Autor I

ESTIMATES OF EFFICIENCY AND EXTENT IN PRIMARY SCHOOLS OF BRAZIL, 1967-1968

Laurence Wolff
Human Resources Office
US Agency for International Development
Rio de Janeiro, Brazil
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A - Introduction *

As Brazil moves towards a comprehensive effort to plan education, it faces the need to improve the transformation of data--masses of facts--into "information"--organized data useful for policy-making.

This analysis seeks to aid this process by suggesting and demonstrating a procedure for analyzing data on primary schools in the 22 states of Brazil. It does not take into account the proposed change in definition and structure of primary schools and ginásios, which will be unified as "fundamental" education, but instead deals with today's reality of the four or five year primary school.

The analysis is based on the recent availability of data on enrollment and repetition in primary schools for the states of Brazil. It develops two estimates of school outputs which can be derived from these data: "school efficiency"-- defined as the fraction of children entering primary school who complete the full course; and "school extent"-- defined as the percentage of the school age population in the primary schools.

The methodology for the first measure is based on the work of the Organization for Economic Cooperation and Development (OECD) in Argentina, as described in Education, Human Resources, and Development in Argentina,[1] but this is the first time it has been applied on a significant scale in Brazil. Using available data, some relationships between socio-economic factors, school factors, and "efficiency", are also examined, in order to help evaluate the measures developed here.

The data for the 22 states came from the statistical organ (Serviço de Estatística da Educação e Cultura - SEEC) of the Ministry of Education and Culture in Rio de Janeiro. The data collection form used consists of four pages for every primary school in the nation, collected at the beginning of every school year by the local offices of the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística). The form for 1968 asks for the following information:

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* I should like to thank Torres Jatobá, head of the Serviço de Estatística da Educação e Cultura do Ministério da Educação e Cultura, for his kindness in supplying preliminary data on enrollment in Brazil. I should also like to thank Roberto Seide, of the Conselho Estadual de Educação do Rio Grande do Sul, Edi M. Fracasso, now a graduate student at Harvard Graduate School of Education, and Dr. Richard Durstine, lecturer at Harvard, for their assistance in the development of this analysis, and Ardwin Dolio, Frank Taylor, and Denise Chagas Leite of the Human Resources Office of AID in Rio de Janeiro, for help revising the analysis for presentation in this form.

[1] Paris, 1967.

1. Name and address of school
2. Whether the school has one teacher or more than one teacher
3. Number of years of the primary school course in the school
4. Number of classrooms; number and lengths of daily sessions
5. Number of teachers and type of training
6. Number of students enrolled as of April 30, 1968, by age, grade and sex
7. Number of students repeating as of April 30, 1968, by age, grade and sex
8. Number of dropouts since the previous year, by grade and reason for dropping out
9. Number of students enrolled and passed at the end of the previous year, by grade and sex

This paper makes use only of the published summaries of the data. It was not possible to use the original raw data, because of problems of time and availability.

For 1967 and 1968, MEC's Service for Educational and Cultural Statistics in Rio de Janeiro keypunched all the forms for Brazil and computed the results on accounting machines. A portion of the data was published in the Statistical Yearbook of Brazil, 1969 and 1970 (Anuário Estatístico do Brasil). In 1970, the following information was available for the 22 states:

1. Enrollments and repeaters by grade, 1967 and 1968
2. Enrollments and repeaters for urban, rural, state, private, municipal, and federal schools, 1967 and 1968
3. Number of teachers, trained teachers, classrooms, and schools, 1967 and 1968, for urban, rural, state, private, municipal, and federal schools
4. Enrollment and promotions at end of the year, by grade, 1967

In many states the same form is processed by the Division of Educational Statistics in the Secretariats. It is useful to compare the results of the Secretariats of Education and the statistical organ at MEC This has been done for the state of Rio Grande do Sul.

While the data are based on the same field situations, the results of the two organs differ significantly in their enrollment data:

TABLE 1 - COMPARISON OF STATE AND FEDERAL DATA ON ENROLLMENTS IN PRIMARY SCHOOLS, RIO GRANDE DO SUL, 1967

Enrollments	State Data	Federal Data	Difference	
			Absolute	As Fraction of State Data
Total	1,038,963	1,007,274	- 31,689	- .031
Federal schools	61	2,012	+ 1,951	+ 31.983
State schools	484,496	516,256	+ 31,760	+ .066
Municipal schools	427,589	367,071	- 60,518	- .142
Private schools	126,817	121,935	- 4,882	- .038
Urban schools	543,535	498,970	- 44,565	- .082
Rural schools	495,428	508,304	+ 12,576	+ .025

According to the federal data, total enrollment is 3.1% less than in the state data. Disrepancies within various subsystems are greater. The federal data greatly overestimate the number of students in the federal schools, of which there is only one in Rio Grande do Sul; and significantly underestimate enrollments in municipal schools. The federal data also show year to year fluctuations in their relationship to the state data. The principal reason for the differences in 1967 is that the state checked all forms against their own lists and other data in the Secretariat of Education, while the federal organ simply processed the forms as received, since it does not have the resources for checking. This comparison suggests that there is a need for better data before detailed conclusions can be drawn. Federal data have been used in this case in order to demonstrate the procedure by state and for the nation as a whole.

B - The Calculation of School Efficiency and Extent

1. Efficiency

Ideally we should measure the efficiency of a primary school system by calculating the amount of "knowledge" accumulated by children over a number of years relative to their "capacities". We would need to define the kinds of knowledge desired -- factual or procedural, cognitive or social -- develop or use appropriate achievement tests, then develop or use I.Q. and other tests to estimate children's capacities. Given the time and purpose of this paper, we have to develop less satisfactory measures using available data.

Another way of measuring efficiency is to study a group of children who enter primary school in a particular year -- a "cohort" -- and then see how many drop out along the way and how many finish the

course -- which is four years long in most of Brazil. This method assumes that (1) children who complete primary school have roughly similar levels of achievement, and (2) dropouts lose whatever achievements they have made. Both these assumptions are not entirely justified. For instance, primary school graduates in rural areas or in the Brazilian Northeast probably have lower achievement than those in urban areas or in the southern part of the country. But we propose to use this idea, the fraction of an entering cohort who complete the course, as the best available estimate of school efficiency. This estimate when combined with "extent" has the added value of showing how well the state fulfills its constitutional obligation to give all children a primary education. In Brazil it has not been possible to follow the same group of children for six or seven years through the primary school system. An up-to-date individualized pupil accounting system would permit this. Aggregated data must be used to estimate the "flow" of a cohort through the system.

The Service of Educational and Cultural Statistics of the Ministry of Education analyzed progressive grade enrollment from 1962 to 1966 and estimated that 24.5% of children entering primary school in 1962 completed the four year course in Brazil. This represents an improvement over the 19.3% who finished the four year course beginning in 1956.[2] For 1967 and 1968 data on repeaters as well as enrollments were available for Brazil. Data on repeaters permit the development of better estimates of the flow of students by looking at only two years' data, rather than following progressive grade enrollments by year.

The method to be used here is described in Education, Human Resources, and Development in Argentina, Methodological Problems and Statistical Data. Rather than present the matrix algebra descriptions in that document, we propose here to work through an example of the method for Brazil, using the following: enrollments, 1967 and 1968, and repeaters, 1968, for all of Brazil.

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[2] Jatobá, Torres, "Análise do Ensino do Brasil", Serviço de Estatística da Educação e Cultura, Ministério da Educação e Cultura, Rio de Janeiro, Brasil, mimeo, n.d.

TABLE 2 - ENROLLMENTS, 1967 AND 1968, AND REPEATERS, 1968, BY GRADE, PRIMARY SCHOOL, BRAZIL

	1967 Enrollment	1968 Enrollment	1968 Repeaters
Grade 1	5,381,486	5,692,105	1,629,798
Grade 2	2,311,210	2,456,733	445,608
Grade 3	1,766,193	1,923,469	303,745
Grade 4	1,225,258	1,353,892	142,972

Source: IBGE, Anuário Estatístico do Brasil, 1970, pp. 664-668

Assuming that all those who were not repeaters in 1968 were either new enrollees in Grade 1 or promoted from the previous grade, and that all those enrolled in 1967 who were neither repeaters or promotees the next year dropped out, we calculate the following "coefficients" to describe what happens to children in each grade in 1967:

TABLE 3 - MOVEMENT OF STUDENTS BY GRADE, PRIMARY SCHOOL, BRAZIL, AS FRACTION OF PREVIOUS YEAR'S ENROLLMENT - 1967-1968

	Promoted to Next Grade	Repeat Same Grade	Drop Out
Grade 1	.374	.303	.323
Grade 2	.701	.181	.118
Grade 3	.686	.172	.142

The first line tells us that of all the children enrolled in grade 1 in 1967, 37.4% were promoted to second grade, 30.3% repeated grade 1, and 32,3% dropped out by the beginning of 1968. The table describes in simple terms the tragic bottleneck of primary education, particularly the first grade.

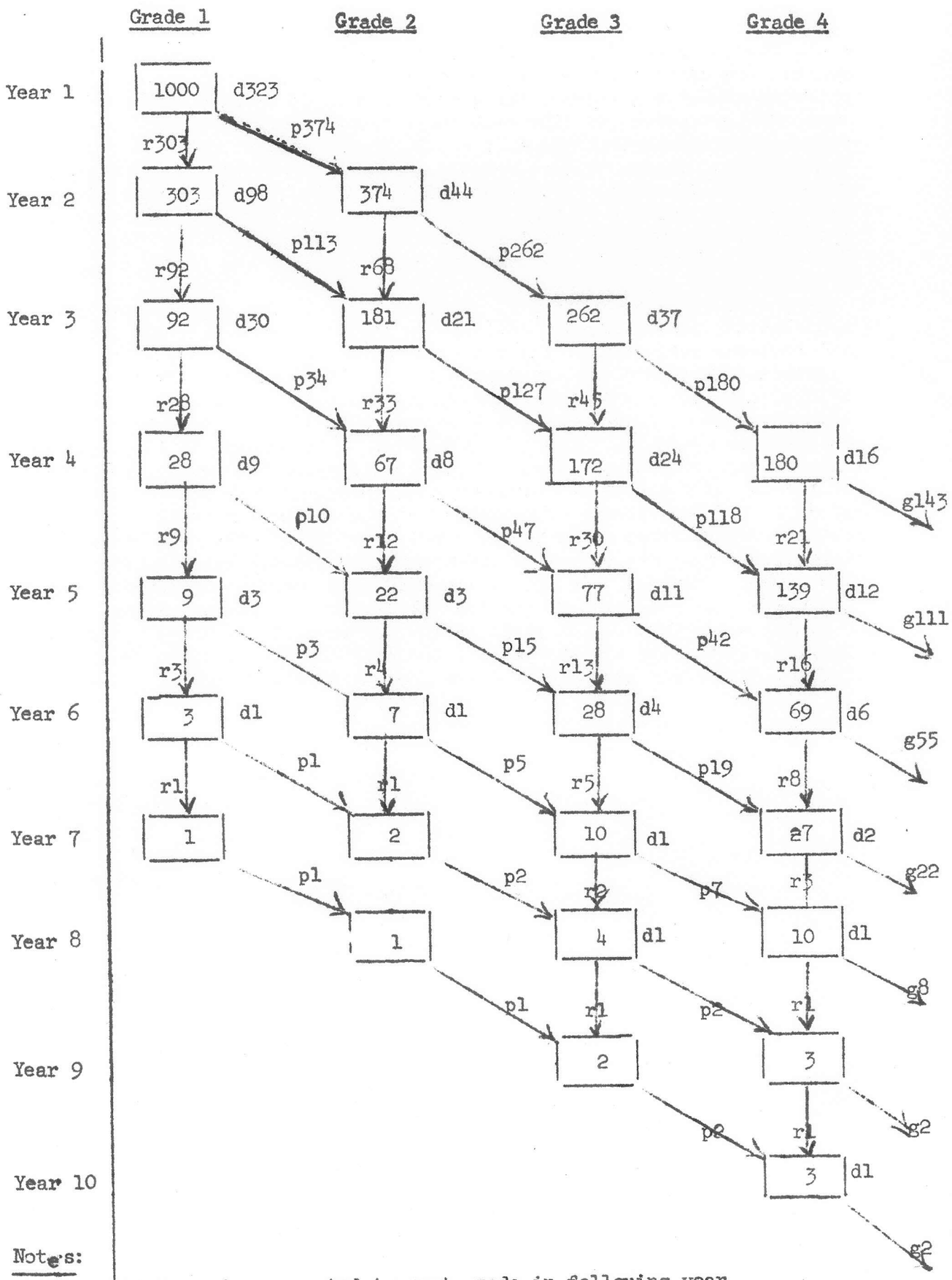
We can assume that students in fourth grade either pass at the end of the year, repeat the grade, or drop out. The number of students who passed fourth grade in 1967 is 975,420. Thus we can estimate the flow of fourth graders in 1967 as,

passed at end of year	.796
repeated fourth grade	.117
dropped out	.087

With the coefficients in Table 3 and above, the OECD method simulates the flow of an entering cohort of 1000 students to fourth grade. The method begins with the coefficients for grade 1. Of 1000 entering students 374 go to the second grade, 303 repeat, and 323 drop out. We now assume that the same coefficients apply to the 303 children who are repeating first grade, i.e., 37.4% of them -- or 113 -- go on to the second grade; 30.3% -- or 92 -- repeat first grade for a second time; and 32.3% -- or 98 -- drop out. In the third year we apply the same coefficients to the 92 first grade "bi-repeaters", and keep on recycling the repeaters until all have either dropped out or completed the course. We then do the same for second, third, and fourth grade.

The result, in Table 4, provides a simulation of the flow of a hypothetical cohort of 1000 children through the primary school system, and includes estimates of the number of dropouts per grade and the number of students who complete the fourth grade. The boxes signify the number of children in a particular grade during a particular year. For instance, the number of children in grade 1 at year 1 is 1000. The number of children is grade 2 at year 3 is 181, etc. The numbers to the right of the box signify dropouts from the particular grade and year. The numbers at the end of the diagonal arrows signify promotions from a particular grade to the next grade. The numbers at the end of the vertical arrows signify repeaters in a particular grade - who return the next year. The table shows that the cohort of 1000 entering students takes 10 years for everyone to drop out or complete the four year course. By summing the numbers in all the boxes we get the total number of student years. By summing the numbers to the right of the boxes we get dropouts by grade. Finally, by summing the numbers for the diagonal arrows after grade 4 we get the number who graduate from the four year primary school system.

TABLE 4. SIMULATION OF THE FLOW OF AN ENTERING COHORT IN PRIMARY SCHOOL, BRAZIL, 1967-1968, FROM GRADE 1 TO GRADE 4



Notes:

p signifies number promoted to next grade in following year.
r signifies number repeating same grade in following year.
d signifies number dropping out of grade before beginning of following year.
g signifies number passing final exam in fourth grade and graduating

Number of student years needed before all 1000 students either drop out or graduate (sum of numbers in boxes): 3076

Total number of dropouts from each grade (sum of d's for each grade):
grade 1 = 464 grade 2 = 77 grade 3 = 78 grade 4 = 38

Total number of graduates of fourth grade (sum of g's): 343

Average number of student years in the system to produce one graduate:

$$\frac{3076}{343}, \text{ or } 9.0 \text{ student years}$$

In 1967, 343 of every 1000 primary school entrants or 34.3%, were expected to complete fourth grade. 464 drop out after the first grade, 77 after the second grade, 78 after the third grade, and 38 drop out of the fourth grade without passing. The data show a significant improvement over the estimate from the Service of Educational and Cultural Statistics that 24.5% of first grade entrants reach fourth grade in the period 1962-1966.

The simulation also gives us an idea of the retardation suffered by those who finally do complete the fourth grade. Of the total of 343, only 143 complete the course without repeating at all. 111 repeat once, 55 repeat twice, and 34 repeat three or more times. By counting the number of years each student takes, we can see that on the average the graduates spend 5 years to complete the 4 year course.

If a student spends two years in first grade and drops out, the country has paid for two "student years" without any return in terms of a graduate of the system. Dividing all the years in Table 4 (3076) by the number who complete fourth grade (343) provides the statistic of 9.0 student years to produce one fourth grade graduate. An "ideal" school system, without repetition or dropout, would require 4.0 years to produce a fourth grade graduate. Brazil requires more than twice this amount of time. Thus, while cost per pupil per year in Brazil may be low, cost per graduate is much higher than it might be, because of the high rate of dropout and repetition.

The estimation of school efficiency by this means requires about 20 minutes and a calculating machine. If many are to be calculated, a simple computer program can be developed. A simple summary formula is also available, and is presented in the appendix. The formula gives slightly different results because of round-off errors in the "simulation" method.

We should note, as reported by the OECD, that this method simplifies the reality of the flow of a cohort through the primary school system. It does not take into account the possibility of (1) deaths, (2) pupils who skip a grade or lose a grade during the year, (3) first enrollments in grades other than the first, (4) migration, (5) pupils who temporarily interrupt their schooling, (6) differing dropout, repeater, and pass rates for repeaters, and (7) changing rates through time. In this analysis we have assumed that most of these factors do not affect relative school efficiency. This may or may not be true. We should also note that the number of repeaters may be underestimated. Children who transfer from school to school or who attend school in 1967 for just a few days may be incorrectly designated as new entrants, although they should be considered repeaters. We have not been able to measure the extent of this error.

2. Extent

The fraction of an entering cohort which completes fourth grade and the number of school years to produce a fourth grade graduate are estimates of efficiency of a school -- how well students move through it. We also need to know the extent of schooling -- how many children the primary school reaches. A highly "efficient" system may enroll only a small percentage of the school age population; thus its output may not be commensurate with the needs and desires of its society.

The ideal way to measure extent is to take a "school census" -- count all the school age children in and out of school. The School Census of 1964 in Brazil showed how expensive and difficult this is.[3] This data will also be available with the results of the 1970 Census.

An alternative is to compare population estimates with school enrollment figures. In the past in Brazil total primary enrollment was compared with the estimated population aged 7-14 to produce the "school deficit", since the Brazilian Constitution states that primary education is obligatory for all children aged 7 to 14. Since primary schools are usually only four or five years long, the results overestimated teacher and construction needs, and tended to turn the interests of leaders from the more pressing problem of quality.

The age group 7 to 14 could be compared with enrollments in both primary schools and ginásios to give a true school deficit; but at present primary schools and ginásios are so different in structure and needs that it is better to analyze separately the school age population of 7 to 10 for the four year primary school and of 11 to 14 for the ginásio. Rio Grande do Sul and Guanabara have many students in the fifth grade, but at this moment we shall confine our analysis to a four year system.

Since the 1960 Census did not produce detailed age breakdowns for most states, we estimated children aged 7 to 10 by assuming that the percentage of children aged 7 to 10 over the total population in the School Census of 1964 is constant to 1968, and applying this percentage to estimated populations from the Statistical Yearbook of Brazil. As soon as the 1970 Census is published, it would be valuable to apply those figures to school enrollment. Thus estimated population aged 7-10 in 1968 in Brazil is 10,430,000, while enrollment is 11,426,199. Brazil enrolls about 996,000 or 9.5% more children than those aged 7 to 10, in primary grades 1 to 4.

This apparent anomaly is resolved when we take into account repeaters and overage children in the system. Every child who is

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[3] See Isabel Deblé, Brazil, estatiques, UNESCO, Paris, 1970, for an evaluation of the School Census.

repeating displaces another who could be in the system. With 21.5% of all primary school enrollment repeating, only 78.5% of the places in Brazilian primary schools are available to children aged 7 to 10. Subtracting the repeaters from enrollment, we see that primary schools enroll about 1,526,000 or 14.6% less students than those aged 7 to 10. This does not mean that 85.4% of all children aged 7 to 10 are in school, but that they theoretically could be in school if all children entered at age 7. Since the age of entrance varies greatly from 7 to 14, we cannot estimate with these data the percentage of any age actually in school. In addition the expansion of primary schools to areas which have no schools will produce temporary large enrollments, as many of the children aged 7 to 14 enter these new schools. As more data on age-grade distribution become available we will be able to see the trends in these complicated relationships.

It is also extremely important to note that the overall figure for Brazil masks large regional differences. Most probably a very large deficiency exists in the rural areas, while urban areas may have enough places for all children.

Measuring extent in both ways -- using enrollment, then enrollment less repeaters -- shows that Brazilian primary schools could enroll and educate all school age children (except for some regional deficiencies) if they all entered at age 7, passed the final examinations and completed the course in four years. Thus efficiency and extent are related, since a system's extent depends at least partly on its efficiency. The measures here -- (1) the fraction of an entering cohort to complete fourth grade, (2) the number of school years to produce a fourth grade graduate, (3) the enrollment-school age population ratio, and (4) the enrollment less repeaters-school age population ratio -- have not previously been utilized significantly in Brazilian primary education because of lack of repeater data. In the following we apply them to the states of Brazil.

C - Efficiency and Extent of Primary Schools in Brazilian States

1. Efficiency in Brazilian States

Table 5 gives efficiency measures for the 22 Brazilian states in 1967-1968:

TABLE 5 - ESTIMATES OF EFFICIENCY OF PRIMARY SCHOOLS IN 22 STATES OF BRAZIL, 1967-1968

State	Portion of Entering Cohort of 1000 who Complete Grade 4	Student-years to Produce One Fourth-Grade Graduate
Acre	069	29.9
Amazonas *	133	14.9
Pará	189	12.0
Maranhão	145	16.6
Piauí	207	11.5
Ceará	185	12.0
Rio Grande do Norte	193	14.3
Paraíba	126	15.4
Pernambuco	167	12.9
Alagoas	149	14.9
Sergipe	202	14.5
Bahia	180	12.4
Minas Gerais	293	11.6
Espírito Santo	353	9.1
Rio de Janeiro	258	9.5
Guanabara **	613	6.6
São Paulo	712	6.3
Paraná	317	9.8
Santa Catarina	527	7.8
Rio Grande do Sul	584	7.5
Mato Grosso	412	7.0
Goiás	228	10.7
BRAZIL	343	9.0

* 1967 enrollments for Amazonas are taken from the 1969 Statistical Yearbook, since the enrollments in the 1970 Yearbook appear incorrect.

** In Guanabara the number of third graders in 1968 appears to be overestimated. Therefore the coefficients for passers from second to third grade were calculated from 1966-1967 data.

Only São Paulo and Guanabara have over 60% of their first grade entrants completing fourth grade, and only they, Rio Grande do Sul, and Santa Catarina have over 50%. In the Northeast- -especially Maranhão, Paraíba, and Alagoas -- and in Acre, Amazonas, and Pará, less than 20% of the entrants graduate from fourth grade. We can consider roughly four levels of educational efficiency among the states:

high, 600-612:	São Paulo, Guanabara
medium, 500-600:	Santa Catarina, Rio Grande do Sul
low, 300-500:	Espírito Santo, Mato Grosso, Paraná
very low, 69-300:	all other states

In terms of student years to produce a fourth grade graduate, São Paulo and Guanabara take somewhat over six years, while the ideal time is four years. Paraíba requires over 15 years, Maranhão 16, and Acre over 29 years of schooling. Thus costs of education vary from one and a half to seven times the ideal minimum cost. The data here fall into four levels of efficiency also:

high, 6-7 years:	São Paulo, Guanabara
medium, 7-8 years:	Santa Catarina, R.G. do Sul, Mato Grosso
low, 9-10 years:	Rio de Janeiro, Paraná, Espírito Santo
very low, above 10 years:	all other states

This measure is dependent not only on the efficiency but in particular on the repeater rate. While Minas Gerais graduates 293 out of 1000 entrants, it also has one of the highest percentages of repeaters (32.6% of enrollment) and thus a very high number of student-years to produce a fourth grade graduate.

If we can calculate the average cost of schooling for one student in the system one year, we can then roughly estimate the cost per graduate by multiplying the cost per student year by the years to produce a graduate. This would give us an extremely valuable tool for an economic analysis of costs and returns in primary education.

The first grade is so crucial in the primary system, that it is valuable to examine the coefficients for first graders, upon which much of the above is ultimately based:

TABLE 6 - MOVEMENT OF STUDENTS FROM FIRST GRADE AS FRACTION OF PREVIOUS YEAR S ENROLLMENT, IN 22 STATES OF BRAZIL, 1967-1968

State	Promoted to Grade 2	Repeat Grade 1	Drop Out
Acre	.231	.222	.547
Amazonas	.296	.115	.588
Pará	.262	.218	.520
Maranhão	.261	.296	.443
Piauí	.200	.315	.485
Ceará	.224	.259	.517
R.G. do Norte	.262	.342	.396
Paraíba	.243	.164	.593
Pernambuco	.273	.196	.431
Alagoas	.211	.286	.503
Sergipe	.170	.470	.360
Bahia	.310	.199	.492
Minas Gerais	.326	.408	.266
Espírito Santo	.387	.354	.259
Rio de Janeiro	.363	.188	.449
Guanabara	.515	.320	.165
São Paulo	.616	.320	.065
Paraná	.401	.309	.290
Santa Catarina	.456	.395	.149
R. G. do Sul	.472	.389	.140
Mato Grosso	.374	.256	.370
Goiás	.319	.213	.468
BRAZIL	.374	.303	.323

The data show the same story of very high dropout in the Northeast -- above 50% -- and low dropout in São Paulo and the South. The repeater data is interesting. A number of states have very high repeater rates -- Sergipe, Minas Gerais, Santa Catarina and Rio Grande do Sul -- while most of the Northeast states have few repeaters but much dropout. We can hypothesize that, as primary education expands, a system tends to increase the number of repeaters until expansion is completed and efficiency begins to improve. Unless special action is taken the Northeast will experience a growth in repeaters as dropouts decrease.

2. Extent in Brazilian States

Table 7 on the next page shows the extent of primary school education in 22 Brazilian states. 16 of the 22 states have more children in primary grades 1 to 4 than children aged 7 to 10. Rio Grande do Sul has the highest percentage of "overenrollment" -- 34%. The low excess in Paraná may be caused by very high population projections; the population in Paraná doubled from 1950 to 1960, but it probably is not doubling in the decade 1960 to 1970. The Northeast, considered the area most deficient in education supply, is in general worse off than other regions, but shows extreme variations.

When we consider only "non-repeaters", all the states are deficient except Rio de Janeiro, Pará, and Rio Grande do Norte The state of Rio de Janeiro's system of "automatic" promotion may have reduced the number of children who ordinarily would be reported as repeaters. The results for Pará and Rio Grande do Norte may suggest significant efforts to build schools in as many localities as possible. Minas Gerais, Paraná, and most states in the Northeast have large quantitative deficiencies.

The four states highest in efficiency -- Guanabara, São Paulo, Rio Grande do Sul, and Santa Catarina -- have school systems which theoretically could reach 96 to 99% of primary school age children. We should note that these data mask local inequities as well as the structure of enrollments in the primary schools, with their very high percentage of children in first grade.

The data show that most states can resolve their quantitative deficiencies either by expanding the present system with the same number of repeaters or by reducing the repeater rate and thus creating room for more new enrollees. Expanding the present system would require even more school places than children presently out of school, since we would assume that new students repeat at the same rate as others. Thus the central problem of Brazilian primary education is not the need for quantitative expansion.

TABLE 7 - ESTIMATES OF EXTENT OF PRIMARY SCHOOL EDUCATION IN BRAZIL, 1968

	Estimated Population 7 to 10	Enrollment Grades 1-4	Ratio between Enrollment and Population 7 to 10	Enrollment less Repeaters Grades 1 - 4	Ratio between enrollment less Repeaters and Population 7 to 10
Acre	26,000	22,661	.87	18,423	.71
Amazonas	108,000	102,106	.95	91,971	.85
Pará	224,000	274,536	1.23	225,214	1.01
Maranhão	398,000	299,691	.75	231,490	.58
Piauí	168,000	195,408	1.16	153,531	.91
Ceará	418,000	404,209	.97	335,410	.80
R. G. do Norte	136,000	190,136	1.40	138,049	1.02
Paraíba	363,000	242,309	.67	207,522	.57
Pernambuco	506,000	568,152	1.12	477,681	.94
Alagoas	147,000	170,000	1.16	131,890	.90
Sergipe	98,000	98,372	1.00	61,350	.63
Bahia	795,000	699,707	.88	592,659	.75
Minas Gerais	1,366,000	1,785,044	1.31	1,199,442	.88
Espírito Santo	188,000	224,029	1.19	172,748	.92
Rio de Janeiro	500,000	613,596	1.23	529,821	1.06
Guanabara	343,000	425,573	1.24	335,674	.98
São Paulo	1,729,000	2,166,219	1.26	1,718,517	.99
Paraná	859,000	873,305	1.02	693,287	.81
Santa Catarina	330,000	430,243	1.30	316,513	.96
R. G. do Sul	728,000	976,899	1.34	723,992	.99
Mato Grosso	166,000	195,301	1.18	162,480	.98
Goiás	333,000	387,863	1.16	323,886	.97
BRAZIL	10,430,000	11,426,199	1.10	8,904,076	.85

Note: Estimated population 7 to 10 is calculated by applying the percentage of children aged 7 to 10 in the 1964 School Census to the estimated total population in 1968 from the Statistical Yearbook of 1970. Goiás was not included in the 1964 School Census; its percentage of population aged 7 to 10 in 1964 is estimated as the same as that of Mato Grosso. Guanabara was not included in the School Census; its percentage of population aged 7 to 10 is based on results of the 1960 Census which were published for Guanabara. The results for Brazil as a whole include the Federal District and the territories.

3. Relationships between Efficiency and Other School and Society Factors

The data show various aspects of unequal development and inefficiency in Brazilian education. In this section we make a modest attempt to see the relationship of other school and socio-economic factors to school efficiency, in order to suggest priorities for changes in schools to improve their efficiency. The data available is very limited. The Service of Educational and Cultural Statistics has published sufficient data in the Statistical Yearbook of Brazil, 1969, to enable here the calculation of school factors such as percentage of teachers trained in normal schools, teacher student ratio, average school size, and students per classroom for the 22 states. Most educators are convinced of the importance of teacher training program as a means of improving efficiency, since in 1968 only 61% of all primary school teachers were trained in normal schools. From the Statistical Yearbook, 1968, we can also calculate per capita income and, from the 1960 Census, percentage of urban population.

The simple correlations between efficiency as measured by the percentage of entering students who complete fourth grade and the six factors measured are very high:

TABLE 8 - CORRELATIONS BETWEEN SCHOOL EFFICIENCY AND SCHOOL AND SOCIETY FACTORS IN 22 STATES OF BRAZIL

Variable	Correlation with Efficiency
Percentage of trained teachers (1968)	.711 **
Teacher student ratio (1968)	-.219
Average school size (1968)	.645 **
Students per classroom (1968)	.488 *
Per capita income (1966)	.865 **
Percent urbanized population (1960)	.692 **

* Significant at .05 level
** Significant at .01 level

These high correlations do not prove causal relationships. In sociological terms the effect of some of the school factors may be "spurious", the result of either the economic or social progress of the state. We would need to examine the variables in a multiple regression equation to ascertain their relative predictive importance when considered together.

In the above all the variables are correlated significantly with school efficiency except the teacher student ratio. The teacher

student ratio is negative because it means that the lower the teacher student ratio the more likely is a state to have higher school efficiency; but the relationship is not very high. The most interesting relationship is that of the percentage of trained teachers with school efficiency. Percentage of trained teachers is highly correlated with per capita income and urbanization, as follows:

TABLE 9 - CORRELATIONS AMONG PER CAPITA INCOME (1968), PERCENTAGE OF POPULATION IN URBAN AREAS (1960), AND PERCENTAGE OF PRIMARY SCHOOL TEACHERS WHO ARE TRAINED (1968) IN 22 STATES OF BRAZIL

	Variables	Correlation
1.	Per capita income by percentage of population in urban areas	.918 **
2.	Per capita income by percentage of primary school teachers who are trained	.825 **
3.	Percentage of population in urban areas by percentage of primary school teachers who are trained.	.789 **

** Significant at .01

We also tried a multiple regression equation of these three variables on efficiency. Because of the very high inter-correlations among them, the result was peculiar and not very useful. The effect of urbanization on efficiency was negative in the equation, although it has a highly positive simple correlation. This result at first suggests that poor urban areas may have lower efficiency than poor rural areas, but a more likely interpretation is technical, because of peculiarities in the equation when independent variables are very highly intercorrelated with each other. A similar problem occurs when we attempt a multiple regression equation with teacher student ratio and average size of class -- the sign is reversed because of very high correlations.

This problem occurs because differences between states are so much higher than the difference between variables, since we are aggregating data into 22 states with widely differing levels of development. A more successful analysis might be made by municípios or by individual schools.

The analysis does have the value of showing that, besides having very different levels of educational development, the 22 states

have greatly varying school, economic, and social resources, which may have relationships with school efficiency. The need in national educational policy is to find the key constraints and break through them among the poorer states. But this analysis has not been able to suggest key areas in which to make such a breakthrough.

D - Further Applications and Uses

These methods of estimating efficiency and extent need not be limited to the examples for the 22 states given above. They can be used for more detailed analysis among the "subsystems" of the primary schools, such as urban and rural schools, and state, municipal, and private schools. The separation of the data by urban-rural is particularly important because of the great differences in education between the two.

Another important extension would be the calculation of efficiency and extent within states, by municípios, to aid state secretariats in their planning for educational change. One problem here in the reduction of the universe to municípios is that small errors in data tend to distort the results. But these results should be considered rough indicators of the educational system rather than exact measures.

A final extension is to use the methods as the basis for estimating enrollments in future years. Enrollments could be predicted on the basis of the existing efficiency and extent, then modifications and improvements could be hypothesized, with their results also projected.

From a policy point of view the analysis of these measures for the 22 states emphasizes the necessity to devise separate policies for efficiency and extent of primary schools. The three states with the highest relationships of non-repeating students to estimated school age population -- Rio de Janeiro, Pará, and Rio Grande do Norte -- have low levels of school efficiency, with only 25.8%, 18.9%, and 19.3% of entering students completing the fourth grade in these three states. These states may face the necessity of making concentrated efforts to improve the quality of their schooling, or to seek other remedies for the high dropout rate. Most of the northeastern states have the double problem of both quantitative expansion and qualitative improvement, while the southern states may need to improve qualitatively by reducing the huge amount of repeaters who burden the system.

Now that repeater data are available yearly, it will be useful to calculate these measures yearly, since they give a much clearer view of primary school problems than simple enrollment figures. Both measures are not ideal because of assumptions not justified and because of their sensitivity to incomplete data. A better measure of school

efficiency might be based on an individualized student record system, and a better measure of school extent on a school census; but until these systems function the available data can be exploited to the fullest.

APPENDIX

A series of equations can give the summary measures of number of graduates and years per graduate without going through the entire exercise of the simulation. The equations were supplied by Dr. Richard M. Durstine of Harvard Graduate School of Education. For a four year system, we must calculate the passers and repeaters, as on page 5. We call the rate of passers by years as p_1, p_2, p_3, and p_4. We call the rate of repeaters for each year as r_1, r_2, r_3, and r_4. Then the fraction of those enrollees in first grade who eventually graduate is:

$$\frac{p_1\ p_2\ p_3\ p_4}{(1-r_1)\ (1-r_2)\ (1-r_3)\ (1-r_4)}$$

In the case for Brazil the result is: $\dfrac{(.374)\ (.701)\ (.686)\ (.796)}{(1-.303)\ (1-.181)\ (1-.172)\ (1-.117)}$

or .343.

The result may often be different from the simulation because of rounding o

The total number of student years delivered by the system is:

$$\frac{1}{1-r_1} + \frac{p_1}{(1-r_1)\ (1-r_2)} + \frac{p_1\ p_2}{(1-r_1)\ (1-r_2)\ (1-r_3)} + \frac{p_1\ p_2\ p_3}{(1-r_1)\ (1-r_2)\ (1-r_3)\ (1-r_4)}$$

In the case for Brazil the result is:

$$\frac{1}{1-.303} + \frac{.374}{(1-.303)\ (1-.181)} + \frac{(.374)\ (.701)}{(1-.303)\ (1-.181)\ (1-.172)} +$$

$$\frac{(.374)\ (.701)\ (.686)}{(1-.303)\ (1-.181)\ (1-.172)\ (1-.117)} \quad \text{or } 3.077.$$

The number of student years per graduate is calculated by dividing the second figure by the first: $\dfrac{3.077}{.343}$ or 9.0 years.

These formulae may be appropriately modified according to the length of the educational system. We do not present here their mathematical derivations.

HRO: LW:ev.