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The Determinant Factors and the Costs of Schooling in Bolivia

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I. Introduction

This study examines some aspects related to the costs and efficiency of the Bolivian school system, using extensive cross section data from the ECIEL Survey of 1975. Our fundamental interest in undertaking the study has been to test the following hypothesis (put in a simplified from): schooling and school resources are important in explaining academic achievement (as measured by suitable test scores) and over-age students (or their absence), whereas conditions of family background and environment are less relevant. If the above theory of school success stands up to our test, we shall further examine the particular impact on achievement of various school resources.[1] The estimation of educational production functions, using regression and related analysis-of-variance methods, provides the basic methodological tool for most of our study. The treatment of the educational models of cognitive achievement and backwardness is followed by a short discussion on the cost-efficiency problem, and on the equity issue.

The literature upon the way that school resources affect pupils is very scarce in Bolivia. We can mention only the official reports of the Bolivian Ministry of Education, and the USAID sector assessment on Education. A critical discussion of the use of resources in education is, however, badly needed.

Bolivia, as many less developed countries in the world, has been investing very heavily in education for the last 25 years; about 30% of the budget of the central government goes into its provision. The rates of growth of enrolment and of the provision of facilities since the early fifties have been of the order of a respectable 6% yearly (the corresponding rate for population growth is 2.1%).[2]

In spite of the efforts undertaken, there is a consensus (warranted or unwarranted) among educational policy makers upon the failure of the system on a number of counts, the main grievance being that of the inability of the system to retain its students. In fact, for a great majority of Bolivian students, school life ends at a very early stage.

The obstacles that are present in Bolivia for the implementation of a coherent educational policy are indeed formidable. The low levels of income as well as their skewed distribution, the cultural heterogeneity with three main languages: Spanish, Aymara and Quechua, and the relative isolation of the country from the world mainstreams of science, technology and trade conspire against the materialization of any well designed policy. To these structural characteristics one may add the overall administrative inefficiencies, and the effects of the influence of pressure groups like the bureaucracy of the Ministry of Education, the

[1] We cannot, unfortunately, answer with our data, in a direct way, the related question of what makes a pupil quit school. This question has a poignant relevancy in a country like Bolivia.

[2] The data on the budget shares and rates of growth can be found in the Ministry of Education sources.

teachers associations as well as the parents associations, that demand extensions and modifications of the school system that might conflict with the objectives of a good scholastic level and an efficient allocation of resources. The general insatisfaction with the working of the system has led to an unusual frequency of reforms, but the changes introduced by these reforms do not seem to substantially modify the basic inadequacies.

Table I reviews the main features of the school age population in what concerns its level of education.

A brief description of the main institutional characteristics of schooling in Bolivia should be helpful for the interpretation of the estimates, in Sections III, IV and V. Since, we cannot describe all the formal features of the Bolivian system of education in a short space, let us only retain the fact that primary education comprises two "cycles": a Basic Cycle spread over five years, and an Intermediate Cycle spread over three years. Secondary education consists of only cycle of four years if high school.

According to Bolivian Law, the eight years of primary education are compulsory, regardless of age. However, the enforcement of this law is very lax, as will be seen later. The high schools are mostly of the traditional academic type, only a handful being technical or vocational.

Within the Bolivian schools system there exists a fundamental distinction between the urban and the rural subsystems. This distinction is not merely administrative as there are also differences in curriculae between the two subsystems.

Table I

Percentage Distribution of Population of School Age According to Educational Level Attained and Age

	Total	No Schooling	Primary Up to 3 Years	Primary More Than 3 Years	Secondary	College	Unknown
Whole Country							
06 - 19 years	100	13.87	38.90	29.79	16.99	0.33	0.13
06 - 09 years	100	32.43	64.15	3.37	-.-	-.-	0.05
10 - 14 years	100	4.04	37.59	45.62	12.72	-.-	0.03
15 - 19 years	100	6.69	15.62	37.94	38.41	1.02	0.33
La Paz							
06 - 19 years	100	7.99	30.96	27.92	31.82	1.18	0.14
06 - 09 years	100	20.62	73.08	6.31	-.-	-.-	-.-
10 - 14 years	100	1.92	19.08	54.03	24.97	-.-	-.-
15 - 19 years	100	3.50	7.51	19.69	65.54	3.37	0.39
Other Cities							
06 - 19 years	100	9.20	32.33	26.83	30.80	0.69	0.15
06 - 09 years	100	22.89	71.50	5.54	-.-	-.-	0.07
10 - 14 years	100	2.45	22.20	51.65	23.64	-.-	0.06
15 - 19 years	100	4.10	7.87	19.46	66.20	2.05	0.32
Rural							
06 - 19 years	100	16.82	42.98	31.30	8.74	0.03	0.13
06 - 09 years	100	37.96	59.92	2.07	-.-	-.-	0.05
10 - 14 years	100	5.05	47.03	41.72	6.18	-.-	0.02
15 - 19 years	100	8.47	20.63	49.67	20.82	0.08	0.33

Source: National Demographic Survey, National Institute of Statistics, La Paz, 1976

Another important characteristic of the system is that of the importance of enrolment in private schools: about one fifth of total enrolment is found in the private schools. This proportion rises to one third ar secondary level.

The private schools exhibit very heterogeneous characteristics; amongst them are to be found the very best as well as the very worst schools. The traditional core of private schools consists of a group of religious schools and of schools that serve the foreign communities in Bolivia. They are usually of a good scholastic level. Together with these schools there coexists a wide array of private schools: some of the them are church-dependant in administrative matters but publicly financed; others are recovery schools for those children who cannot continue in the established schools, public or private. The latter are managed by teachers in the public system operating on a part-time basis.

We remark also that the structure of the educational system is very rigid, with a high degree of centralization in the decision making process. Detailed academic curriculae are set forth by the authorities of the Ministry of Education, and have a compulsory character both for the public and the private schools.[3]

In this study we try to shed more light on some of the crucial issues that have been defined in the general context described above. The paper is organized as follows: the specifications of our analytical models are given in Section III, while a critical assessment of the data base on which our inferences are founded appears in Section II. An evaluation of the costs of various combinations of school inputs to improve the learning of the children is furnished in Section IV. The problem of the social selectivity of the system is analyzed in Section V.

[3] In fact, the unified study programs are very loosely followed, not only because there are some foreign-owned schools which are not obliged to follow them, even if their diplomas are accredited, but also because most schools are not endowed with either the personnel of the teaching aids to follow the rather stringent requirements of the Ministry.

II. The Data Base

The ECIEL Survey in Bolivia covered 53 schools, taking in 2000 students, 113 teachers and 53 principles.[4]

The questionnaires were designed in such a way as to give relevant information on:

a) Pupil's demographics and family background;

b) The main features of the teacher (including demographics and family variables) of each class where pupils were interviewed;

c) The characteristics of the school where the student is enrolled.

The survey included, furthermore, a battery of tests in reading comprehension and science for pupils in the 4th, 6th and 12th grade. The tests were based on the IEA ones.

In the sample design, standard multi-stage sampling techniques were used. The first stage units of sampling were the schools; once the school was chosen, the students to be interviewed were drawn out at random in a second stage. The schools were chosen according to a stratified random sampling procedure.

The principle of trying to capture most of the qualitative differences among the schools guided the stratification. The first layer in the procedure stratified the sample on the basis of urban-rural schools. Note that this distinction is a proxy for a complex set of economic, cultural and socio-economic variables that affect our dependent variables under study. Since complex sets of variables cannot be included in the formal models, it seems appropriate to control them by stratification.[5]

Further strata were defined in the urban schools, distinguishing the public from the private schools, and from the schools run by the big state corporations.[6]

In still another stratification a distinction was made between primary and secondary schools; and in the private secondary schools we allowed for the distinctions between the schools of the traditional core and the other private schools (see Section I). For short, we shall denote them "bug schools" and "small schools".

Among the rural schools a distinction was made between the primary and secondary schools, is an the case of the urban ones. The primary schools were also classified according to the languages spoken by their students: Spanish - Aymara - Quechua, or only Spanish. The rationale for this can be built on the consideration that by taking the Indian languages into account where they are a main vehicle for communication, we can approximate a complex st of socio-cultural variables that otherwise could not be controlled (Stratification acts as an instrument of control). Furthermore, there is a lively ongoing debate in Bolivia as to the relative merits of imparting primary instruction in the mother languages of the recipient. Up to now, all the teaching in done in Spanish.

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[4] Students in the 1st, 4th, 6th, and 12th grades were interviewed. The sample was taken in four Departments: La Paz, Cochabamba, Santa Cruz and Oruro.

[5] See the analogous comment on race by Murnane, pp. 94.

[6] I.e. by the state owned mining and oil consortiums.

Table II

A Comparison by Strata of the Population Distribution of Schools
and the Distribution in the ECIEL Sample

Stratum	All Schools*		ECIEL Sample**	
	Number of Schools	%	Number of Schools	%
Urban public primary	1.009	50	14	22
Urban public secondary	230	11	4	6
Urban private primary	140	7	15	23
Urban private secondary	137	7	14	23
Urban private secondary				
- big	(35)	(2)	(6)	(10)
- small	(102)	(5)	(8)	(13)
Rural primary Spanish-Aymara	194	10	5	8
Rural primary Spanish- Quechua	150	7	6	10
Rural primary Spanish	124	6	4	6
Rural secondary	39	2	1	2
T o t a l	2.023	100	63	00

Source: See text

* Comprehends all schools in the Departments of La Paz, Oruro, Cochabamba and Santa Cruz

** Schools that have at least one primary class and one secondary class appear in both primary and secondary strata

Table III

A Comparison by Strata of the Percentage Distribution of Enrolment
and the that of the ECIEL Sample*

Stratum	1st Grade Popul.	ECIEL Sample	4th Grade Popul.	ECIEL Sample	6th Grade Popul.	ECIEL Sample	12th Grade Popul.	ECIEL Sample
Urban public primary	45	34	65	33	73	28		
Urban public secondary							57	21
Urban private primary**	7	28	10	32	17	51		
Urban private secondary**							43	71
- big							(22)	((37)
- small							(21)	(34)
Rural primary Spanish-Aymara	25	16	13	14	5	10		
Rural primary Spanish-	11	9	6	10	2	7		
Quechua	12	13	6	11	3	4		
Rural primary Spanish							0	1
Rural secondary								
T o t a l	100	100	100	100	100	100	100	100

Source: See text

* Schools enrolment in four Departments: La Paz, Cochabamba, Oruro, and Santa Cruz

** Including pupils of the schools run by state consortiums.

In the two stages of sampling, we have narrowed our investigation to the use of uniform sampling fractions. In particular, the sampling fraction varies across the strata of schools. For example, in Table II we can notice that the private schools are over-represented. Hence in some of our estimates below we have made allowance for corrections in the weights because of the non-uniform character for our sampling fractions.

Admittedly, the structure of our sample is rather skew, and this may cause some estimation problems.[7] However, complex sample structures are not uncommon in observational studies of human populations. Frequently, budget constraints together with the objective of obtaining information on a wide variety of (relevant) experiences preclude more straightforward forms of obtaining information.

The Table II and III compare the ECIEL sample design with the population structure.

[7] Although less severe than they might appear at first glance.

III. Educational Production Function Estimate

A. Model Specification and Estimation

Educational model of the following formula have been estimated:

(1) $y_{is} = x^{(1)}_{is} \beta_1 + x^{(2)}_{is} \beta_2 + u_{is}$ $\quad i = 1, 2, ..., N_s$, $\quad s = 1, 2, ..., S$

Where $x^{(1)}_{is}$ is a p-q dimensional (row) vector of family background variables of pupil i in school s; $x^{(2)}_{is}$ is a q-dimensional (row) vector of school variables for the same pupil; y_{is} is the observed dependent variable that will be alternatively achievement in reading and in science, or over-age; u_{is} is a random term that we will suppose normally distributed with mean zero and variance σ^2 for all i and all s.[8] β_1 and β_2 are the corresponding vectors of unknown parameters. Notice that the unit of observation is the individual student.

It is well known that under the given hypothesis for the disturbances terms, the likelihood ratio test for $\beta_2 = 0$ leads to a central F distribution with (q, N-p) degrees of freedom where

$$N = \sum_{s=1}^{S} Ns$$

Note that p is the number of explanatory variables (including the constant term) and q is the number of school variables.[9]

Thus the analytical tool to test our main proposition, namely that school effects are important, will be based on F-statistics, derived from two separate regressions: the first one is estimated without the school variables while the second is estimated with family background variables and school variables.

The aforementioned test has been used extensively in the Coleman report. Its use has been however criticized on the grounds that the order in which the variables are entered affects the results because of collinearity between the family variables set and school variables set. See in this point e.g. Bowles.

The definition of the dependent variable deserves more discussion. Since the educational models are to be estimated for <u>each grade</u> of those included in our sample (i.e. the 1st, 4th, 6th and 12th), no other index of over-age is needed than <u>the age of a pupil for a given grade</u>.

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[8] This hypothesis is very stringent in view of the fact that some schools may possess special characteristics that are not included explicitly in the model. Thus the disturbance term could vary across schools. This problem has been discussed in Morales.

[9] The technical details for the derivation of F-Statistic can be found in Seber or Kmenta. A more intuitive approach to the test can be couched in terms of the increment i the determination coefficient R^2, that results from adding school variables to a model that does not include them. If the increment is substantial, the statistic F will take values far away from 1 and lead possibly to the rejection of the null hypothesis $\beta_2 = 0$. The F-Statistic and the determination coefficient are related by the following formula:

$$F = \frac{R^2_0 - R^2_1}{1 - R^2_0} \cdot \frac{n-p}{q},$$

Where R^2_0 and R^2_1 are the coefficients of determination for the model including all variables and the model excluding school variables, respectively.

When y_{is} represents the test scores only the raw score has been retained; this quantity varies between 0 and 40.

The regressions have been run by stratum, and also by aggregating the strata in two basic different categories: urban and rural. In the latter case no weighing has been undertaken on the grounds that this simpler procedure, although less efficient than the alternative one of weighing, nevertheless furnished unbiased estimates. The number of schools in each stratum or category imposes an upper limit to the number of school variables that can be used in a given regression specification.

It can be shown that a necessary condition for the identification of the $ß'_s$ is given by $S \geq q-1$ (See Morales and Pinell, or Morales. This explains why, in our estimations, the number of school variables varies from one regression to another.

B. The Impact of School Resources

The following hypothesis have been tested using the method described above:

H1: School resources are important in the determination of over-age

H2: School resources are important in the determination of achievement in reading and science.

The pertinent F-statistics are summarized in Tables IV and V.

Table IV

F - Values to Test Hypothesis H1 (Degrees of Freedom are in Parenthesis)
F - Values

	Rural Schools	Urban Public Schools	Urban Private Schools	Urban Schools Data
1st Grade	3.3526* (11.145)	2.5526* (9.127)	5.0448* (7.103)	4.0608* (13.246)
4th Grade	1.6007 (11.156)	1.5924 (9.150)	5.5663* (7.147)	3.5010* (14.314)
6th Grade	5.5863* (6.103)	1.9490 (8.142)	1.7991 (13.270)	2.5053* (14.434)
12th Grade		5.8740* (4.90)	a) 7.1940* (7.124) b) 0.6412 (5.111)	3.6255* (14.350)

Source: See text
* Significant at the 5% level
a) Small schools
b) Big schools

It appears from those tables that school characteristics and teachers significantly affect children, not only regarding cognitive achievement but also in the over-age question, in most of the cases. Our results can be partially explained by the great heterogeneity of the school system in Bolivia. However, it is quite surprising that the effectiveness of the school variables has

been corroborated even within homogeneous strata. It is also possible that the school variables are better proxies for family conditions than the proxies that we have used, and hence, the high explanatory power of the former. In other words, the type of a school that a given child attends, is more informative on family background than the used proxies. If this last statement is true, we cannot identify the proper school effects.

If our family variables are sufficiently informative (a crucial assumption), we have then that the proposition that school variables (including teacher characteristics) are important cannot be falsified by the data. But our results are definitely less precise in the identification of which school variables are crucial, or which teacher characteristics make them good. Our main conclusion concerns school influences taken as a whole, and says little about the particular influences of individual variables.

Table V

F - Values to Test Hypothesis H2 (Degrees of Freedom are in Parenthesis)
F - Values

	Rural Schools		Urban Public Schools		Urban Private		Urban Schools	
	Reading	Science	Reading	Science	Reading	Science	Reading	Science
4th Grade	4.2259* (11.153)	5.0912* (11.153)	0.9238 (9.148)	1.9300* (9.148)	2.8249* (7.145)	6.456* (7.145)	3.3818* (14.323)	4.6960* (14.323)
6th Grade	2.0338 (6.100)	1.3483 (6.100)	2.6545* (8.140)	5.3831* (8.140)	4.3745* (13.268)	4.2910* (13.268)	6.3597* (14.432)	4.9461* (14.432)
12th Grade			1.8693 (4.880)	0.8553 (4.880)	a) 0.8447 (7.115) b) 0.8244 (5.109)	4.1316* (7.115) 3.6676* (5.109)	3.8059* (14.348)	3.8704* (14.348)

Source: See text
* Significant at the 5% level
a) Small schools
b) Big schools

C. Findings for the Explanatory Variables

Complete results on the regressions appear in Morales and Pinell. Our assertions below concerning some numerical values of estimated coefficients can be verified in that reference. Summaries of the sign pattern and precision levels of the estimated coefficients of the main explanatory variables appear in Tables VI to VIII. It should be stressed that only a subset of the explanatory variables is examined in the latter tables, namely, those that we have considered important ex-post.[10]

[10] In an explanatory study like ours, without a strong theoretical base, this might not seem too unnatural.

A list of selected variables for the interpretation of Tables VI to VIII appears below:

Sex:	Sex of pupil, 1 for boys and 0 for girls
Age of Student:	Age of pupil
Nobas:	Number of brothers and sisters
Mother Educ.	Education of the mother of the student. An ordinal variable with 1 = no studies; 2 = primary; 3 = secondary; 4 = college educated
F R R E N P	Frequency in reading newspapers in the pupil's family. An ordinal variable with 1 = never; 2 = sometimes; 3 = always
Height:	Height of pupil
RD Score:	Reading score
Teach Age:	Age of the teacher
Teach Stu:	Training of the teacher. An ordinal variable with 1 = incomplete primary; 2 = complete primary; 3 = secondary or teacher training school incomplete; 4 = secondary; 5 = teacher training school graduate; 6 = college incomplete; 7 = college graduate.
Teach Salary:	Hourly salary of the teacher
ED Teach Fat:	Education of the teacher's father
Principal Qualf:	Training of the principal. An ordinal variable with 1 = no formal training; 2 = college degree; 3 = teacher training school degree; 4 = college degree in education; 5 = graduate studies.
Expend per Stu:	Expenditure per student
Stu Teach Ratio:	Student teacher ratio
School Size:	School size

Although our results are not as sharp as we could have wished, we can however sketch some of our general findings.

Among the pupil demographics and family background characteristics, two variables stand out in the explanations of over-age (or its absence) and cognitive achievement: the pupil's sex and the education of the mother, Boys generally do better than girls, and better educated mothers generally have children with higher cognitive achievement.

On the other hand, none of our proxies for family income, including parental occupation, yielded significant results. On this point further research is clearly needed.

Table VI

A Summary of the Effects of the Main Variables in the Over-Age Equations[a]

Main Explanatory Variables	1st Grade			4th Grade			6th Grade			12th Grade		
	Rural	Urban Public	Urban Priv.	Rural	Urban Public	Urban Priv.	Rural	Urban Public	Urban Priv.	Rural	Urban Public	Urban Priv.
Sex	?	?	?	?	?	?	?	?	--	?	?	--
Nobas	++	?	?	?	?	?	?	?	++	?	?	?
Mother Education	?	-	?	?	?	?	?	?	?	-	--	?
F R R NP	++	?	?	?	?	?	?	?	?	?	?	?
RD Score		NA	?	?	?	?	--	?	?	?	--	?
Teach Age	NA		++	?	?	++	++	?	?	NA	?	--
Teach Stu		?	?	?	++	--		?	?	++	?	--
Ed Teach Fat	?	?	NA	?	--	NA	++	?	+	NA	NA	?
Teach Salary	?	?	?	?	+	?	NA	?	?	NA	NA	NA
Principal Qualf	--	?	NA	?	NA	NA	NA	?	?	NA	NA	NA
Expend per Stud	?	?	?	?	+	--	NA	?	--	?	?	?
Student Teach Ratio	?	+	++	?	?	+	++	?	?	+	?	--
School Size	?	?	--	?	?	?	?	?	?	--	--	?
	?	?					?					
	?											
R - Squared	0.29	0.26	0.27	0.28	0.23	0.34	0.33	0.21	0.23	0.34	0.20	0.42
No. of Observations	270	149	124	181	174	169	123	165	298	109	131	138
No. of Explanatory Variables in Equation	23	21	19	25	22	20	13	21	26	17	18	20

[a] Notation: ++ = Positive Coefficient, significant at the 5% level
+ = Positive Coefficient, significant at the 10% level
-- = Negative Coefficient, significant at the 5% level
- = Negative Coefficient, significant at the 10% level
? = No definite effect of explanatory variable
NA = Not available

Expenditure per student plays an important positive role in many cases; this is especially true for the urban schools, public or private. But student teacher ratios do not affect children significantly. We underline the fact that this variable is crucial in any cost minimization policy. More specific findings concerning the various strata are commented below.

Table VII

A Summary of the Effects of the Main Variables in the Regarding Achievement Equations[a]
Equations

Main Explanatory Variables	4th Grade			6th Grade			12th Grade		
	Rural	Urban Public	Urban Priv.	Rural	Urban Public	Urban Priv.	Rural	Urban Public	Urban Priv.
Sex	?	++	++	?	+	+	?	?	?
Age of Student	?	?	?	--	?		?	--	?
Nobas	?	?	?	?	?	?	?	-	?
Mother Education	?	?	?	?	?	?	?	?	++
F R R NP	++	?	?	?	?	?	?	?	?
RD Score	?	?	++	?	?	?	?	?	+
Teach Age	?	?	?	?	?	?	NA	?	
Teach Stu	--	++	+	?	?	?		?	?
Ed Teach Fat	?	?	NA	NA	--	?	?	NA	?
Teach Salary	?	NA	++	NA	++	?	?	NA	NA
Principal Qualf	?	?	NA	NA	NA	?	NA	NA	?
Expend per Stud	?	?	++	?	++	++	?	?	NA
Student Teach Ratio	?	?	?	?	?	++	?	?	?
School Size	?	?	?	?	?	?	?	?	?
						?	?		?
R - Squared	0.33	0.20	0.28	0.28	0.23	0.33	0.21	0.16	0.22
No. of Observations	181	174	169	123	165	298	109	131	139
No. of Explanatory Variables in Equation	26	24	22	21	23	28	19	20	22

[a] Notation: ++ = Positive Coefficient, significant at the 5% level
+ = Positive Coefficient, significant at the 10% level
-- = Negative Coefficient, significant at the 5% level
- = Negative Coefficient, significant at the 10% level
? = No definite effect of explanatory variable
NA = Not available

Table VIII

A Summary of the Effects of the Main Variables in the Over-Age Equations[a]

Main Explanatory Variables	4th Grade			6th Grade			12th Grade		
	Rural	Urban Public	Urban Priv.	Rural	Urban Public	Urban Priv.	Rural	Urban Public	Urban Priv.
Sex	++	?	+	?	++	?	+	--	+
Age	?	?	?	?	?	?	?	++	++
Nobas	?	++	?	?	++	?	?	?	?
Mother Education	++	?	?	?	++	?	?	?	?
F R R NP	?	?	?	?	?	?	?	?	?
Height	?	?	++	?	?	?	-	?	?
Teach Age	?	?	?	?	?	?	NA	++	++
Teach Stu	?	?	?	?	?	?	?	--	?
Ed Teach Fat	++	?	NA	NA	?	?	NA	NA	NA
Teach Salary	?	?	++	NA	-	?	NA	NA	++
Principal Qualf	?	NA	NA	NA	NA	++	NA	NA	NA
Expend per Stud	--	++	++	?	?	++	?	++	++
Student Teach Ratio	--	?	++	?	++	?	?	--	--
School Size	?	+	?	?	?	?	?	NA	NA
R - Squared	0.44	0.26	0.33	0.23	0.34	0.26	0.22	0.45	0.38
No. of Observations	181	174	169	122	165	298	109	131	139
No. of Explanatory Variables in Equation	26	24	22	21	23	28	19	21	23

[a] Notation: ++ = Positive Coefficient, significant at the 5% level
+ = Positive Coefficient, significant at the 10% level
-- = Negative Coefficient, significant at the 5% level
- = Negative Coefficient, significant at the 10% level
? = No definite effect of explanatory variable
NA = Not available

1. Findings for the Rural Schools

The main results in the rural schools, as they appear in the regressions, pertain to the following variables:

i) The fact of having one of Indian languages as a mother tongue does not seem to have an incidence on over-age or in scholastic achievement.[11] The over-age phenomenon and the poor scores in reading and science are due to the students being in rural schools, regardless of the language spoken at home. (All the teaching is done in Spanish).[12]

ii) The number of siblings affects average only in the case of first graders; an additional brother or sister causes 0.1359 years of over-age (standard deviation is 0.0636). In the higher grades there is no significant incidence of this variable, either in over-age or in cognitive achievement.

iii) The education of the pupil's mother plays a crucial explanatory role in the other strata of our sample, as will be seen below. But this variable is not significant in the case of the rural schools, either in the over-age regressions or in the achievement ones.

[11] However, there is some evidence of late arrival at school of first grades in the aymara zones. These results are reported in Morales and Pinell.

[12] In a regression run only with family variables, the language variables were significant in several cases. Quechua speaking students in the 4th and 6th grades presented less over again than the Spanish and Aymara speaking students in the same grades.

iv) The frequency of reading newspapers has ben used among the variables to proxy the cultural environment of the pupil's family. Surprisingly, this variable has resulted significant and with right signs in the achievement regressions, with the notable exception of reading for 6th graders.

v) The variables pertaining to the teacher and to the principal present some unexpected features in both the over-age and the achievement variables.

Better trained or more experienced teachers signify more over-age students. A plausible explanation of this result is that the better trained teachers have more rigid criteria for promoting the students from one year to the next. But should the same explanation be valid for more experienced teachers? There is of course a problem with the assumed cardinality of the variable pertaining to the training of the teacher in the regression runs.

Similar comments to the ones above can be made about the principal's training and experience. Furthermore, the influence of the principal is notable even in the first grade. There it seems that age is used by experienced principals as a rationing device for the number of places that the school can offer to entering students.

Better trained and more experienced teachers do not seem to positively affect the scores in achievement. If this statement cannot be falsified by further empirical evidence, we would have the important implication that investment to up-grade the teach training schools will not substantially affect cognitive skills in the rural areas.

vi) The presence of material facilities such as benches for everybody blackboards, and so on, are significantly and negatively related to over-aging. The better the conveniences the lesser the backwardness. But if we examine the expenditure per student, we notice that it does not appear significant except in the 6th grade, and here more expenditure per student leads to an increase in over-aging.[13] In fact, given the weight of salaries in total expenditure, the aforementioned result is not surprising. High levels of expenditure per student as well as low student teacher ratio can be associated with low overall levels of efficiency. Hence the backwardness associated with high expenditure levels and low student teacher ratios.[14]

In many rural schools the constraining factor seems to lie in the material facilities, while the mixture of inputs does seem to have the right proportions.

2. Findings for the Urban Public Schools

The main features revealed by the regression runs are the following:

i) In the over-age equations, there are only two noticeable significant variables among the pupil's demographics and family background variables. Namely, the mean age of the parents, and the mother's education. Older parents tend to have children who present greater school backwardness. Regarding the education of the pupil's mother, we notice that there is less over-aging when the mother is better educated; this is noticeably true for first graders.

[13] We may note incidentally that low student teacher ratios are conductive to more backwardness.

[14] The result pertaining to the influence of the school variables in the determination of achievement are rather erratic. We have precise estimates for the 4th grade only, and they seem to corroborate mutatis mutandis our inferences regarding efficiency in our analysis of over-aging.

ii) Sex is an important variable in explaining achievement. In all the cases where the coefficient was significant it had a positive sign (the omitted variable designated girls), meaning that boys do better than girls. In reading, boys in 4th grade obtain 1.4 points more (standard deviation 0.7) than girls; boys in the 6th grade obtain 1.5 points more) with standard deviation of 0.9); in the 12th grade girls do better than boys but the coefficient is affected by a large standard deviation that precludes any reasonable conclusion. The pattern is somewhat less definite in the science scores: the boys obtain 2.1 points more (standard deviation 0.7) than girls in the 6th grade, and 6.3 points more in the 12th grade (standard deviation 4.9).[15]

iii) The parental occupation variables do not seem to greatly affect the relative backwardness. Neither do the other proxies used for incomes.

iv) Teacher characteristics are important in the explanation of backwardness. We have found a significant positive relationship between higher training of the teacher and over-age; that is, the more educated the teacher the more likely the over-aging.

This result, analogous to be one found in the rural schools, is indeed surprising. Our regressions suggest that besides the training and experience of the teacher, other personality traits should be included. We have found, for example, that the occupation of the teacher's father was significant in the explanation of backwardness: the better educated the teacher's family, the less backwardness is observed in his pupils.

v) No significant effect was found concerning the presence of material facilities. We also found that only in a few cases was the expenditure per student significant. However, when this latter variable had a noticeable impact, the signs were correct. For example, under the ceteris paribus clause, an additional thousand pesos expenditure produced an increase of 8.6 points (s.d. 3.3) in the 6th grade reading scores. Similarly, an additional thousand pesos expenditure produced 4.7 more points (s.d. 1.5) in the science scores in the 4th grade. The student teacher ratio is not significant generally.

vi) In the achievement regressions, if the coefficients pertaining to the school size are significant, they have a positive sign, thus showing that in the bigger public schools students obtain better scores, ceteris paribus.

3. Findings for the Urban Private School System

The main characteristics found are:

i) Family variables are not important at the low levels of schooling, but they are at the higher levels. This result can be explained by the fact that in the primary schools children exhibit more or less homogeneous characteristics with regard to family background. But, at the higher levels there is more heterogeneity, as many children who start school in the public system transfer themselves to the private system for their secondary education.

The education of the mother appears as significant in explaining over-age in the 12th grade of small private schools. The contribution of the variable for the number of siblings is also important in over-age in the 6th grade. An additional brother or sister causes, ceteris paribus, 0.08 years of backwardness (s.d. 0.03).

[15] Incidentally our results confirm the widely held opinion in Bolivia that the teaching of science is very poor, and that it is specially poor for girls. There is indeed some sexism in this neglect.

The aforementioned variables do not seem to matter in the achievement equations. In the latter, the only important demographic variable is sex; boys obtain generally better scores than girls in primary schooling. For example in the 4th grade, boys obtain 3.25 (s.d. 1.44) points more in reading and 1.9 (s.d. 1.1) points more in sciences than girls. In the 6th grade, boys obtain 1.6 (s.d. 0.76) more points than girls. No important inference concerning achievement can be drawn from the 12th grade data.[16]

ii) Among the teacher characteristics we notice that age is an important explanatory factor for backwardness. At the lower levels of schooling backwardness increases with the age of the teacher, whereas in the higher levels the opposite phenomenon is observed.

The effect of the variables pertaining to the education of the teacher is estimated with precision only in the 4th and 12th grades of the small private schools. In both cases the sign of the coefficient of these variables in the over-age runs is negative. This means that, at least in those cases, the teacher qualifications are an important explanatory factor of over-age.

Concerning achievement, we obtain a clear picture of the effects of the teacher characteristics only in the 4th grade. There, we may observe that the training of the teacher is positively associated with the scores: an additional degree in his training results, ceteris paribus, in 4.09 (s.d. 2.4) points more in reading for his students. Furthermore, the scores are better the younger the teacher, and the greater his hourly salary.[17]

Regarding this latter point, let us mention that an additional 10 pesos in the hourly salary means, all things being equal 5.2 (s.d. 2.9) points more in reading, and 7 (s.d. 2.2) points mote in science for his students.

iii) The effect of the specific school variables, such as the expenditure per student and the student teacher ratio, is neat mainly for the 4th grade in the over-age equations as well as in the achievement ones. Less over-age is associated with more expenditure. Concerning achievement, we notice that, all other things being equal, better scores in reading and science are associated with more expenditure per student. In the 4th grade, a thousand additional pesos improves, ceteris paribus, the reading score by 4.2 points (s.d. 1.4), and the science score by 2.5 (s.d. 1.0). In the 6th grade, those marginal values are 2.5 (s.d. 0.8) and 1.7 (s.d. 0.7) for reading and sciences respectively. In the 12th grade, significant results are obtained only for science, where the respective marginal coefficients are an astonishing 15.1 (s.d. 2.91) for the traditional core of private schools, and 2.1 for the small private schools.

A high student teacher ratio is associated with more backwardness in the 4th grade (and also in the 1st. grade). The influence of this variable in the achievement scores is highly uncertain.

The variable size of the school does not have any noticeable effect either in the backwardness phenomenon or in the achievement scores.

iv) The qualifications of the principal of the school are important to the explanation of the achievement scores in reading as well as in science. The better qualified the principal

[16] In the traditional core of private schools we have an estimate of 3.9 (1.79) more points in science of girls than boys. We do not attach much importance to this result since the test scores for the 12th grade exhibit a low mean and a low variance that preclude any important inferences.

[17] It is important to note that better payment for the teachers is usually associated with higher academic quality in a school. The higher hourly salary is a representative element of a complex set of characteristics that make a (private) school good.

the better the scores. Unfortunately, due to data limitations (see above), the variables pertaining to the principal were included only for the 6th grade.

IV. Costs and Achievement

Bolivia exhibits a very heterogeneous picture concerning school endowments as well as school results, as we have seem. Our system runs the gamut from rich private schools to small rural schools with a handful of students and scarce facilities for the students. Table IX gives an overall view of the cost structure of the different types of schools considered.

Table IX

Mean Costs and Mean Achievements according to Type of School and Level
(In Bolivian Pesos, 1 U$ = 20.40 Bolivian Pesos)

	Urban			Rural			
	Total	Private	Public	Total	Only Spanish	Spanish Aymara	Spanish Quechua
All Levels							
Total cost per pupil	2.411	2.639	2.262	2.227	1.702	2.739	2.419
Operating cost per pupil	1.683	1.580	1.716	1.983	1.622	2.322	2.123
Capital cost per pupil	728	1.059	444	244	80	417	296
No. of students per school	453	675	477	193	311	138	171
No. of students per teacher	21.2	23.6	21.2	15.4			
First Grade							
Total cost per pupil	2.275	2.646	1.862	1.919	1.702	1.982	2.450
Operating cost per pupil	1.523	1.405	1.568	1.766	1.622	1.696	2.287
Capital cost per pupil	752	1.241	295	153	80	285	163
No. of students per school	419	789	393	194	311	129	144
No. of students per teacher	22.6	27.3	21.1	16.9			
Fourth Grade							
Total cost per pupil	13	16	11	9	10	9	7
Operating cost per pupil	2.268	2.646	1.910	1.908	1.702	1.982	2.346
Capital cost per pupil	1.535	1.405	1.603	1.755	1.622	1.696	2.180
No. of students per school	734	1.241	306	153	80	285	166
No. of students per teacher	405	789	387	182	311	129	119
	22.6	27.3	20.7	16.9			
Sixth Grade							
Total cost per pupil	13	15	12	9	10	9	8
Operating cost per pupil	2.477	2.769	1.880	2.429	1.931	3.237	2.333
Capital cost per pupil	1.699	1.631	1.687	2.222	1.890	2.825	2.113
No. of students per school	779	1.139	193	204	41	412	220
No. of students per teacher	526	840	516	225	322	146	225
	20.1	23.3	21.6	11.8			
Twelfth Grade							
Total cost per pupil	17	18	14	12	--	--	12
Operating cost per pupil	2.763	2.744	2.841	2.700	--	--	2.700
Capital cost per pupil	1.732	1.666	1.960	2.000	--	--	2.000
No. of students per school	1.031	1.078	811	700	--	--	700
No. of students per teacher	627	694	519	230	--	--	230
	21.9	23.2	18.3	15.3	--	--	

Source: ECIEL Survey

The higher costs per student in the private schools reflect the higher capital cost per student of those schools. The high capital cost has a double source: higher quality equipment,

and a low utilization of the installed capacity. The phenomenon of low capacity utilization appears also in the rural schools. On the other hand, the urban public schools work with two or three "shifts" of students, holding classes for separate groups in the mornings, afternoons, and in some cases in the evenings.

We may also observe in the same table the private schools are more efficient than the public schools, urban or rural, in what concerns operating costs.

The main factor in explaining the observed difference of operating costs lies in their different student teacher ratios. The school that exhibit higher operation costs also have lower student teacher ratios. It should be noted that the highest student teacher ratios are associated with the bigger schools.

An inspection of Table IX also reveals that higher operating costs per student are not associated with higher mean scores in reading.[18]

In fact, the ordering of the mean test scores is in inverse relationship to that of the operating costs, and this applies to all grades.

We have already mentioned that the student teacher ratio is a crucial variable in the explanation of operating costs. In regressions where the operating cost has been used as a dependent variable against a host of school characteristics, the student teacher ratio has proved to be highly significant. An increase of one student per teacher causes a decrease of 27.57 (s.d. 6.3) pesos per student in operating costs.

Another feature that appears on examination of the operating costs concerns the rural condition. The rural schools have ceteris paribus $b. 607 (s.d. 152.3) more operating costs per student than their urban counterparts.

School size does not seem to influence unit operating costs in a significant way. The teachers salaries merit a special mention within the operating costs.

We have found that the most important factor in explaining salary scales is age, which is itself closely associated with seniority. On this point there is not a noticeable difference between the private and the public schools. We have found, however, that the salaries in the all-boys schools are significantly higher than is the all-girls or coeducational school.

Regarding the capital costs, the regression results using these quantities as dependent variables point out that the most important explanatory variables pertain to the condition of private or public. For example, the private religious-run schools have about $b. 920 more capital costs per student. We have also found that the sex composition of a school is a significant variable, with girls schools having lower capital costs ceteris paribus.

Generally speaking, all the variables that describe a school's economic conditions, like facilities for the students, laboratories, and so forth, have a marked impact on the capital cost per student.

In short, it appears from the above discussion that an efficient use of resources in the public schools can only be reached if the actual student teacher ratios can be increased. This would decrease costs without impairing the proficiency level. Furthermore, the capital cost-operating cost mix seems very inappropriate for the public schools, urban or rural. More reasonable mixtures could be obtained by changes in the rules of hiring, and payment based on seniority for teachers. This reform should be accompanied by more investment in the material facilities of the schools. Private schools are substantially better endowed in facilities than their public counterparts. At the same time the former have lower operating costs than the latter,

[18] The mean reading test score has been taken as representative of the mean quality throughout schools of the same subsystem.

suggesting a better school resources mix. Still, it must be said that many private schools operate at a low level of capacity utilization.

The school system clearly discriminates against the rural children, not only in the sense that it does not compensate for the advantageous family conditions of these children, but also because the rural school facilities are precarious, relatively and absolutely i.e. vis-à-vis the urban schools. In fact, the high drop-out rates in the rural areas can be explained by partly the constraint in the supply of places that the government has decided to make available. Not only are resources very scarce in the rural schools, but there are furthermore some gross efficiency problems, such as the exaggerated share which salaries take in the total costs.

One last point to emphasize is the importance of the principal's qualifications and experience in the management of the educational costs. It has been found that the better qualified the principal the less the operating costs; each additional degree in a principal's qualifications represents, all other factors being equal $b. 150 off operating costs. It also results that the more experienced the principal the more able in decreasing costs.

V. Equity and Efficiency

Besides the considerations of efficiency made above some further comments concerning the equity aspects are called for.[19]

Given the extremely high drop-out rate in the Bolivian school system, one of the most important questions in educational research concerns the degree of selectivity of the system, and the tendencies toward greater access for children from the pooper segments of the population to higher levels of scolarity. Indeed, the search for reasons why pupils end their school life before the statutory requirements, or before what has been established in educational development plans, as well as what makes students complete all the grades, is one of the most important investigations that can be undertaken.

Unfortunately, with our data base including only children that are in school, we cannot directly find out the causes for dropping out of the school process. However, the family and social characteristics of those who stay in the school system furnish us indirectly with information upon those who have left it. We can do this by comparing the composition in the different selected school levels, according to a given social or family characteristic.[20]

We may consider the composition and the evolution, below, of enrolment shares in the 1st, 4th, 6th and 12th grades in accordance with paternal occupation status.

A more detailed examination of the evolution of the enrolment shares throughout the school process, taking into account the rural, urban public, and urban private strata reveals some important characteristics.

In the rural schools we remark that the share of students whose parents belong to Category 6 remains practically constant during the whole primary cycle.[21] Concerning the public urban schools we see that they exhibit a pattern of the shares that is slightly more egalitarian that the pattern for the whole system.

The table of percentage distribution of enrolment in the private urban schools shows that they are more elitist than the other types of schools from the very beginning, but that, on the other hand, the drop-out rates are lower in the former than in the latter for children of a low paternal occupation level.

We acknowledge that the private schools are elitist but still, they are less so than is commonly believed. We can see that they admit a broad spectrum of children regardless of social origin. Nevertheless, the traditional core of private schools is definitely more elitist than the small private school system, as can be confirmed from an inspection of the relative shares of enrolment in the 12th grade.

The fact that there is more uniformity in the enrolment shares throughout the school

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[19] In our discussions in Section III, there were implicit considerations on equity, especially in our treatment of the over-age variables.

[20] On this point we follow a suggestion of Castro. See Castro.

[21] The data on rural secondary schools was totally unreliable. The share of Category 6 in the considered levels of primary school seems too low. We are possibly in presence of gross underestimation and misreporting by the children interviewed. Generally speaking, there is still another source of underestimation of the degree of selectivity of the system when we realize that the school ar different moments in time. There is a lapse of eleven years, for example, between the entrance of first year pupils and twelfth grade students. During that period the occupational structure of the population may have changed, with an increase in the proportion of higher status occupations.

process when considering the three subsystems separately, rather than as a whole, suggests that the critical sector for any policy of equalization of school opportunities is to be found in the rural sector. The drop-out and repetition rates are indeed the highest in this sector.

Table X

Percentage Distribution of Enrolment According to Paternal Occupation Status

Paternal Occupation Status	1st Grade	4th Grade	6th Grade	12th Grade
1. Upper echelon civil servants; big business managers and owners; liberal professions	2.58	5.50	7.68	18.53
2. Lower echelon mangers; small businessmen	3.06	6.33	8.39	17.17
3. Clerks and non-manual employees	6.76	12.32	18.04	12.76
4. Supervisors of manual work and similar occupations	14.06	10.44	15.06	16.91
5. Skilled manual workers and similar occupations	30.37	31.27	30.55	20.08
6. Farm laborers, peasants, and non skilled urban workers including domestic servants	43.17	34.14	20.28	14.55
T o t a l	100.00	100.00	100.00	100.00

Source: ECIEL Survey

Table XII

Percentage Distribution of Enrolment According to Father's Education

Father's Education	1st Grade	4th Grade	6th Grade	12th Grade
1. No studies	21	20	8	4
2. Primary	52	29	26	35
3. Secondary	20	24	39	36
4. College	7	27	27	25
T o t a l	100	100	100	100

Percentage Distribution of Enrolment According to Mother's Education

Mother's Education	1st Grade	4th Grade	6th Grade	12th Grade
1. No studies	40	35	19	12
2. Primary	44	30	30	45
3. Secondary	14	19	37	38
4. College	2	16	14	5
T o t a l	100	100	100	100

Source: ECIEL Survey 1975

Finally, if we consider the evolution of the enrolment shares according to parental education as indicated in Table XII, we notice that the school life of a given child is also closely related to the father's educational level. We may also remark that completion of the school cycle is predictable if the mother completed her primary education.

VI. Conclusions

By way of conclusion, it may be appropriate to comment again on our main results:

1) School characteristics are important factors in the explanation of both cognitive achievement and the over-age phenomenon.
2) Public schools operate at low levels of efficiency, and there is ample room for improvement without substantial additional costs.
3) Bolivian schools are potentially an effective instrument for achieving equality of opportunities. But as they stand now, they are quite far from this egalitarian objective. In particular, the school system discriminates heavily against the rural school population.

The first conclusion has theoretical and practical relevance. The other conclusions have more policy overtones, and will be discussed below together with the policy implications of our first result.

With respect the first conclusion, we emphasize that it is conditional upon our specifications of the education models and the tests used, and that, possibly, it is not robust vis-à-vis other model specifications. This remark is especially pertinent in view of the absence of an accepted theory of the learning process. Furthermore, our first result is rather general; for the more specific education on school factors we note that the production function or the demand-for-education function research program does not seem to be as fruitful as might have been excepted at the outset. Indeed, the results of our research concerning those functions are quite unstable. The signs and magnitudes of the coefficients and their statistical significance change from one grade considered to the next, and from one stratum to another.

The trouble lies in the explanatory nature of our research. There is a lack of an underlying theory. Even with a carefully designed questionnaire, a good sample design, and ideal conditions of application of the tests, it is difficult to capture the features of school facilities and the personality traits and abilities of both the teacher and the pupil that make the school an effective institution. Particularly, additional information is needed on the cognitive skills and the achievement motivations of the teachers. The information on their formal education is not sufficient. Furthermore, the literature has shown that the influences of all the teachers that one child has had must be considered and not only the impacts of the particular teacher that is associated with the child at the moment of the interview.[22] Attempts to obtain this type of information do not appear feasible in Bolivia.

But, after all the warnings given above, what has remained from studying the influence of schools? First, in clearly identifying some problems and some crucial variables, we have laid the basis for further research. Second, and here we impinge upon some policy implications, our results show that schools deserve a better understanding from authorities and from the public, and they must be better understood by educational researchers.

Our research suggests that, for better or worse, schools do matter, in the process of cognitive (and economic) development. Furthermore, the research confirms that valid efforts to improve their quality should not wait for sweeping social reforms. This last remark is the more pertinent since lately, Bolivian schools have had to respond to attacks in the press, and that many Bolivian educators favor now alternative instruments to schools for education (like the so called non-formal education).

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[22] See e.g. Hanushek.

Since schools are important, one has to look for means to improve their efficiency. Our research suggests that some policies of limited scope, like higher student-teacher ratios, mote capital expenditure per student, and better training in management for principals can improve substantially the cognitive skills of children, reduce the number of over-age students and, possibly, diminish the number of drop-outs.

Substantial increases in the investment in school facilities are required in the rural areas to compensate for their long neglect. At the same time, the design of curriculae and of the internal policies for the rural schools should follow radically different patterns and evaluation norms from those of the urban schools, in order to reckon with the cultural deficiencies of peasant children.

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