The Relationship Between Population Growth and the Expansion of Education Systems in Developing Countries 1950-1970

RICHARD E. BILSBORROW*

In the past two decades or so an education revolution has occurred in developing countries. Most people want education for their children and governments have responded to the rapidly growing demand by increasing the supply of educational services at a rate without precedent in human history.

But, questions have recently been raised about qualitative aspects of the expansion in school enrolments in developing countries. A number of studies have illustrated the potential awesome effects of population growth on education budgets in developing countries [4, 5, 8, 12, 13, 15 and 21 pp. 497-498]. The obvious question arises as to whether the negative qualitative implications of such population growth on education systems in developing countries are already apparent. The present paper evaluates available evidence on the extent to which quantitative and qualitative indicators of education trends have been related to population trends in developing countries over the period 1950-1970.

RELATIONSHIP TO PREVIOUS WORK

The most important body of previous work related to the present paper is that concerned with investigating possible future relationships between population growth and government education expenditures in developing countries [1, 3, 9, 13, 14, 19]. Most of this work has been specifically directed at analyzing the effects of different alternative future levels of fertility on future needs for government expenditures on education, often aimed at illustrating the consequences of unchanged fertility.

*The author is associated with International Programme of Laboratories for Population Statistics, University of North Carolina at Chapel Hill, U.S.A.

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However, all the previous quantitative work on the effects of demographic trends on educational costs in developing countries is essentially hypothetical: that is, in investigating the future consequences of what would happen if . . . , under specified assumptions. There has been no real empirical work on what has already occurred in the past. This is certainly in part for two very good sets of reasons. First, not enough time has transpired since the population explosion began in the 1940's and 1950's for its full impact on the school age population to be apparent. The level of population growth, and consequently any change in the level resulting from a change in any demographic parameter such as fertility(infant mortality should be added, but has been seldom mentioned in the literature) in year t starts to affect the relevant school age population only in year t+x, where x is the usual age of beginning that level of school.

The second set of reasons is concerned with the characteristics of the potential data set available for analysis. Until recently there has not been a sufficiently long time series of data to consider an analysis of the type necessary for studying cumulative, long-run relationships. Furthermore, the limitations from the quality of the data are quite serious and enough to daunt all but the most intrepid, or perhaps naive, investigators. But, now (1978) perhaps these reasons are no longer valid. Enough time has passed since the population upsurge began and enough data now seem to be availabe, for the two decades between 1950 and 1970 to permit a preliminary evaluation. The present paper does just that.

SOME HYPOTHESES AND A PRELIMINARY LOOK AT ENROLMENT DATA

We begin by looking at some simple quantitative relationships between population expansion and enrolment expansion. Both population and school enrollment have grown considerably in developing countries in the postwar period, population growth generally on the order of 2 to 3.5% per annum and school enrolments at a much faster rate, between 4 and 9% per year. Although the growth in the school age population has generally been slightly larger than that in the population as a whole [5, p. 27; 21, p286], the growth in enrolment was still greater.

While it is possible that accelerating population growth stimulated governments in developing countries to construct more schools and to train more teachers, it seems unlikely that it could have been much of an inducement to the expansion of educational systems simply because of the much *greater* rate of enrolment growth. The major reasons for the growth in education in developing countries are noted in the introductory paragraph of this paper and further spelled out in [5, 6, 8].

Table 1 shows the resulting vast increases in primary school enrolment rates in most developing countries during the period 1950-1970, particularly in those developing countries which had the lowest rates of enrolment in 1950. Since this has occurred in spite of the dramatic growth in school age populations, growth in the latter could not be considered as a factor keeping enrolment rates from growing. But clearly it could be a restraining influence on their growth, particularly in countries undergoing the most rapid population growth. Furthermore, since many authors have expressed concern about changes in the quality

of education, relationships between population growth and quality changes will also be examined. Below we list a number of plausible hypotheses concerning the possible negative consequences of recent population growth on the expansion of education systems in developing countries. All of these hypotheses can be reasonably defended and some of them have been explicitly suggested in previous works.

Table 1

Estimated Primary School Enrolment Rates, in 49 Developing Countries, 1950-1970

Region & Country	Enrolment Rates (percent)[a]			Average Annual Growth[b]		
	1950	1960	1970	1950-1960	1960-1970	1950-1970
Asia						
Ceylon (Sri Lanka)	73.0	79.8	76.5	0.68	—0.33	0.18
India	20.2	29.3	—	0.91	—	—
Indonesia	27.8	38.1	41.2	1.03	0.31	0.67
Korea (S.)	51.2	58.1	67.3	0.69	0.92	0.80
Malaysia (W.)	44.3	59.7	53.8	1.54	0.59	0.48
Pakistan	15.7	20.6	30.0	0.49	0.94	0.72
Philippines	77.4	53.8	72.0	—2.36	1.82	—0.27
Taiwan	47.9	65.8	61.2	1.79	—0.46	0.66
Thailand	58.2	55.6	58.8	— .26	0.32	0.03
Latin America						
Argentina	66.5	69.6	75.8	0.31	0.62	0.46
Bolivia	24.0	41.3	53.9	1.73	1.26	1.50
Brazil	28.4	40.1	51.3	1.17	1.12	1.14
Chile	62.4	61.8	76.8	—0.06	1.50	0.72
Colombia	27.7	41.0	49.7	1.33	0.87	1.10
Costa Rica	45.4	60.5	76.8	1.51	1.63	1.57
Dominican Republic	40.1	56.9	63.2	1.68	0.63	1.16
Ecuador	41.1	52.1	58.6	1.10	0.65	0.88
El Salvador	30.6	48.7	51.3	1.81	0.26	1.04
Guatemala	21.1	30.2	32.3	0.91	0.21	0.56
Guyana	79.0	84.6	63.3[c]	0.56	—	—
Honduras	21.3	35.6	47.8	1.43	1.22	1.32
Jamaica	64.2	62.1	56.5	—0.21	—0.56	—0.38
Mexico	38.8	48.9	72.6	1.01	2.37	1.69
Nicaragua	22.8	41.2	40.1	1.84	—0.11	0.86
Panama	53.4	57.6	66.8	0.42	0.92	0.67
Paraguay	51.1	65.0	64.0	1.39	—0.10	3.64
Peru	45.6	53.0	71.1	0.74	1.81	1.28
Trinidad	88.3	80.9	81.2	—0.74	0.03	—0.36
Venezuela	40.8	61.4	60.5	2.06	—0.09	0.98

Continued—

Table 1—*Contd.*

Region & Country	Enrolment Rates (percent)[a]			Average Annual Growth[b]		
	1950	1960	1970	1950-1960	1960-1970	1950-1970
North Africa and Middle East						
Iran	16.5	25.8	34.7	0.93	0.89	0.91
Iraq	15.2	41.4	42.6	2.62	0.12	1.37
Morocco	11.4	26.9	25.9	1.55	—0.01	0.72
Syria	32.5	39.5	52.6	0.70	1.31	1.00
Tunisia	17.9	44.9	63.4	2.70	1.85	2.28
Turkey	33.5	40.0	51.2	0.65	4.12	0.88
UAR (Egypt)	—	38.3	42.5	—	0.42	—
Sub-Saharan Africa						
Ethopia	0.95	4.8	8.9	0.38	0.41	0.40
Ghana	18.3	38.7	57.9	2.04	1.92	1.98
Kenya	24.0	34.4	41.7	1.04	0.73	0.88
Mauritius	56.1	65.4	67.0	0.93	0.16	0.54
Sierra Leone	9.3	20.8	36.8	1.15	1.60	1.38
Sudan	5.8	10.0	16.0	0.42	0.60	0.51
Tanzania	9.9	17.7	24.9	0.78	0.72	0.75
Uganda	19.0	32.8	40.9	1.38	0.81	1.10
Zambia	25.8	35.6	61.1	0.98	2.55	1.76
Europe						
Cyprus	62.9	61.9	62.1	— 0.10	0.03	—0.04
Greece	63.2	64.7	67.1	0.15	0.24	0.20
Portugal	39.6	52.5	54.6	1.29	0.21	0.75
Spain	56.0	59.2	62.8	0.32	0.36	0.34

Source: See data Appendix.
— Data not available.
[a]Calculated as primary school enrolment divided by population 5-14.
[b]Average annual increment in enrolment rate (see text).
[c]Figure not comparable with earlier years. Therefore only 1950-1960 data used.

Some possible reflections of effects of demographic pressures on the quantitative expansion of education systems in developing countries, may include, with respect to enrolment rates (all points here made hypothetically): enrolment rates rose more slowly in countries with higher population growth; enrolment rates rose more slowly in most countries during the decade (usually 1960-1970) of faster population growth; and enrolment rates increased more slowly in the decade of faster population growth, within each country.

The hypothesized impact of demographic pressures on the quality of education systems may receive support if: student-teacher ratio rose (or fell less) in countries during the decade of faster population growth; student-teacher ratios rose (or fell less) in general in 1960-1970 than in 1950-1960; student-teacher ratios rose (or fell less) in countries with higher population growth; and real expenditures per pupil rose less rapidly than real output per person in countries with higher population growth.

While these hypotheses seem plausible data are not available to permit investigating all of them. More important, they are formulated, as it were, *in vacuo*, whereas in the real world of social science research there are always unfortunately many confounding influences. Many other factors affect the expansion of education systems in developing countries, and some are most difficult to measure and therefore to statistically isolate and control. Such factors include: the growth in the value of output in the society and thus in its capacity to finance the expansion of its education system; changes in the ratio of total government revenues or expenditures relative to total output (that is changes in the government share) and hence in the government capacity to finance an expansion in education; autonomous changes in the levels of exports and imports in the society, which are major determinants of the tax base for government revenues in most developing countries [10, 16]; the increase in teachers may be slower than the increase in students because of the purely demographic restraint of small cohorts of teachers (or low secondary school enrolments) trained in the recent past; the rate of urbanization may influence the demand for education, on the one hand, and facilitate the expansion of the supply of schools, on the other; significant cultural differences across regions may relate to the order with which educational expansion is pursued—*e.g.* African countries relative to others.

Another set of factors which affect educational and all other governmental functions in developing countries includes political disturbances and wars. Such events can have serious effects on school enrolment and on government education expenditures, and therefore on enrolment rates and the quality of education. Such influences are evident in some of the data used in this analysis, but if they are essentially random they will mainly introduce "noise" rather than systematic biases.

This is only a preliminary investigation and only one of these non-demographic factors affecting the expansion of education systems is included here as a control variable, the growth of real Gross National Product as an indicator of the increase in the society's capacity to support its education system.

DATA AND METHODOLOGY EMPLOYED

The analysis in this paper is based upon primary school enrolment rates, student-teacher ratios, per pupil expenditure data, primary school population growth and growth in Gross National Product. All of the analyses will be based upon comparing trends over time in the above variables, usually comparing trends across countries. All of these data are subject to the usual disclaimers with respect to their use for cross-section analysis, but this problem is partly reduced here by examining some changes within countries. For the latter all that is required is that the data for each country be internally consistent over time.

The sources for the data are the standard ones used in most multi-country work [22], for population data [20], for most education data [17,18,23]. Data sources, limitations, and adjustment procedures are described in the Appendix. In general the data on enrolment levels and enrolment rates are fairly reliable, statistics on per pupil costs are not very reliable, and data on student-teacher ratios fall somewhere in between.

Two comments should be made about the measurement of enrolment rates (ERs). First, the denominator in the calculation of ERs is the whole population 5-14 rather than the population aged 7-12, or whatever corresponds to the optimal or minimum years of attendance at primary schools in each country. UNESCO and others have presented and carried out descriptive analyses based upon "adjusted" school ERs, which use the "ideal" denominator (ideal in the sense that the recommended age of commencing primary school is x and the number of years is n so the population x to x+n constitutes the denominator). But in most developing countries a considerable percentage (say 20-30%) of the students in primary school are outside the ideal ages (mostly older, aged 13 or 14 or more), so that adjusted ERs overstate "actual" ERs by that percentage. Since this percentage varies generally with the stage of development of the country and therefore inversely with the actual enrolment rate, the use of ajusted ERs tends to artificially reduce cross-country differences. Our use of the entire population 5-14 has the opposite bias in artificially reducing ERs in all countries, but especially in countries with customary late beginning or early completion of primary school. Thus an ER of 75 or 80 in Table 1 connotes nearly complete primary school enrolment.

The other point to mention with respect to ERs is that the measurement of changes over time is not the average annual growth rate, because it can be enormously high if the base is low. One recalls the 1950-era projections of the USSR economy overtaking the U.S. economy by 1965 or 1975, obtained by extrapolations of 1920-1950 growth trends. (Such projections, not without forecast of dire consequences as they were made in the Cold War environment, proved incorrect). The average annual change in ERs offers a much better measure for comparing the experiences of countries with widely different initial ERs.

With respect to the appropriate measure of population growth or demographic pressure, many alternatives come to mind: total population growth, growth of population 5-9 (population entering primary school), population 5-14, the entire child dependent population (0-14), the corresponding levels or changes in the child dependency *ratio*, fertility, population density, etc. I chose the growth rate of the age group 5-14 simply because it refers to the relevant age group for primary school education.

It is clear from the considerable effort required for examining and adjusting the data that they are not adequate for most sophisticated quantitative analyses. As a consequence the methodologies employed will be more elementary. In this kind of study simple tabular procedures are likely to be more revealing and less prone to lead to incorrect inferences than complex analyses. The specific tabular procedures used will include examining covariations in trends in primary education enrolments and enrolment rates with trends in population and in real (constant prices) Gross National Product. The same

type of procedure will be used for investigating trends in student-teacher ratios and in real expenditures per pupil. Countries will be categorized according to their rates of economic growth and population growth, and corresponding mean and median levels for the trends in the education indicators will be calculated and compared across population growth categories. Chi-square and partial correlation techniques will be used in some cases. Since the purpose of this paper is to study relationships between demographic trends and education trends in developing countries, only brief mention will be made here about the education trends implied by the data. The latter will be discussed in a subsequent article.

Statistical results will be obtained for various groups of developing countries to ensure that they are not dependent on the somewhat arbitrary distinction between developed and developing countries. As I have noted elsewhere [2] statistical results for developing countries can be grossly distorted by inclusion of "marginal" countries such as Argentina, Spain, or Puerto Rico, not to mention Hong Kong, Israel, Japan, Bulgaria, etc. Therefore in this paper results will usually be obtained for all available countries (listed in Table 1) but including and excluding the "marginal" countries such as Argentina, Chile, Cyprus, Greece and Spain. Also the sensitivity of the results to the inclusion of other countries which had very high initial levels of enrolment rates will be tested in the same manner (includes Chile, Guyana, Jamaica, Trinidad); this is desirable because they had little capacity to increase their ERs further and therefore little possibility of being influenced by demographic trends one way or another.

EMPIRICAL RESULTS

Enrolment Rates

Table 1 above shows the estimated growth in primary school enrolment rates for the 49 developing countries with the necessary data on enrolment levels, population 5-14, and real GNP, during at least one decade in the period 1950 to 1970. Table 2 shows the average annual growth rates of the primary school age population and of real Gross National Product during the two decades 1950-1960 and 1960-1970, as well as over the period 1950-1970. Most of the developing countries experienced economic growth rates in the range of 4 to 6% per year, resulting in growth of GNP per capita of 1 to 3% per annum.

A preliminary examination of positive and negative covariations in population growth and enrolment growth suggested no relationship between the two, although there appeared a slight positive relationship between changes in ERs and growth in GNP. I then divided the sample into two groups according to those countries which had growth in ERs above the median and those with ER growth below the median, and cross-classified them in a second dimension the same way with respect to whether population growth was above or below the median. All countries were then located in one of the resulting four cells. If relatively high population growth is associated with relatively low growth in enrolment rates the sum of the numbers of countries in the two off-diagonal cells should exceed the number in the two diagonal cells. Omitting the three marginal European countries (all except Portugal) and the median country on the enrolment change dimension, we find the number of covariations between

ER growth and population growth of the expected sign (*i.e.* negative) to be 19 and the number of sign opposite to that hypothesized to be 26. There was no significant difference across the four regions of developing countries (noted in tables).

Table 2

Estimated Rates of Growth of Primary School Age Population and of Real Gross National Product in 49 Developing Countries, 1950-1970

Region & Country	Growth of Primary School Age Population[a]			Growth of Gross National Product[b]		
	1950-1960	1960-1970	1950-1970	1950-1960	1960-1970	1950-1970
Asia						
Ceylon (Sri Lanka)	3.1	2.4	2.7	3.8	5.0	4.4
India	2.9	2.7	2.8	4.2	3.7	3.9
Indonesia	2.1	3.3	2.7	—	3.3	—
Korea (S.)	1.8	3.2	2.5	5.8	9.1	7.5
Malaysia (W.)	3.2	2.3	2.8	3.7	5.1	4.4
Pakistan	2.3	2.9	2.6	2.7	5.0	3.8
Philippines	4.0	3.1	3.5	6.5	5.6	6.1
Taiwan	4.3	3.6	3.9	7.9	9.7	8.8
Thailand	4.4	3.1	3.8	6.2	7.0	6.5
Latin America						
Argentina	2.1	0.9	1.5	3.0	4.6	3.8
Bolivia	1.5	3.2	2.3	0.3	4.9	2.6
Brazil	3.4	3.0	3.2	6.1	3.2	4.6
Chile	4.3	2.7	3.5	3.6	4.2	3.9
Colombia	3.5	2.7	3.1	4.7	5.1	4.9
Costa Rica	3.6	3.6	3.6	5.7	5.8	5.7
Dominican Republic	4.4	3.4	3.9	6.2	4.9	5.5
Ecuador	3.2	4.3	3.8	4.9	4.2	4.5
El Salvador	3.4	4.2	3.8	4.2	5.8	5.0
Guatemala	2.7	4.8	3.8	4.5	5.1	4.7
Guyana	4.6	3.0	3.8	3.3	4.0	3.6
Honduras	4.8	4.0	4.4	4.5	5.0	4.7
Jamaica	2.0	5.2	3.6	7.0	5.0	6.0
Mexico	3.8	3.5	3.7	6.0	7.6	6.8
Nicaragua	3.2	6.1	4.6	5.5	6.4	5.9
Panama	3.2	3.2	3.2	5.1	8.0	6.5
Paraguay	2.0	3.6	2.8	2.1	4.2	3.1
Peru	2.1	3.5	2.8	5.1	5.2	5.1
Trinidad	4.9	2.9	3.9	7.7	4.2	6.1
Venezuela	4.9	3.9	4.4	8.1	4.4	6.2

Continued—

Table 2—*Contd.*

Region & Country	Growth of Primary School Age Population[a]			Growth of Gross National Product[b]		
	1950-1960	1960-1970	1950-1970	1950-1960	1960-1970	1950-1970
North Africa and Middle East						
Iran	3.5	4.5	4.0	6.4	8.7	7.5
Iraq	3.2	3.5	3.4	6.6	5.0	5.8
Morocco	2.6	4.4	3.5	1.9	4.2	3.0
Syria	3.6	3.7	3.6	3.5	6.7	5.1
Tunisia	1.4	3.8	2.6	0.9	4.4	3.6
Turkey	4.0	3.2	3.6	5.7	5.3	5.5
UAR (Egypt)	3.7	2.4	3.0	—	5.2	—
Sub-Saharan Africa						
Ethopia	1.2	2.4	1.8		5.2	—
Ghana	4.4	3.6	4.0	5.3	2.6	3.9
Kenya	4.4	4.2	4.3	4.1	7.5	5.8
Mauritius	5.1	2.7	3.9	1.5	4.2	1.3
Sierra Leone	1.1	1.3	1.2	—	5.9	—
Sudan	3.4	2.5	2.9	4.3	0.7	2.5
Tanzania	2.2	2.6	2.4	—	5.1	—
Uganda	3.2	5.0	4.1	3.5	3.4	3.5
Zambia	2.5	3.5	3.0	5.8	6.7	6.2
Europe						
Cyprus	2.9	0.1	1.5	3.4	6.0	4.7
Greece	0.0	0.0	0.0	6.2	7.5	7.0
Portugal	0.6	0.7	0.6	3.9	6.3	5.1
Spain	1.1	1.5	1.3	6.1	7.2	6.6

Source: See data Appendix.
[a]Annual compound rate of growth of population 5-14.
[b]Annual compound rate of growth of real Gross National Product.

The above procedure fails to control for the rate of economic growth. Therefore in the next approach a three-variable procedure was used. Countries were classified according to the rate of economic growth in one dimension and the rate of population growth in the other, with the mean and median values calculated for the countries classified in the resulting four cells. Unlike the previous analyses of covariations which were based upon the entire 1950-1970 period, this approach will be applied to each period separately to investigate whether any lack of the expected negative relationship over the period as a whole is obscured by differences in relationships between the variables in the two decades 1950-1960 and 1960-1970. Certainly many would believe that any

negative effects of population growth (which accelerated in many countries only in the 1950's) should have become more evident during the 1060's. Tables 3 and 4 show mean and median levels of ER growth corresponding to different levels of population growth and economic growth for each of the two decades. It should be noted that in situations such as the present where the mean of a cell can be strongly distorted by an extreme observation (which may be a statistical artifact), the median may be a better measure of central tendency. We would expect the median, and perhaps the mean, cell values to rise going down the table with lower population growth, and to fall moving across to the right of the table, as the rate of economic growth falls. In Table 3 we observe that there does appear a week tendency for the values to rise going down the table if the total figures at the right are examined and if the means are used; but this tendency disappears when the median is used. These results are not appreciably changed if the countries with high initial ERs or the marginal developing countries are omitted from the sample. The results in Table 4 for the more recent period, 1960-1970, are similar to those in Table 3. Since almost half the countries in the entire study—20 out 49—are from Latin America, separate analyses were carried out to see if there was any negative relationship between enrolment growth and population growth in Latin America. Again, none was observed.

Finally, simple and partial correlations were calculated between the rates of growth in ER, population growth, and economic growth, for a number of regions, as follows: Latin America, excluding the five countries previously cited with high initial ERs; Latin America including all countries; non-Latin American countries excluding Cyprus, Greece, and Spain; and finally the full sample of 49 countries. Some of the simple correlation coefficients of ER growth and population growth were found to be as follows (using subscript e for change in ER, p for population growth, and g for GNP growth): for the entire sample of 49 countries, $r_{ep} = .120$; for the total excluding the three marginal European countries, $r_{ep} = -.001$; and for the 15 Latin American countries, $r_{ep} = -.102$. When the correlations between population growth and real GNP growth (not per capita) are taken into account (they are positive), the resulting partial correlations are as follows: for the sample of 46 countries, $r_{ep \cdot g} = .007$; and for the 15 Latin American countries, $r_{ep \cdot g} = -.187$. These results indicate that for developing countries as a whole there is no consistent relationship, positive or negative, between the rate of population growth and the rate of increase in primary school ERs, statistically controlling for the growth in real GNP. Nevertheless, it is interesting to observe that for one regional breakdown of interest, that of the 15 non-marginal Latin American countries, not only the simple correlation but more important the partial correlation coefficient is indeed negative. This may suggest that Latin American countries with higher rates of population growth in the period 1950-1970 had lower increases in ERs than countries where population growth was lower. While some would hypothesize that this is a logical consequence of the fact that population growth has been higher in Latin America than in other developing countires, it must be recalled that the relationship does not hold when all the developing countries are pooled.

In one sense the above results are not necessarily conclusive (even apart from the many caveats about the quality of the data). The analyses above are all cross-section analyses, comparing the experiences of a broad variety of countries. A question of significant importance is whether the countries manage

Table 3

Mean and Median Levels of Enrolment Rate Growth According to Different Rates of Population Growth and Economic Growth, 1950-1960[a]

		Rate of Economic Growth, 1950-1960[b]			
		High	Medium	Low	Total
Rate of Population Growth, 1950-1960[c]	*High*	0.68, 1.01 (11)	1.34, 1.38 (6)	0.53, 0.63 (4)	0.84, 1.01 (21)
	Medium	1.31, 1.41 (4)	0.82, 0.91 (5)	0.90 (8)	0.97, 0.91 (17)
	Low	0.39, 0.32 (3)	—	1.91, 1.73 (3)	1.15, 0.99 (6)
	Total	0.77, 0.95 (18)	1.10, 1.04 (11)	1.00, 0.93 (15)	0.93, 0.95 (44[d])

[a]The first value is the arithmetic mean, the second value (to the right) is the group median, and the number below in parentheses is the number of cases (countries) in the cell.

[b]See Table 2. Rates of economic growth are classified as follows: High: 5.5 to 8.1; Medium: 4.0 to 5.3; Low: —1.5 to 3.9.

[c]See Table 2. Rates of population growth are classified as follows: High: 3.4 to 6.1; Medium: 2.0 to 3.3; Low: 0.0 to 1.8.

[d]Data were incomplete or not available for five countries: Indonesia, UAR (Egypt), Ethiopia, Sierra Leone, and Tanzania.

—Indicates no countries in group.

to achieve higher increases in their ERs during their periods of less rapid population growth, controlling for trends in GNP. That is, we should investigate whether within-country experiences of comparing rates of growth in enrolment and rates of growth in the school age population can yield useful insights. For 37 countries with the necessary data on all 3 variables in both decades, a Chi-square test was made testing whether the decade of faster ER growth was independent of the decade of slower population growth. We find that indeed 23 countries are located in the two cells where the decades of higher population growth and higher ER growth do not match, whereas only 14 countries are located in the cells where the two do match. This seems to indicate that the two are not entirely independent, and provides some support for the hypothesis that enrolment rates increased more in countries during their decade of lower population growth. However, the value of the Chi-square statistic for the sample as a whole was only 1.97 which is not significant at the 5% level on a one-tail test. When the Latin American countries are analyzed separately ($n = 16$), the Chi-square statistic is 2.62, which is almost significant at the 5% level. Again this suggests that the hypothesis of negative effects of population growth on growth in enrolment rates receives little support in general but may have some slight statistical support for the Latin American region.

Table 4

Mean and Median Levels of Enrolment Rate Growth According to Different Rates of Population Growth and Economic Growth, 1960-1970[a]

		Rate of Economic Growth, 1960-1970[b]			
		High	Medium	Low	Total
Rate of Population Growth, 1960-1970[c]	*High*	1.09, 0.89 (9)	0.85, 0.42 (12)	1.36 (2)	0.85, 0.69 (23)
	Medium	1.00, 0.92 (4)	0.71, 0.72 (11)	0.68, 0.60 (3)	0.77, 0.70 (18)
	Low	0.60, 0.30 (4)	0.62 (1)	—	0.60, 0.36 (5)
	Total	0.95, 0.89 (17)	0.64, 0.63 (24)	0.95, 0.81 (5)	0.79, 0.66 (46[d])

[a]The first value is the arithmetic mean, the second value (to the right) is the group median, and the number below in parantheses is the number of cases (countries) in the cell.

[b]See Table 2. Rates of economic growth are classified as follows: High: 5.5 to 8.1; Medium: 4.0 to 5.3; Low: —1.5 to 3.9.

[c]See Table 2. Rates of population growth are classified as follows: High: 3.4 to 6.1; Medium: 2.0 to 3.3; Low: 0.0 to 1.8.

[d]Enrolment data not available for India in 1970 and not comparable 1960-1970 for Guyana and Cyprus. (Subsequently an adjustment was made for Cyprus, which was incorporated in Table 1. It has no effect on the conclusions here.)

Student-Teacher Ratios

Many who hypothesize that high population growth results in pressures on the education systems in developing countries believe that it is manifest in qualitative deterioration in education. One indirect but commonly used measure of qualitative changes is the change in the student-teacher ratio. Table 5 presents available data on the level of and changes in the student-teacher ratio for 49 developing countries during the period 1950 to 1970. A positive value indicates an increase in the student-teacher ratio and therefore presumably a deterioration in educational quality, while a decrease indicates the contrary. Over the period as a whole, for the 43 countries with the necessary data, 19 had increases in their student-teacher ratios and 24 had declines. Breaking this down by decades shows that there were 25 increases in 1950-1960 and 21 declines, while there were 16 increases in 1960-1970 and 29 declines. This certainly does not suggest a general deterioration in educational quality in developing countries particularly in the more recent decade when demographic pressures would have been expected to be greater than in the earlier decade because of higher population growth and mounting demographic pressures. When countries are cross-tabulated according to the average annual change in the student-teacher ratio and the average rate of growth in the primary school population, a slight positive relationship is found: countries with higher rates of growth in the primary school population tended to have slightly higher changes (slight increases instead of slight decreases) in their student-teacher ratios.

Table 5

Student-Teacher Ratios at Primary School level in 49 Developing Countries, 1950-1970

Region & Country	Student-Teacher Ratio			Average Annual Change in Student-Teacher Ratio[a]		
	1950	1960	1970	1950-1960	1960-1970	1950-1970
Asia						
Ceylon	35.31	27.79	23.87[c]	— 0.75	— 0.78[c]	— 0.76[c]
India	27.08	29.00	35.51[c]	0.19	1.30[c]	0.56[c]
Indonesia	59.20	38.79	38.55	— 2.04	— 0.02	— 1.05
Korea (S.)	56.50	58.21	56.87	0.17	— 0.13	0.02
Malaysia (W.)	32.92	27.54	30.92	— 0.54	0.34	— 0.10
Pakistan	33.21	38.61	44.44	0.54	0.58	0.56
Philippines	50.96	35.86	29.09	— 1.51	— 0.68	— 1.09
Taiwan	43.44	45.63	42.18[c]	0.22	— 0.69[c]	— 0.10[c]
Thailand	36.33	36.20	29.96	— 0.013	— 0.62	— 0.32
Latin America						
Argentina	23.70	21.96	19.25	— 0.17	— 0.27	— 0.22
Bolivia	41.47[b]	26.71	20.06	— 2.95[b]	— 0.06	— 1.03[b]
Brazil	32.31	33.08	28.01	0.08	— 0.51	— 0.22
Chile	41.25[b]	44.63	51.03	0.68[b]	0.64	— 0.65[b]
Colombia	41.47	37.72	35.65	— 0.38	— 0.21	— 0.29
Costa Rica	28.44	25.94	30.36	— 0.25	0.44	0.10
Dominican Republic	—	56.93	53.64	—	— 0.33	—
Ecuador	41.65	38.84	38.01	— 0.28	— 0.08	— 0.18
El Salvador	30.01	37.03	36.64	0.70	— 0.04	0.33
Guatemala	21.80	30.49	35.84	0.87	0.54	0.70
Guyana	42.45	40.67	29.09[d]	— 0.18	—	—
Honduras	22.63	31.80	37.77	0.92	0.60	0.76
Jamaica	49.64	55.72	46.87	0.61	— 0.88	— 0.14
Mexico	40.21	43.96	56.08	0.38	1.21	0.79
Nicaragua	22.00	35.25	37.53	1.32	0.23	0.78
Panama	32.23	28.53	27.14	— 0.37	— 0.14	— 0.26
Paraguay	31.62	28.15	32.29	— 0.35	0.41	0.03
Peru	42.16	33.61	41.62	— 0.86	0.80	— 0.03
Trinidad	48.06	33.00	37.66	— 1.51	0.47	— 0.52
Venezuela	36.03	35.24	34.74	— 0.08	— 0.05	— 0.06
North Africa and Middle East						
Iran	29.29	33.76	32.78	0.45	— 0.10	0.18
Iraq	28.54	30.36	22.06	0.18	— 0.83	— 0.32

Continued—

Table 5—*Contd.*

Region & Country	Student-Teacher Ratio			Average Annual Change in Student-Teacher Ratio[a]		
	1950	1960	1970	1950-1960	1960-1970	1950-1970
Morocco	26.13	42.39	34.29	1.63	— 0.81	— 0.41
Syria	—	46.37	36.80	—	— 0.96	—
Tunisia	34.25	61.10	47.52	2.68	— 1.36	0.66
Turkey	45.07	45.84	37.80	0.08	— 0.80	— 0.36
UAR (Egypt)	38.30[b]	39.35	37.88	0.21[b]	— 0.15	— 0.03[b]
Sub-Saharan Africa						
Ethopia	26.75[b]	37.04	49.35	2.06[b]	—1.23	151[b]
Ghana	22.70	31.38	29.61	0.87	— 0.18	0.35
Kenya	43.09	41.95	34.42	— 0.11	— 0.75	— 0.43
Mauritius	41.22	36.20	34.41	— 0.50	— 0.21	— 0.35
Sierra Leone	36.72	35.72	32.86	— 0.10	— 0.29	— 0.18
Sudan	49.90[b]	41.14	46.01	— 1.75[b]	0.49	— 0.26[b]
Tanzania	43.46	45.26	47.30	0.18	0.20	0.19
Uganda	29.14	30.75	49.78	0.16	1.90	1.03
Zambia	42.08[b]	50.50	46.77	1.68[b]	— 0.37	0.31
Europe						
Cyprus	39.38	41.56	38.17	0.22	— 0.44	— 0.22
Greece	48.09[b]	39.64	33.71	— 1.69[b]	— 0.59	— 0.96[b]
Portugal	42.74	34.01	33.58	— 0.87	— 0.04	— 0.46
Spain	34.92	35.15	28.82	0.02	— 0.63	— 0.31

Source: See data Appendix.
—Data not available.
[a]Average annual increase or decrease (—) in ratio: Value in end year minus value in initial year divided by number of years.
[b]1955 used instead of 1950.
[c]1965 used instead of 1970.
[d]Figure not comparable with earlier years. Therefore only 1950-1960 data used.

Again, this provides support for accepting the null hypothesis that the rate of population growth and changes in educational quality (as measured by changes in the student-teacher ratio) were not systematically related over the period 1950-1970. Table 6 presents the results, showing the frequency with which countries were located in each of the cells. It should be noted that the outlying countries tend to be those with the weakest quality of data.

Expenditures on Primary School Students

As indicated by the discussion and earlier in the Appendix, data on education expenditures are much weaker than the other data used here. Thus the results of this section must be considered more tenuous. Table 7 presents estimates of real primary expenditures per pupil in developing countries for the

years 1950, 1960 and 1970 (in terms of the currency of the country, usually 1965 or 1968 as the base year). It would be convenient if we could simply take any increase in real expenditures per pupil as indicative of an imporvement in educational quality, and *vice versa*, but this would be incorrect. This may be illustrated by a simple example. Suppose the student-teacher ratio remained constant and the growth in teacher salaries (about 75-80 percent of total recurring education expenditures in developing countries) and related recurrent costs were the same as the growth in real GNP per capita. Then real expenditures per primary pupil must also increase at that same rate of growth in real income per capita. Alternatively, the student-teacher ratio must be rising or real expenditures per teacher are rising at a rate lower than the growth in income per capita, the latter suggesting a decrease in the relative quality of teachers over time in comparison with other workers in the society.

Table 6

Relationship Between Growth in Primary School Population and Change in Student-Teacher Ratio, 1950-1970

		Annual Rate of Growth of Primary School Population					
		<2	2-2.4	2.5-2.9	3-3.4	3.5-3.9	>4
Average Annual Change in Student-Teacher Ratio	1+	1[a]					1[b]
	0.5 to 0.99			3		3	2
	0 to 0.49		1	2	1	3	2
	—0.49 to 0	1		3	5	6	1[f]
	—0.99 to —0.49			1			
	—1+		1[c]	1[d]		1[e]	

Source: Derived from Tables 2 and 5.

[a]Ethopia
[b]Uganda
[c]Bolivia
[d]Indonesia
[e]Philippines
[f]Kenya

Therefore the two right hand columns of Table 7 indicate whether the estimated real expenditures per pupil rose at a faster rate than GNP per capita, at about the same rate (within 20%), or at a lower rate. In the Appendix it is suggested that the data for 1960-1970 are much better (or less bad) than the 1950-1960 data, so we will concentrate on the latter decade. In the period 1950-1960 most of the changes are positive; in 1960-1970 20 of the 38 signs for developing countries (excluding Europe) 20 were negative, 8 unchanged, and only 10 positive. Two way tables were prepared with five categories for "real relative expenditure

change" classified against six categories for the rate of population growth or rate of enrolment growth. The results, shown in Table 8, indicate no relationship between relative growth rates of real per pupil expenditures and the rate of growth of the school age population during 1960-1970. This again suggests there has been no systematic relationship between population growth and qualitative changes in education in developing countries up to 1970.

Table 7

Estimated Real Expenditures per Pupil in Primary School in Developing Countries 1950-1970[a]

Region & Country	Year			Implied Relative Growth[e]	
	1950	1960	1970	1950-1960	1960-1970
Asia					
India		47.73	40.86[b]		—
Korea (S.)	3110[c]	2345	4520	—	0
Malaysia (W.)	26.06	110.2	142.2	+	+
Pakistan	8.14	25.47	23.49	+	—
Taiwan	93.64	216.1	737.1	+	+
Thailand		293.9[d]	341.4		—
Latin America					
Argentina	3057[c]	3389	2674	0	—
Bolivia		46.78	197.2		+
Brazil	1.48[c]	141	0.19[b]	—	—
Colombia	62.87	176.1[d]	91.95	+	—
Costa Rica	97.99	385.7	462.1	+	—
Dominican Republic		30.63[d]	27.10		—
Ecuador	124.8	268.0	361.6	+	+
El Salvador		53.24	76.21		0
Guatemala		15.07	41.48		+
Honduras	9.70[c]	50.86	65.35	+	0
Jamaica	17.85	16.00	18.82[b]	—	—
Mexico		409.8[d]	401.3		—
Nicaragua		125.1	235.7		+
Panama		42.00	70.14		0
Paraguay	893.7	1872	2202	+	—
Peru	150.2	533.9	512.3	+	—
Trinidad	412.2[c]	82.52	91.67	—	0
Venezuela	45.65[c]	376.8	546.2	+	+

Continued—

Table 7—*Contd.*

Region & Country	Year			Implied Relative Growth[e]	
	1950	1960	1970	1950-1970	1960-1970
North Africa and Middle East					
Iran		2565	2709		—
Iraq		29.65[d]	35.09		0
Morocco	248.2[c]	256.9	255.8	0	—
Tunisia		15.37	15.42[b]		—
UAR (Egypt)		5.99	10.80		+
Sub-Saharan Africa					
Ethopia		50.07[d]	58.04		—
Ghana		9.63[d]	11.65		+
Mauritius	93.50	231.8	214.5	+	—
Sierra Leone		15.61	12.95		—
Sudan		12.70	10.78		—
Zambia		5.57	9.11		0
Europe					
Cyprus		22.74	31.34		0
Portugal	334.2	573.1	538.9	+	—
Spain	443.7	1380	4167	+	+

[a]In domestic currency, the base year varying per country, and available from the author. Clearly cross-country comparisons are not possible with this data, which are presented only to justify inferences in the text about relative increases.

[b]1965 used instead of 1970

[c]1955 used instead of 1950

[d]1965 used instead of 1960

[e]+ greater than growth of real per capita GNP; 0 about same as growth of GNP per capita (within 20%)—less than growth of per capita GNP.

CONCLUSIONS

The purpose of this paper was to make a preliminary investigation into several hypothesized negative effects of population growth on quantitative and qualitative trends in education in developing countries. Data on the growth of the school age population, increases in enrolment rates, changes in student-teacher ratios, and relative changes in real expenditures per student were obtained at the primary school level for some 49 developing countries over the period 1950-1970. A quantitative indicator of trends in the education system used was the primary school enrollment rate. The qualitative indicators used

Table 8

Relationship Between Growth in Primary School Population and Relative Growth in Real Per Pupil Expenditure in Primary Schools, 1960-1970

		Annual Rate of Growth of Primary School Population					
		<2	2-2.4	2.5-2.9	3-3.4	3.5-3.9	>4
Relative	++	1		1	1	2	2
Growth Rate	+			1			1
of Real Per	0	1		1	3	1	2
Pupil	—	1		1	1	4	1
Expenditure*	——	3		4	2	4	

Source: Tables 2, 7 and [22].

*++ means 40% greater growth in real per pupil expenditures than in real per capita GNP; +signifies 20-40% greater; 0 means both grew within 20% of each other; — indicates 20-40% lower growth (or decrease) in per pupil expenditure growth relative to GNP growth per capita; and——means at least 40% lower growth in per pupil expenditures relative to GNP growth per capita.

included the student-teacher ratio and the growth rate of real expenditures per pupil relative to the growth rate of real GNP per capita.

The empirical results indicate that population growth has not been systematically associated with slower growth in enrollement rates nor in qualitative deterioration in the education systems of developing countries in the period 1950-1970. This does not mean that in some countries higher population growth has not had one or more of these effects, and that in all countries it has not had the effects of reducing what could have been achieved with slower population growth. It is a mathematical truism that using the same resources on a smaller number of people can achieve a higher quality of product, or using less resources in education could make it possible for the government to expand other socially needed programmes.

The forces that have shaped trends in educational systems of developing countries, at least at the primary school level in the past two decades, appear here to have been largely non-demographic and quite possibly non-economic as well. This does not mean that the type of education projection models developed by [13, 19], are not useful. They are, but not for indicating empirical relationships. Rather they, and most other economic-demographic models, should be considered as useful in indicating answers to hypothetical questions of the sort, "what would happen if . . . , assuming . . .", and thereby in indicating the constraints imposed by population growth on the future choices confronting political leaders and societies.

Appendix

DATA SOURCES AND ESTIMATION PROCEDURES USED

Enrolment level data were taken from (a) various UNESCO *Statistical Yearbooks*, the most recent being the 1972 yearbook, [20, table 3.2]; and (b) unpublished data compiled by Frederic Harbison, Princeton University, for the United Nations, in 1972, covering most Latin American and African countries included in this study, providing annual data during the period 1950-1965 [7].

Population data (population 5-14) are from (a) various UN *Demographic Yearbooks*, the latest being 1972; and (b) Harbison, 1972 [7,22].

Information on numbers of teachers was obtained from UNESCO Yearbooks [20].

Statistical data on expenditures per pupil and on total primary school expenditures were obtained from UNESCO yearbooks combined with data from Harbison, 1972 [7, 20] following the procedure described below.

Economic data on current and real (constant prices) GNP are taken from OECD (1968, 1970), various editions of the UN *Yearbook of National Accounts Statistics*, latest being 1972, [17, 18, 23], and occasionally U.S. Agency for International Development, *Gross National Product: Growth Rates and Trend Data.* In a few cases current GNP data were not available so the country's consumer price series in the International Monetary Fund's *International Financial Statistics*, 1971 and 1972 Supplements, (IMF, 1972 and 1973) [11] was used to reflate real GNP statistics to make them comparable to (current) education expenditures.

But often data series from different sources (even different editions of the same UN publication and even for population statistics) did not match, or were not available for the same year desired (1950, 1955, 1960, 1965, 1970). Whenever there was an overlapping year, a continuous series was obtained by splicing the two together. Whenever an intermediate year was needed (*e.g.* between two years up to six or eight years apart), linear interpolation was used. An attempt was made at minimizing the much more risky linear extrapolation, which was restrained to one or two years, except in some instances where a data series indicated regular, "reliable" changes. Interpolation and extrapolation procedures were least needed for school enrolment and school age population, and most needed for expenditure data (see below).

Data were generally collected for every year (except expenditure data). This facilitated determining where discontinuities occurred, *e.g.*, from a change in the definition of the number of years in primary versus secondary education (*e.g.*, Guyana after 1967), or in including/excluding certain population groups (Cyprus' exclusion of enrollment of Turkish students starting in 1965). 1970 census data were used for modifying earlier UN or Harbison population data.

In a few countries estimates of the population 5-14 for 1950 had to be obtained by backwards projection of a later figure using estimated total population growth between the years (Syria, Morocco, Ethopia, Sierra Leone).

Problems with primary school enrolment data occurred with Guyana (1950-1960 not reconcilable with 1965-1970), Cyprus (adjusted), Philippines (included here anyway).

Economic data required extrapolations backwards or forwards of one to five years for Argentina, Ethiopia, Iraq, Kenya, Malaysia, Pakistan, Sierra Leone, Sudan, Trinidad and Tunisia.

While recurring expenditures per pupil could be found for recent years (1960-1968), for earlier years often only total education expenditures and its distribution were available (pre-school, first level, second level, third level, teacher training, administration other). Such data were allocated to the three levels by combining teacher training with second level and distributing the remaining expenditures proportionately among the three main levels. This yielded the proportion of the total at each level. Then per pupil recurring expenditures at primary (p) level in year t were estimated using reported data in some other "base" year (o) from:

$$\text{per pupil expenditures in 0} \times \frac{\text{total expenditures in t}}{\text{total expenditures in 0}} \times \frac{\text{proportion of total on primary in t}}{\text{proportion of total on primary in 0}}$$

This procedure was used to obtain estimates of per pupil costs back to 1955 and 1950 when the percentage distribution figures (obtained by procedure above) seemed to change in a regular fashion over time.

REFERENCES

1. Arriaga, Eduardo E. "Impact of Population Changes on Education Costs". *Demography*. v. 9. no. 2, May, 1972. pp. 275-293.
2. Bilsborrow, Richard E. *Dependency Rates and Savings Rates: Comment and Extensions*. Princeton, N.J.: Office of Population Research, Princeton University. 1972. Mimeographed.
3. ————————and Malcomb J. Foley. "Planeacion de Education por Computador". 1975.
4. Cassen, Robert. "Population Growth and Public Expenditure in Developing Countries". in International Union for the Scientific Study of Population. *International Population Conference Liege*, 1973. Vol. 1, pp. 333-350. Liege, Belgium: IUSSP 1973.
5. Coombs, Philip H. *The World Education Crisis: A Systems Analysis*. New York: Oxford University Press. 1968.
6. Fields, Gary S. "The Allocation of Resources to Education in Less Developed Countries". *Journal of Public Economics*. v. 3, 1974. pp .133-143.

7. Harbison, Frederick. *Data Appendix to Education Study for United Nations*. Princeton University. 1972. Unpublished.

8. ————.*Human Resources as the Wealth of Nations*. New York: Oxford University Press. 1973.

9. Herzog, John. "Some Implications of Rapid Population Growth for Public Expenditures in the EROPA Region". Presented at Conference on Administrative Implications of Rapid Population Growth in Asia. Eastern Regional Organization for Public Administration, Manila, August 14, 1971. Mimeographed.

10. Hinrichs, Harley. "Determinants of Government Revenue Share among Less Developed Countries". *Economic Journal*. v. 75, September, 1965.

11. International Monetary Fund. *International Financial Statistics*, 1971-1972 *and* 1972-1973.

12. Johnston, J.A., "Population Growth and Education". in W. Borrie and M. Cameron (eds.) *Population Change: Asia and Oceania. Proceedings of International Union for the Scientific Study of Population, August*, 1967. Canberra, Australia. 1969.

13. Jones, Gavin W. "Effect of Population Change on the Attainment of Educational Goals in the Developing Countries". In Roger Revelle (ed.) *Rapid Population Growth: Consequences and Policy Implications*. Baltimore: The Johns Hopkins Press. 1971.

14. ———— and Jayati Mitra. *The Demographic Obstacle to the Attainment of Educational Goals in Pakistan*. New York: The Population Council. 1969. Mimeographed.

15. ———— and Paul Gingrich. "The Effects of Differing Trends in Fertility and of Educational Advance on the Growth, Quality and Turnover of the Labour Force". *Demography*. v. 5, no. 1, February, 1968. pp. 226-248.

16. Lotz, Joergen R., and Elliott R. Morss. "A Theory of Tax Level Determinants for Developing Countries". *Economic Development and Cultural Change*. v. 18, no. 3, April, 1970. pp. 328-341.

17. Organization for Economic Cooperation and Development. *National Accounts of Less Developed Countries*, 1950-66. Paris. 1968.

18. ———— (and supplements). *National Accounts of Less Developed Countries*, 1959-1968. Paris. 1970.

19. Ta Ngoc, Chau. *Population Growth and Costs of Education in Developing Countries*. Paris, France: UNESCO, International Institute for Educational Palnning. 1972.

20. UNESCO. *Statistical Yearbook*. Various years.

21. United Nations, Department of Economic and Social Affairs. *The Determinants and Consequences of Population Trends*. Volume 1, Population Studies Number 50. New York. 1973.

22. United Nations. *Demographic Yearbook*. Various years.

23. ————. *Yearbook of National Accounts Statistics*. Various years.