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International Measures of Schooling Years and Schooling Quality

By ROBERT J. BARRO AND JONG WHA LEE*

This study provides an update on measures of educational attainment for a broad cross section of countries. In our previous work (Barro and Lee, 1993), we constructed estimates of educational attainment by sex for persons aged 25 and over. The values applied to 129 countries over five-year intervals from 1960 to 1985. The schooling figures indicated the fractions of the adult population for whom the highest level of attainment fell into seven standard classifications: no formal education, incomplete primary, complete primary, first cycle of secondary, second cycle of secondary, incomplete higher, and complete higher. Information by country about the typical duration of each level of schooling then allowed us to compute the number of years of attainment achieved by the average person in each country at the various levels and in total schooling.

The estimation procedure began with census information on school attainment for males and females aged 25 and over. These data came from individual governments, as compiled by UNESCO and other sources. The census values provided benchmark numbers for a subset of the dates (roughly 40 percent) that we were considering. Missing cells were filled in by using school-enrollment ratios by sex at various levels of schooling. The basic idea is that the enrolled population is the flow that adds over time to the prior stock of schooling to determine the subsequent stocks. In this manner, full estimates of educational attainment were obtained at five-year intervals for most countries from the benchmark figures for one or more years and from the reasonably complete data on school-enrollment ratios.

The schooling figures that we constructed have clear advantages over the educational

variables that have been used in many previous cross-country investigations of the effects of schooling. These studies have typically relied on school-enrollment ratios or adult literacy rates, concepts that do not correspond to the stock of human capital that influences current decisions about fertility, health, and so on. For these reasons, the new estimates have already been used in many empirical studies.¹

Despite these advantages, the data assembled in our previous study had a number of shortcomings. First, the available census information motivated an initial concentration on the adult population aged 25 and over; that is, the data were most plentiful for this age group. For many developing countries, however, a large portion of the labor force is younger than 25. For that reason, the present study provides estimates of school attainment for the population aged 15 and over.

Our previous fill-in procedure used the UN's readily available figures on the gross school-enrollment ratio, the ratio of all persons enrolled in a given level of schooling to the population of the age group that national regulation or custom dictates should be enrolled at that level. For example, the total registered students in primary school are typically compared with the population aged 6–11 years. A tendency for students to repeat grades or to return after previously dropping out means that the gross ratio will overstate the accumulation of human capital. One indication of

¹ George Psacharopoulos and Ana Maria Arriagada (1986) also use census information, but the Barro and Lee (1993) study compiles more of these data and uses the school-enrollment ratios to fill in the missing observations. The procedures of Lawrence Lau et al. (1991) and Vikram Nehru et al. (1995) rely on school-enrollment ratios. These studies therefore require estimates of school enrollment over a long history to generate initial stocks of attainment. The inadequacy of the long-term data on enrollment means that these benchmark stocks have a substantial measurement error.

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this problem is that the reported ratio in primary school is often above 1.0.

The present project follows Nehru et al. (1995) in using estimates of the more appropriate concept of the net enrollment ratio, the ratio of students at a given level of schooling in the designated age group to the total population of the same age group. For example, the registered students aged 6–11 years in primary school are compared with the total population aged 6–11 years. Accordingly, this concept does not count students in primary school who are older than 11, a group that tends to be repeaters. The net enrollment ratio is always less than 1.0.

The data in Barro and Lee (1993) applied from 1960 to 1985. The present study adds census information for 1985 and 1990 and updates the estimates of educational attainment to 1990. We have also been able to add a few countries, notably China, which were previously omitted because of missing data.

Our basic data measure years of schooling by sex at various levels of education but do not take account of the quality of each year of schooling. We have compiled a number of proxies for the quality of inputs, and these data efforts are ongoing. The main constraint here is that the information must be available over time on a reasonably accurate and consistent basis for a large number of countries. Measures have been assembled in a broad panel for real public educational spending per student, teacher–pupil ratios, estimated real salaries of teachers, and length of the school year (days per year and hours per day). We also have information on two outcome variables: the percentages of students who are repeaters and dropouts.

We plan to relate the figures on quantity and quality of school inputs to results from internationally comparable test scores in mathematics, science, and reading comprehension. Students from 53 countries have now participated in at least one of these examinations, and these data have recently been analyzed by Eric A. Hanushek and Dong-Wook Kim (1995).

Our data on years of schooling for the population aged 15 and over apply to 126 countries, each of which has at least one census observation on educational attainment. Among the 126 countries, 29 have one census obser-

vation, 33 have two observations, and 64 have three or more observations. The census data are most plentiful for 1960 (59 countries), 1970 (62 countries), and 1980 (75 countries). Overall, the 310 census observations fill 35 percent of the 882 possible cells from 1960 to 1990. Our fill-in procedure allows us to construct a complete data set at five-year intervals for 105 of the countries. The data are incomplete for the other 21 countries.

Table 1 summarizes the time-series data on schooling by region for the 105 countries that have complete information. The table considers groups of 23 OECD countries, nine countries that formerly had centrally planned economies (CPE's), and 73 developing countries. The developing group is further broken down into five regions: Middle East/North Africa (10 countries), sub-Saharan Africa (23), Latin America/Caribbean (23), East Asia/Pacific (10), and South Asia (7). Regional averages are computed by weighting each country's observation by its share of the population aged 15 and over.

The characteristics of the data are broadly similar to those presented by Barro and Lee (1993 table 6) for the population aged 25 and over. Table 1 shows for the 73 developing countries that the average years of schooling for the overall population of persons aged 15 and over more than doubled from 2.1 years in 1960 to 4.4 years in 1990. For the 23 OECD countries, the average years of attainment grew by 28 percent from 7.0 in 1960 to 9.0 in 1990. In the nine CPE's, the average years of schooling grew by 32 percent, from 7.5 to 10.0, and the average level of attainment was always somewhat higher than the average for the OECD countries.

For the developing countries, 40 percent of the population aged 15 and over in 1990 still had no formal schooling, compared with 64 percent in 1960. Only 26 percent had received some secondary training, compared with 7 percent in 1960. For the OECD and CPE countries in 1990, 63 percent and 73 percent, respectively, of the population had at least some secondary schooling, compared with 38 percent and 34 percent in 1960.

We have used the same sources and methodology to construct a panel data set from 1960 to 1990 on the educational attainment of

TABLE 1—TRENDS OF EDUCATIONAL ATTAINMENT
OF THE POPULATION AGED 15 AND OVER

Region	Year	POP	Education		
			None	Primary	
				Some	Full
DC	1960	685	0.640	0.289	0.101
	1970	866	0.561	0.331	0.122
	1980	1138	0.497	0.296	0.093
	1990	1492	0.398	0.345	0.120
M/NA	1960	28	0.810	0.130	0.053
	1970	37	0.698	0.180	0.065
	1980	52	0.553	0.232	0.080
	1990	73	0.410	0.286	0.098
SSA	1960	66	0.689	0.243	0.070
	1970	85	0.638	0.268	0.061
	1980	112	0.568	0.328	0.070
	1990	151	0.483	0.371	0.076
LA/C	1960	119	0.379	0.479	0.129
	1970	156	0.312	0.521	0.184
	1980	210	0.238	0.528	0.137
	1990	275	0.173	0.530	0.132
EA/P	1960	116	0.525	0.374	0.194
	1970	148	0.354	0.489	0.201
	1980	198	0.225	0.505	0.190
	1990	261	0.154	0.522	0.261
SA	1960	355	0.742	0.219	0.070
	1970	440	0.693	0.236	0.089
	1980	566	0.669	0.136	0.048
	1990	732	0.552	0.212	0.075
OECD	1960	458	0.050	0.572	0.333
	1970	524	0.050	0.503	0.324
	1980	598	0.047	0.355	0.179
	1990	662	0.045	0.326	0.160
CPE	1960	236	0.025	0.632	0.295
	1970	270	0.021	0.472	0.248
	1980	307	0.015	0.405	0.221
	1990	329	0.016	0.255	0.157

Region	Year	Education				Mean school years
		Secondary		Higher		
		Some	Full	Some	Full	
DC	1960	0.062	0.016	0.008	0.004	2.05
	1970	0.091	0.025	0.016	0.006	2.66
	1980	0.176	0.058	0.031	0.012	3.57
	1990	0.208	0.071	0.048	0.023	4.43
M/NA	1960	0.052	0.016	0.009	0.004	1.22
	1970	0.105	0.032	0.017	0.006	2.05
	1980	0.178	0.058	0.036	0.014	3.26
	1990	0.244	0.085	0.059	0.024	4.47
SSA	1960	0.064	0.015	0.004	0.003	1.73
	1970	0.085	0.018	0.009	0.006	2.06
	1980	0.097	0.014	0.006	0.003	2.34
	1990	0.134	0.018	0.012	0.005	2.93

TABLE 1—Continued.

Region	Year	Education				Mean school years
		Secondary		Higher		
		Some	Full	Some	Full	
LA/C	1960	0.126	0.041	0.015	0.007	3.26
	1970	0.143	0.050	0.025	0.010	3.82
	1980	0.181	0.056	0.052	0.020	4.46
	1990	0.214	0.074	0.082	0.037	5.24
EA/P	1960	0.085	0.028	0.016	0.008	2.83
	1970	0.130	0.041	0.027	0.012	3.80
	1980	0.219	0.101	0.050	0.022	5.10
	1990	0.248	0.115	0.076	0.035	6.08
SA	1960	0.034	0.005	0.004	0.001	1.51
	1970	0.060	0.011	0.011	0.002	2.03
	1980	0.175	0.052	0.021	0.007	2.97
	1990	0.204	0.064	0.032	0.017	3.85
OECD	1960	0.310	0.116	0.068	0.030	7.05
	1970	0.347	0.116	0.099	0.040	7.58
	1980	0.443	0.227	0.155	0.067	8.76
	1990	0.413	0.153	0.216	0.102	9.02
CPE	1960	0.314	0.109	0.031	0.015	7.54
	1970	0.445	0.145	0.063	0.035	8.58
	1980	0.504	0.117	0.077	0.045	8.95
	1990	0.617	0.209	0.112	0.077	9.98

Notes: Regional averages are weighted by each country's population aged 15 and over. Population (POP) is in millions of individuals aged 15 and over. The fractions shown for education refer to the population over 15 that has the indicated level of school as its highest achievement. "Some" means that the indicated level is the highest attained. "Full" means that completion of the indicated level is the highest attained. (The total of none and the three categories labeled "some" is 1.0.) The last column is the average years of schooling at all levels. Regions (number of countries): DC = all developing countries (73), M/NA = Mideast and North Africa (10), SSA = sub-Saharan Africa (23), LA/C = Latin America and the Caribbean (23), EA/P = East Asia and the Pacific (10), SA = South Asia (7), OECD (23), CPE = (former) centrally planned economies (9).

females aged 15 and over. Table 2 uses these results to compare the regional figures for schooling of females with those for males. The last column of the table contains the "gender ratio," defined to be the ratio of female to male attainment.

The gender ratio varies considerably by region and over time. For the OECD, CPE's, and Latin America, the ratios are typically well over 90 percent and show little trend. In sub-Saharan Africa, the ratios are stable over time

TABLE 2—EDUCATIONAL ATTAINMENT BY SEX
FOR THE POPULATION 15 AND OVER

Region	Year	Mean school years		Gender ratio
		Females	Males	
DC	1960	1.46	2.62	0.56
	1970	1.93	3.37	0.57
	1980	2.73	4.38	0.62
	1990	3.61	5.23	0.69
M/NA	1960	0.82	1.61	0.51
	1970	1.38	2.73	0.50
	1980	2.39	4.11	0.58
	1990	3.54	5.38	0.66
SSA	1960	1.31	2.18	0.60
	1970	1.54	2.61	0.59
	1980	1.79	2.91	0.61
	1990	2.23	3.65	0.61
LA/C	1960	3.22	3.31	0.97
	1970	3.52	4.14	0.85
	1980	4.32	4.60	0.94
	1990	5.14	5.34	0.96
EA/P	1960	2.10	3.58	0.59
	1970	3.06	4.54	0.68
	1980	4.42	5.80	0.76
	1990	5.57	6.60	0.84
SA	1960	0.71	2.26	0.31
	1970	1.07	2.92	0.37
	1980	1.73	4.12	0.42
	1990	2.60	5.02	0.52
OECD	1960	6.87	7.24	0.95
	1970	7.38	7.80	0.95
	1980	8.53	8.99	0.95
	1990	8.78	9.32	0.94
CPE	1960	7.20	7.96	0.90
	1970	8.22	9.00	0.91
	1980	8.57	9.40	0.91
	1990	9.69	10.31	0.94

Notes: The last column is the ratio of female to male average years of schooling. Region (number of countries): DC = all developing countries (73), M/NA = Mideast and North Africa (10), SSA = sub-Saharan Africa (23), LA/C = Latin America and the Caribbean (23), EA/P = East Asia and the Pacific (10), SA = South Asia (7), OECD (23), CPE = (former) centrally planned economies (9).

and remain between 57 percent and 61 percent. In the three other regions of developing countries, the ratio rose markedly from 1960 to 1990: from 51 percent to 66 percent in Middle East/North Africa, from 59 percent to 84 percent in East Asia/Pacific, and from 31 percent to 52 percent in South Asia. Thus, except for sub-Saharan Africa, the approach toward equal educational opportunity for women ap-

pears to be a worldwide phenomenon, at least when measured in terms of average years of schooling.

Table 3 contains regional averages of some of the variables that proxy for the quality of educational inputs. The values shown are un-weighted averages of the countries with data in each region.

At the primary level, the pupil-teacher ratios² are much lower in the OECD and CPE countries than in the developing countries. The ratios have typically declined over time: from 1960 to 1990, the value fell from 30 to 16 in the OECD, from 30 to 18 in the CPE's, and from 38 to 32 in the overall group of developing countries. However, the ratio rose in South Asia (from 37 to 44) and in sub-Saharan Africa (from 42 to 43).

At the secondary level, the regions are more similar in pupil-teacher ratios. From 1960 to 1990, the OECD ratio fell from 18 to 13 and that in the CPE's fell from 17 to 16. The ratio for the overall group of developing countries rose from 19 to 21.

Table 3 also shows the spending per pupil at primary and secondary schools (as a fraction of per capita GDP). One shortcoming of these data is that the spending figures comprise only public outlays (including subsidies to private education), whereas the pupil counts are typically for all schools. From 1970 to 1990, the primary spending ratios go from 0.13 to 0.20 in the OECD, from 0.33 to 0.16 in the CPE's, and from 0.14 to 0.10 in the developing countries. The secondary ratios go from 0.18 to 0.20 in the OECD, from 0.58 to 0.32 in the CPE's, and from 0.67 to 0.26 in the developing countries.

Table 3 also shows the ratio of estimated average salaries of primary school teachers to per capita GDP. These ratios tend to be higher in developing countries (3.6 in 1990), especially in sub-Saharan Africa (5.1 in 1990), than in the OECD (2.2 in 1990). The ratios for the CPE's have fallen markedly from 4.6 in 1970 to 1.7 in 1990.

² A teacher is defined as "a person directly engaged in instructing a group of pupils." For most countries, the counts of teachers and pupils cover public and private schools.

TABLE 3—INDICATORS OF THE QUALITY
OF SCHOOL INPUTS

Region	Year	Teacher/pupil ratio		Spending per pupil	
		Primary	Secondary	Primary	Secondary
DC	1960	38	19	0.14	0.90
	1970	37	20	0.14	0.67
	1980	34	22	0.12	0.41
	1990	32	21	0.10	0.26
M/NA	1960	35	20	0.16	0.51
	1970	31	20	0.14	0.55
	1980	27	18	0.14	0.53
	1990	24	16	0.11	0.25
SSA	1960	42	20	0.22	2.19
	1970	43	20	0.18	1.28
	1980	42	26	0.16	0.68
	1990	43	24	0.10	0.39
LA/C	1960	37	17	0.09	0.24
	1970	36	19	0.09	0.21
	1980	31	21	0.09	0.13
	1990	28	19	0.09	0.13
EA/P	1960	35	24	0.08	0.20
	1970	32	22	0.09	0.22
	1980	29	22	0.08	0.12
	1990	26	21	0.11	0.16
SA	1960	37	23	0.10	0.36
	1970	38	24	0.09	0.28
	1980	43	24	0.08	0.14
	1990	44	23	0.09	0.12
OECD	1960	30	18	0.09	0.13
	1970	25	17	0.13	0.18
	1980	19	16	0.19	0.20
	1990	16	13	0.20	0.20
CPE	1960	30	17	—	—
	1970	22	15	0.33	0.58
	1980	20	16	0.15	0.34
	1990	18	16	0.16	0.32

Region	Year	Teacher salary (primary)	Repeat fraction	
			Primary	Secondary
DC	1960	4.5	—	—
	1970	4.5	0.145	0.103
	1980	3.6	0.126	0.105
	1990	3.6	0.125	0.115
M/NA	1960	5.7	—	—
	1970	4.7	0.130	0.131
	1980	3.5	0.116	0.105
	1990	3.1	0.086	0.123
SSA	1960	6.7	—	—
	1970	6.7	0.174	0.105
	1980	5.6	0.174	0.153
	1990	5.1	0.204	0.169
LA/C	1960	2.6	—	—
	1970	2.9	0.147	0.077
	1980	2.1	0.123	0.084
	1990	2.6	0.105	0.078

TABLE 3—Continued.

Region	Year	Teacher salary (primary)	Repeat fraction	
			Primary	Secondary
EA/P	1960	2.9	—	—
	1970	2.7	—	—
	1980	2.4	0.044	0.067
	1990	2.9	0.039	0.010
SA	1960	4.1	—	—
	1970	3.6	0.213	0.225
	1980	2.0	0.143	0.105
	1990	2.5	0.092	0.087
OECD	1960	1.9	—	—
	1970	2.3	0.053	0.084
	1980	2.4	0.038	0.105
	1990	2.2	0.033	0.120
CPE	1960	—	—	—
	1970	4.6	0.052	0.050
	1980	2.3	0.020	0.016
	1990	1.7	0.031	0.021

Notes: The figures are unweighted averages of countries with available data in each region. The numbers of countries included varies over time. Primary and secondary spending per pupil and salaries of primary school teachers are expressed as ratios to per capita GDP. Regions: DC = all developing countries, M/NA = Mideast and North Africa, SSA = sub-Saharan Africa, LA/C = Latin America and the Caribbean, EA/P = East Asia and the Pacific, SA = South Asia, CPE = (former) centrally planned economies.

The last two columns of the table show the fractions of students that are repeaters in primary and secondary schools. These fractions are highest in sub-Saharan Africa and are notably low for the CPE's, East Asia, and primary schools in the OECD.

Our planned uses of the data involve further investigations of the effects of the quantity and quality of schooling on a number of variables related to economic development. As part of this analysis, we will use the data by level of schooling and sex to construct panel information on educational inequality. We will then assess the impact of adult schooling on fertility, child mortality, and education of children. Then we shall consider the links through these and other channels between education and economic growth. We want especially to re-examine some previous puzzling results, which failed to isolate a positive relation between female schooling and growth.

We plan, in addition, to assess the connection between education and political freedom. Ongoing research on the interplay between democracy and economic performance, as reported in Barro (1996), indicates that female schooling is the best positive long-term predictor of democracy. We think that our improved data will help us to understand this linkage.³

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³ We anticipate that the full data set will be available by late spring 1996. As with our previous data, this information will be available on disc from Ingrid Sayied, Economics Department, Harvard University, and by anonymous FTP from the National Bureau of Economic Research (NBER@Harvard.edu).

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