	(2)	(3)	(4)	(5)	(6)
ln(real GDP per capita)	90.857	28.250	-39.537	57.965	-5.371	-75.892
	(5.66)**	(2.05)*	(3.23)**	(2.55)*	(0.25)	(5.41)**
ln(real GDP per capita) squared	-5.113	-1.309	2.778	-3.381	0.542	4.735
	(5.58)**	(1.58)	(3.65)**	(2.62)**	(0.42)	(5.70)**
Gini	-13.928	-30.788	-0.012	-21.900	-10.492	4.836
	(1.55)	(3.27)**	(0.00)	(2.03)*	(0.99)	(0.58)
Average Years of Schooling, 40–74 Years Old	1.297	3.163	1.951	-1.621	-0.403	1.013
	(2.37)*	(5.42)**	(4.01)**	(1.76)	(0.34)	(1.10)
Total Fertility Rate	-2.910	-3.156	2.206	-2.312	-3.727	2.524
	(3.41)**	(3.06)**	(3.69)**	(2.12)*	(3.10)**	(2.67)**
Education Expenditure, by Level	0.933	4.969	3.916	-0.812	3.449	2.191
	(0.98)	(4.42)**	(1.80)	(0.94)	(2.87)**	(1.26)
Emerging Asia Dummy	4.863	3.795	4.240			
	(1.19)	(1.40)	(1.90)			
Observations	260	260	260	260	260	260
Number of countries	80	80	80	80	80	80
R-squared	0.69	0.87	0.69	0.54	0.81	0.78

* significant at 5%; ** significant at 1%.

Note: Absolute value of z/t statistics in parentheses. Primary and secondary enrollment rates are adjusted; tertiary enrollment rate is gross. Viet Nam was excluded in the sample because education expenditure by level for Viet Nam was not available. Constant and time dummies are not reported here but were included across all specifications. We obtained similar results when the Emerging Asia dummy was excluded.

For the tertiary level, since female tertiary students are women of reproductive age, a 5-year lag of total fertility rate (TFR) may be more appropriate to use. Nonetheless we obtained similar results when using 5-year lag of TFR instead of concurrent TFR.

The above results are robust using alternative specifications (e.g., using ln(gini), adding average years of schooling squared, using ln(TFR), or using ln(education expenditure).

Source: Authors' estimates.

Meanwhile, the coefficient for income inequality is negative across all levels, but significant only for the primary enrollment rate under fixed-effects specification, and for the secondary enrollment rate under random effects specifications.[8] This suggests that holding all other variables the same, countries with lower income inequality would tend to have higher primary and secondary educational investment.

The estimates for parental education are also positive and strongly significant across all levels, especially at the secondary level, in the random effects specifications (see columns (1)–(3) in Table 4).[9] This indicates that, on average, while controlling for income

[8] Results are similar when using ln(gini).

[9] Results remain qualitatively the same with the addition of squared years of schooling. The coefficient of this squared term is negative for both primary and secondary levels, but significant for primary enrollment rate only. It is positive and significant for tertiary enrollment rate, which implies that tertiary enrollment of children increases, at an increasing rate, with parents' education level.

and nonincome factors, a population with a higher level of education is more likely to invest in children's education and is thus more likely to have an increasing level of education over time. The coefficient estimates indicate that for every additional year of education among parents, the enrollment rate increases by 1.3 percentage points at the primary level, 3.2 percentage points at the secondary level, and about 2 percentage points at the tertiary level. The estimates are less statistically significant in the fixed effects specifications, columns (4)–(6) in Table 4.

Investments in primary and secondary education decline significantly with the total fertility rate. That is, holding all else constant, households with bigger family size are less likely to invest in primary or secondary education than smaller households. Specifically, for every additional child per woman of reproductive age, the primary enrollment rate declines by 2.9 percentage points and the secondary enrollment rate by 3.2 percentage points. It is intriguing, however, that our estimates indicate a strong positive and significant relationship between tertiary enrollment and fertility rate, under different specifications (i.e., random effects and fixed effects specifications, using ln(TFR), or whether using concurrent or 5-year lag TFR values). This implies that, all else being equal, communities with larger families are more likely to invest in tertiary education.[10]

Our estimates also show that enrollment is positively related to current public education expenditure. But this relationship is strongly significant for secondary enrollment rate only under both specifications.[11] The results of our random-effects estimation include a dummy variable for emerging Asian economies. The estimated coefficients for the dummy variable in equations (1)–(3) are positive but statistically insignificant. This implies that the estimated specifications explain the major part of the changes in enrollment rates in emerging Asian economies.

IV. Projections of Human Capital Growth in Emerging Asia

In this section, we discuss our methodology for generating projection estimates of average years of schooling for emerging Asian countries for 2015–2030.[12] Projection estimates are also presented and discussed here.

[10] This empirical result may be capturing the role of religion on the historical development of education in some societies. It is well established in demographic studies that religious affiliation is an important determinant of fertility patterns and other demographic behavior (McQuillan 2004). It can be tested whether the strong positive relationship between tertiary enrollment and fertility indicates the positive influence of religion on access to tertiary education.

[11] We get similar results when using ln(Public education expenditure).

[12] A more detailed discussion of the estimation methodology is presented in the Appendix.

A. Projection Method

We use the Barro and Lee (2010) educational attainment data to examine how educational progress in emerging Asia will continue in the next 20 years. Following their methodology, we apply forward extrapolation, using their 2010 educational attainment by age-group data as benchmark figures, to calculate the educational attainment of the population by 5-year age groups from 2015 to 2030 at 5-year intervals.

First, we calculate the distribution of educational attainment in four broad categories—no formal education (*lu*), primary (*lp*), secondary (*ls*), and tertiary education (*lh*). The forward extrapolation method assumes that the distribution of educational attainment of age group *a* at time *t* is the same as that of the age group that was 5 years younger at time *t*-5:

$$h_{j,t}^{a} = h_{j,t-5}^{a-1} \tag{7}$$

where age group *a* denotes, *a* = 3: 25–29 age group, … *a* = 10: 60–64 age group. This setting applies to people who have completed their schooling by time *t*-5. In other words, the educational attainment of a person belonging to these age groups remains unchanged between age 25 and 59. Also, the survival rate in the same 5-year age group is the same regardless of a person's educational attainment. For the old-age population (65 years and over), we adjust the forward extrapolation formula by considering different mortality rates by education level.

For the two youngest cohorts between ages 15 and 24, we consider that part of the population as still in school. Hence, for these age groups (*a* = 1: 15–19 age group and *a* = 2: 20–24) we account for the changes in enrollment rates, $\Delta enroll_{j,t}^{a}$, for age group *a* in level *j* during the transition period from *t* to *t*+5 (see Barro and Lee 2010):

$$h_{j,t}^{a} = h_{j,t-5}^{a} + \Delta enroll_{j,t}^{a} \tag{8}$$

We implement two methodologies for generating enrollment rate projections: (a) a regression-based approach, and (b) a logistic time trend estimation. For (a) we use the estimates presented in Section III to predict how enrollment rates will change with changes in per capita income, parental education, and fertility in the same period; and make enrollment rate projections for 2015–2030. We use Lee and Hong's (2010) GDP growth projections and UN population projections (medium fertility variant) to estimate GDP per capita for 2015–2030. Educational attainment among 40–74-year-olds was estimated using Barro and Lee (2010), while fertility rate projections (medium fertility variant) were taken from the World Population Prospects (United Nations 2009b). We assume the other regressors, including income inequality and public education expenditure, remain constant.

For (b) we estimate the trend in enrollment rates from 1950 to 2005 using a logistic growth equation (see Appendix for more details about this methodology). Then we use our estimates to construct enrollment rate projections for 2010–2030. Our time trend estimation and regression-based enrollment rate projections exhibit similar trends.

After estimating school attainment by broad levels of schooling—no school, some primary, some secondary, and some higher—we break down the three levels of schooling into incomplete and complete education by using completion ratio estimates. To estimate completion ratios by educational attainment and by 5-year age group, we also apply forward extrapolation (see Barro and Lee 2010 for details).

The number of years of schooling is computed using duration data and attainment distribution by level as shown in equation (2) in Section II. The number of years of schooling for the population aged 15 and above is then constructed by aggregating the estimated years of schooling for all age groups and weighted using population,[13] as shown in equation (3) in Section II.

B. Estimates of Average Years of Schooling for Emerging Asian Economies, 2015–2030

The projections show that in the next 20 years, as primary enrollment ratios rise in emerging Asia, illiteracy rates are expected to decline further, albeit at a limited pace (from 17.4% in 2010 to 15% by 2030). Meanwhile, the proportion of the population aged 15 years and above who attain primary education as the highest level is expected to decline from 25.9% to 22.2% by 2030, as the proportions of those who will attain secondary and tertiary levels are expected to reach 51.8% and 11.1%, respectively. With this, emerging Asia's average years of schooling is expected to increase marginally from 7 years in 2010 to 7.6 years by 2030.

The increase in Asia's average years of schooling by just 0.54 year over the next 2 decades is a significant deceleration from the 2.1 year increase between 1990 and 2010. Of the 0.5 year expected increase in total attainment, the increase in average years of secondary schooling accounts for 0.25 and 0.18 year each in both primary and tertiary schooling.

Because of the slower progress in the next 20 years, emerging Asia's educational capital will only be around the same level as that of advanced countries' educational capital in 1970 (7.7 years). After 20 years, emerging Asia's educational capital will remain 3.5 years behind advanced countries' educational capital in 2010 (a 0.5 year reduction in the gap in 2010).

[13] We use 2015, 2020, 2025, and 2030 population projection data by 5-year age group (medium fertility variant) from the World Population Prospects (United Nations 2009b). UN population projection data are available for all emerging Asian countries except Taipei,China. For Taipei,China we used US Census projections.

Significant reductions in the percentage of the "no schooling" population are expected in the next 20 years for both India (by 5.1 percentage points) and Pakistan (by 7.8 percentage points). Together with a decline in the proportion of population reaching primary education only, the reduction in illiteracy rates implies greater improvement at the secondary and tertiary levels in both India and Pakistan.

The proportion of the population reaching the secondary level of education increases to 65.8% of the total population in the PRC; 64.2% in Malaysia; and 60.6% in Hong Kong, China by 2030. The proportion reaching tertiary level increases to 48.3% in the Republic of Korea; 44.8% in Taipei,China; and 32.2% in the Philippines.

Overall, educational capital is expected to rise from 5.6 in 2010 to 6.9 years of schooling by 2030 in Pakistan, and from 5.1 years to 5.8 years in India. In the Republic of Korea, average years of schooling is expected to increase further by 0.8 year, to 12.5 years by 2030. Average years of schooling is expected to reach 11 years or more by 2030 in Taipei,China (12.2); Hong Kong, China (11.7); and Malaysia (10.9). Educational capital is also expected to increase in other emerging Asian economies—Singapore (to 10.4 years), Malaysia and the Philippines (9.5), the PRC (9), Thailand (8.9), and Viet Nam (6.8).

V. Concluding Remarks

Along with its remarkable economic growth, emerging Asia has also shown strong progress in educational capital in the past 40 years. Among the population aged 15 years and above, average years of schooling increased by 4.1 years, to 7 years in 2010 from only 2.9 years in 1970. Emerging Asia's rapid educational growth is mainly due to the outstanding improvements in enrollment at the primary and secondary levels, supported by its relatively young population structure. Nonetheless, while overall progress was strong, substantial gaps in educational attainment still exist among emerging Asian countries as well as between emerging Asia and the advanced countries.

Based on our estimates, the proportion of those with no education in the population aged 15 years and above in emerging Asia is expected to decline at a more limited pace (from 17.4% in 2010 to 15% by 2030). The proportion of those who attained only primary education is expected to decline from 25.9% to 22.2% by 2030, while those reaching the secondary level will increase to 51.8% and the tertiary level to 11.1%. Overall, emerging Asia's average years of schooling is expected to increase from 7 years in 2010 to 7.6 years by 2030, a significant deceleration from the 4.1-year increase from 1970 to 2010.

Our regression analysis indicates that parental income and education improve investment in children's education. Our results also confirm that primary and secondary enrollment rates increase with lower fertility, and that lower income inequality and higher current

public education expenditure promote higher enrollment rates, although, significantly, only at the secondary level.

Based on these results we conclude that the remarkable economic development of East Asia, along with increasing average years of schooling, lower income inequality, and declining fertility rates, account for the outstanding improvements in emerging Asia's enrollment at the primary and secondary levels that brought about significant progress in emerging Asia's educational capital.

Our projections of estimates of educational attainment provide a reasonable proxy of educational capital in emerging Asia for 2015–2030. However, they account neither for the effects of international migration or lifelong learning, nor for differences in the quality of schooling across countries. Also, our estimates are for total population only and do not investigate the differences in educational progress between males and females. These issues will be addressed in our subsequent research.

Appendix: Estimation of Enrollment Rates Based on Logistic Trend

We assume that primary, secondary, and tertiary enrollment rates ($enroll_j$, j = (pri, sec, ter levels)) grow logistically over time (t), at a rate equal to $\beta_j \cdot enroll_{j,t}(1 - enroll_{j,t}/enroll_j^{max})$ whereas it approaches the maximum rate, $enroll_j^{max}$. That is, enrollment rates follow the following logistic growth time trend:

$$enroll_{j,t} = enroll_j^{max} / (1 + \exp(-\alpha - \beta_j \text{ time})) \quad \text{(A1)}$$

From equation (A1), we fit 1950–2005 enrollment data by educational level for 144 countries to estimate enrollment rates for 2010–2030 using:

$$\ln(enroll_{j,t}/(enroll_j^{max} - enroll_{j,t})) = \alpha + \beta_j \text{ time} + \mu_{j,t} \quad \text{(A2)}$$

The appendix table below presents our regression estimates for β_j. Using the random effects estimates we generate forward estimates for enrollment rates for 2010–2030 by 5-year intervals.

Appendix Table: Regression Results for Enrollment Rate Time Trend

	Random			Fixed		
	Primary	**Secondary**	**Tertiary**	**Primary**	**Secondary**	**Tertiary**
	(1)	(2)	(3)	(4)	(5)	(6)
Year	0.063	0.063	0.069	0.063	0.063	0.069
	(15.32)*	(27.11)*	(21.76)*	(15.32)*	(27.11)*	(21.76)*
Observations	144	144	144	144	144	144
Number of countries	12	12	12	12	12	12
R-squared	0.43	0.54	0.43	0.64	0.85	0.78

* significant at 1%.

Note: Absolute value of z/t statistics in parentheses. Primary and secondary enrollment rates are adjusted; the tertiary enrollment rate is gross. A constant term is included in all specifications but not reported. We set $enroll_{pri}^{max} = 110$; $enroll_{sec}^{max}$, $enroll_{ter}^{max} = 100$.

Source: Authors' estimates.

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About the Paper

Jong-Wha Lee and Ruth Francisco find that high educational attainment, especially at the secondary level, has significantly improved emerging Asia's human capital accumulation in the past 40 years. Better parental education and income, lower income inequality, declining fertility, and higher public educational expenditures contributed to higher school enrollment. They argue that for sustained human development in the next 20 years, Asian economies must invest in raising enrollment rates at the secondary and tertiary levels and in improving educational quality.

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