The Indigenous Test Score Gap in Bolivia and Chile

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I. Introduction

The four most common indigenous languages in South America are Quechua, Aymara, Mapudungun, and Guaraní (Grinevald 1998). The two countries analyzed in this article—Bolivia and Chile—have large numbers of each linguistic minority. In Bolivia's 1992 census, 1.8 million Bolivians acknowledged some facility in Quechua, 1.2 million in Aymara, and 70,000 in Guaraní or another indigenous language (see table 1). In Chile's 1992 census, almost 1 million identified themselves as Mapuche, although it is not clear how many actually spoke the language of Mapudungun. Another 70,000 identified themselves either as Aymara or belonging to another indigenous group.

This article is concerned with the academic achievement of indigenous children. For several reasons, their achievement is probably lower than that of nonindigenous children. First, indigenous parents typically have less formal schooling and lower earnings than other adults (Psacharopoulos 1993; Psacharopoulos and Patrinos 1994; Chiswick, Patrinos, and Hurst 2000). Both are common measures of the quality of the educational environment in the home. Second, indigenous families are more likely to live in rural areas or poor urban areas, where public schools may have fewer and lower-quality instructional resources. Third, schools have usually ignored and occasionally punished the use of indigenous languages (Comitas 1972; Plaza and Albó 1989; Herrera Lara 1999). They have also balked at modifying their instruction to accommodate linguistic diversity, although this has changed in recent years.[1]

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[1] On recent experiences with bilingual education in Latin America, see Patrinos and Velez (1995), Hornberger and King (1996), Herrera Lara (1999), and Hornberger (2000).

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TABLE 1
INDIGENOUS POPULATIONS IN BOLIVIA AND CHILE, 1992

	Number (Thousands)	Percentage of Population
Bolivia:		
Knows Quechua	1,806	34
Knows Aymara	1,238	23
Knows another indigenous language	70	2
Knows only Quechua	428	8
Knows only Aymara	169	3
Knows only another indigenous language	11	<1
Chile:		
Self-identifies as Mapuche	928	10
Self-identifies as Aymara	48	<1
Self-identifies as Rapanui	22	<1

Sources. Albó (1995) and Instituto Nacional de Estadística (1993).
Note. Bolivian data refer to the population ages 6 and over. Chilean data refer to the population ages 14 and over.

Any of these factors—alone or in concert—may drive a wedge between the mean achievement of indigenous and nonindigenous students.

Yet, there is a dearth of empirical research on the magnitude of differences in the mean achievement of indigenous and nonindigenous students, hereafter referred to as the test score gap.[2] We know even less about whether the presumptive gap is explained by differences in family attributes, in school attributes, or some combination thereof. This article analyzes test score gaps in Bolivia and Chile for three reasons. First, each country is home to a large proportion of an important linguistic minority in South America. Even though Chile has a proportionally smaller indigenous population than Bolivia and other countries (e.g., Ecuador and Peru), it is home to one of the four largest indigenous language groups on the continent. Second, Bolivia and Chile are among the few countries with recent and nationally representative data on indigenous status and academic achievement. Third, recent education reforms in each country have focused on the equitable distribution of resources and student outcomes; in Bolivia, such reforms are directly targeted at indigenous students. The magnitude and determinants of the indigenous test score gap are a pertinent input to the design and evaluation of such policies.

In order to describe the size of test score gaps in primary schools, the article uses data from Bolivia's SIMECAL (Sistema de Medición de la Calidad de la Educación) assessment in 1997 and from Chile's SIMCE (Sistema de Evaluación

[2] For an early study of Paraguay, see Rivarola, Corvalán, and Zuniga (1977). For recent studies of Bolivia and Peru, respectively, see Vera (1998) and World Bank (2001). The small amount of research in Latin America contrasts with U.S. research on the black-white test score gap (e.g., Jencks and Phillips 1998; Cook and Evans 2000).

de Calidad de Educación) assessments in 1997 and 1999. It finds a consistent gap of 0.3–0.5 standard deviations, favoring nonindigenous students. The gap is surprisingly consistent across countries, despite the different proportions of indigenous pupils. The article then decomposes the gap into several components: (1) a component based on different family attributes between indigenous and nonindigenous students, (2) a component based on different peer-group and school attributes, and (3) an unexplained component. To do so, the article uses a modified version of the Blinder-Oaxaca decomposition, commonly employed in labor economics to assess the determinants of mean wage differences between two groups. In each subject and grade level, more than half of the gap can be explained by the quality of schools or peer groups. That is, a substantial proportion of the gap can be explained by the fact that indigenous students attend worse schools, on average, with worse peer groups. A smaller but still important proportion of the gap—between 20% and 40%—is explained by the lower socioeconomic status of indigenous families. An even smaller proportion of the gap is left unexplained.

The article is organized in the following manner. Section II provides a brief overview of the size and distribution of indigenous populations in Bolivia and Chile, while Section III describes features of recent education reforms in each country. Sections IV and V review the data and method that are used to decompose the test score gap. The results are presented in Sections VI and VII, and Section VIII summarizes and concludes.

II. Indigenous Populations in Bolivia and Chile

A. Overall Population

There is no consensus regarding the appropriate definition of indigenous status. Such status is most commonly determined by whether individuals report competence in an indigenous language or whether they identify themselves as members of an indigenous group. Regardless of the definition, there is no means of ensuring that individuals provide an honest report of either measure. The most common concern is that individuals will underreport their indigenous status, owing to the lower prestige of indigenous languages (Albó 1995). Thus, population estimates are usually interpreted as lower bounds.

In Bolivia, indigenous status has been most commonly measured by linguistic competence. In the 1992 census, 34% report that they know Quechua, and 23% report knowledge of Aymara; a far smaller percentage know Guaraní or another language (see table 1). In contrast, Chilean data typically measure indigenous status by self-identification. In the 1992 census, 10% of the population identify themselves as Mapuche, and a small percentage as Aymara or another indigenous group.

TABLE 2
INDIGENOUS STUDENTS IN BOLIVIAN PRIMARY SCHOOLS

	Indigenous (%)	Quechua (%)	Aymara (%)	Dissimilarity Index	Observations
Third grade, 1997:					
Chuquisaca	42	40	1	.61	1,232
La Paz	40	3	38	.54	3,008
Cochabamba	46	44	4	.45	1,863
Oruro	39	21	24	.42	1,477
Potosí	59	57	5	.61	1,327
Tarija	5	3	1	.48	984
Santa Cruz	9	6	1	.54	1,634
Beni	2	1	1	.65	1,280
Pando	3	1	1	.53	362
National	32	20	13	.61	13,167
Sixth grade, 1997:					
Chuquisaca	27	27	0	.50	1,153
La Paz	30	4	27	.50	2,703
Cochabamba	26	25	2	.37	2,092
Oruro	35	22	20	.38	1,421
Potosí	43	43	2	.53	1,424
Tarija	4	3	1	.44	1,368
Santa Cruz	5	3	1	.57	1,672
Beni	1	0	0	.70	1,308
Pando	1	1	1	.44	281
National	22	15	8	.57	13,422

Sources. SIMECAL 1997; and author's calculations.
Note. See appendix for definitions of indigenous.

B. Primary School Populations

Among the students who attend primary schools, these percentages decline markedly. In 1997, 20% of Bolivian third graders spoke Quechua in their families, and 13% spoke Aymara (see table 2).[3] Just 15% and 8% of sixth graders spoke Quechua and Aymara, respectively. There are similar patterns of decline in Chile, where indigenous status is measured by the self-identification of a child's mother. In two rounds of data from the late 1990s, 6% of fourth graders and just 4% of eighth graders are Mapuche (see table 3).

There are two explanations why percentages are lower in primary schools than in the overall population. First, relatively younger cohorts in the population are less likely to report themselves as indigenous than older cohorts (McEwan and Jimenez 2002).[4] This may stem from a declining grasp of indigenous languages, from generational shifts in cultural identification, or

[3] See the appendix for definitions of variables used to define indigenous status in Bolivia and Chile.
[4] In a 1997 household survey, for example, 35% of individuals ages 51–60 report knowing Quechua; among individuals ages 21–30, this declines to 25%.

TABLE 3
INDIGENOUS STUDENTS IN CHILEAN PRIMARY SCHOOLS

	Indigenous (%)	Mapuche (%)	Dissimilarity Index	Observations
Fourth grade, 1999:				
Region 1	11	2	.40	6,722
Region 2	7	1	.42	8,444
Region 3	19	1	.25	4,094
Region 4	3	2	.40	9,724
Region 5	3	2	.46	24,422
Region 6	4	3	.46	12,717
Region 7	4	4	.43	15,508
Region 8	7	6	.40	30,828
Region 9	26	25	.48	13,155
Region 10	13	12	.39	13,064
Region 11	14	13	.31	1,489
Region 12	6	5	.36	2,371
Region 13	5	5	.36	93,096
National	7	6	.45	235,634
Eighth grade, 1997:				
Region 1	9	1	.40	5,527
Region 2	5	1	.47	6,474
Region 3	19	1	.23	3,561
Region 4	2	1	.48	7,609
Region 5	2	1	.52	20,774
Region 6	2	2	.51	9,955
Region 7	2	2	.52	11,831
Region 8	4	4	.45	24,986
Region 9	22	22	.50	10,569
Region 10	9	8	.40	12,084
Region 11	6	6	.37	1,239
Region 12	3	3	.43	2,328
Region 13	4	3	.41	75,452
National	5	4	.50	192,389

Sources. SIMCE 1997, 1999; and author's calculations.
Note. See appendix for definitions of indigenous. Region 13 includes Santiago.

from the greater stigma that younger cohorts attach to identifying themselves as indigenous.

Second, indigenous students are more likely than nonindigenous students to enter school late, to repeat grades, and to drop out early (Patrinos and Psacharopoulos 1996). Hence, they will be underrepresented in primary school populations relative to their overall population proportions. Table 4 reports some evidence of this phenomenon, drawing upon a Bolivian household survey. Among the youngest cohorts, a greater percentage of nonindigenous students attend school than indigenous students. The attendance gap closes—presumably as indigenous children enter school late—but then widens as indigenous children leave school after the age of 13. If indigenous nonattendees are low achieving, on average, then test score gaps in the entire population of school-age children are understated. This article's emphasis on primary schools, in

TABLE 4
BOLIVIAN SCHOOL ATTENDANCE BY AGE, 1997

Age	Nonindigenous (%)	Indigenous (%)
5	52	34
6	84	75
7	96	89
8	97	92
9	98	92
10	97	95
11	98	96
12	96	88
13	94	91
14	90	78
15	86	63
16	85	62

Sources. *Encuesta Nacional de Empleo* (database), October 1997; and author's calculations.
Notes. Observations are weighted.

which attendance rates are at least 90% in Bolivia, may diminish such concerns.[5] Nevertheless, the obvious caveat is that all subsequent inferences about the test score gap can be generalized to the population of children who currently attend a particular grade of primary school.[6]

C. Geographic Dispersion and School-Based Segregation

Indigenous schoolchildren are not evenly dispersed across either country. In some Bolivian departments, notably Chuquisaca, Cochabamba, and Potosí, Quechua is the predominant indigenous language, while Aymara is most common in La Paz (see table 2). In some parts of the country, such as Santa Cruz, there is very little indigenous presence in primary schools. An even more pronounced pattern of geographic dispersion is evident in Chile. Mapuche populations are concentrated in the southern regions of the country, especially Region 9, where over 20% of schoolchildren are indigenous (see table 3). Nonetheless, migration to Santiago (located in Region 13) has led to a substantial number of indigenous children in the capital. While only 3%–5% of

[5] Similar data are not available to confirm this impression in Chile. Even so, it is generally assumed that Chile has attained universal primary enrollments.

[6] Even without nonattendance by indigenous students, age-grade distortion is a potential source of bias. In this article's data, the modal ages of Bolivian students attending third and sixth grade are 9 and 12, respectively. However, indigenous students in each grade are slightly older because of late entrance or grade repetition. This could widen the test score gap, if late-entering or repeating students possess characteristics that lower achievement. Likewise, this could diminish the gap if maturation or additional years in school contribute to higher achievement. In other results, not reported here, test score gaps in Bolivia were reduced by around 0.02 standard deviations after controlling for students' age, suggesting some role, albeit a small one, for the first explanation.

Region 13's primary enrollments are Mapuche, these students account for almost one-third of all Mapuche students.

To assess whether indigenous enrollments are evenly distributed across schools within each department or region, tables 2 and 3 also report dissimilarity indexes that range between zero and one. A value of zero would indicate an even distribution of indigenous students across schools—reflecting the overall sample proportion in each department or region; a value of one would indicate perfect segregation of indigenous and nonindigenous students. It is interpreted as the percentage of indigenous students that would have to change schools in order to attain an even distribution. In both countries, the index rarely falls below 0.4, which confirms a common anecdotal impression: that indigenous children often attend school with other indigenous children.

III. Education Reform and Indigenous Students

In the past 2 decades, Bolivia and Chile have each embarked upon ambitious programs of education reform that are designed to improve the quality of primary schools. Chile's reform has been widely implemented since 1990 but has placed little emphasis on the targeting of indigenous populations. The Bolivian reform, though it started later, has placed extensive emphasis on bilingual education aimed at indigenous students.

Chile's centralized system of public schools was decentralized to municipal control in 1980.[7] At the same time, public and private schools were financed by equal per-student subsidies if they did not charge tuition (some private schools opted not to participate in the system and still charge substantial tuition). Students were free to attend any public or subsidized private school, if the school admitted them. Many have interpreted this market-based approach as a voucher system. The reform made no specific provision for indigenous students, but there was little to prevent an indigenous group from starting a private subsidized school. There is no evidence of the extent to which this occurred, but it is noteworthy that similar proportions of nonindigenous and indigenous students attend private subsidized schools (in contrast, indigenous students are much less likely to attend tuition-paying private schools).

With the resumption of democracy in the 1990s, Chile's ministry of education pursued a different tack that emphasized central government interventions. Under the guise of the P-900 program, it began distributing resources to schools with low mean achievement, as identified by the SIMCE assessment (Chay, McEwan, and Urquiola 2003). In 1992, the ambitious MECE program (Mejoramiento de la Calidad y Equidad de la Educación)

[7] For details on Chilean reforms, see McEwan and Carnoy (2000) and Hsieh and Urquiola (2003).

sought to endow all publicly funded schools with infrastructure, instructional materials, and training. One subcomponent of the plan—dubbed MECE-Rural—was designed to improve small schools in isolated areas. However, the MECE reform did not specifically target Mapuche populations (although many Mapuche did participate, especially if they attended rural or low-achieving schools). The ministry of education has subsequently provided some support for a program of bilingual education targeted at indigenous schools, but it has not been implemented on a large scale.

Bolivia began its education reform later than Chile, but it gave more prominence to components targeted at the indigenous population. In 1994, an education reform law mandated new instructional materials (to accompany a new curriculum), teacher training, and increased community participation. It also emphasized the importance of bilingual education (Hornberger and King 1996). Under the reform, students in predominantly indigenous schools are eligible to receive instruction in both Spanish and their indigenous language (students in Spanish-speaking schools are presumably eligible to take an indigenous language as an additional subject, but this seems rare). In 1996, the reform was applied in an initial group of schools in the first grade. In subsequent years, the reform has been applied to additional schools and to successively higher grades in participating schools. Because the Bolivian data used in this study were collected in 1997, this article's estimates are best considered a prereform baseline.

IV. Data

A. Bolivian Data

The Bolivian data were collected by SIMECAL, a unit of the ministry of education, which administered a national survey of achievement for the first time in 1997. A sample of primary schools was drawn, and all students in the third and sixth grades took achievement tests. In addition, students, parents, teachers, and principals completed background surveys. However, the teacher and principal surveys are missing a large amount of data, and few variables are used in subsequent analyses.

A limited number of variables, described in the appendix, are used in this article's analyses. The Spanish and mathematics tests are each standardized to a mean of zero and a standard deviation of one. Hence, all subsequent test score gaps can be interpreted as percentages of a standard deviation. This will facilitate comparisons across tests and across countries.

The essential variable is INDIG, equal to one if a parent reports that an indigenous language is used to communicate in the home, and zero otherwise.[8] Two more detailed variables, QUECHUA and AYMARA, indicate whether those languages are spoken in the home. The two variables are not always mutually exclusive, since a very small number of families report that both languages are used. About 1% of the Bolivian sample reported that Guaraní or another language was spoken in the home; these cases are excluded from the analysis.

The remaining variables can be divided into three categories: family and student variables, peer variables, and school variables. The first category includes measures of gender, parental schooling, sewer access, electricity access, and availability of a telephone. Peer variables include the percentage of mothers in each student's school that have completed secondary school. They further include the mean of INDIG—effectively the percentage of indigenous students in a given school. School variables are limited to measures of the class size and whether a school is private or rural.[9] In Bolivia, two kinds of private schools are considered: PRIVATE indicates the usual kind of private school that charges tuition. CONVENIO indicates that a privately managed school receives some public subsidies.

B. Chilean Data

The Chilean data are drawn from two rounds of the SIMCE, administered by the ministry of education. The first round was collected in 1997 from eighth graders, the second in 1999 from fourth graders. The Chilean data differ in one important respect from the Bolivian data. They include data on the population of fourth and eighth graders.[10] Thus, Chilean test score gaps can be estimated with greater statistical precision, despite a smaller proportion of indigenous students than Bolivia.

The definitions of variables are provided in the appendix. As with the Bolivian data, Spanish and mathematics test scores are standardized to a mean of zero and a standard deviation of one. The variable INDIG is equal to one

[8] The SIMECAL data also contain a student-reported variable ("What languages do you speak?"). The parent-reported variable is used for two reasons. First, there are fewer missing cases. Second, the parent-reported variable may diminish the likelihood of measurement error. In any case, the later analyses were all repeated with the student-reported variable and this article's conclusions were robust.

[9] Although other school variables are available, they are missing for a large percentage of cases (more than 50% in the case of sixth graders).

[10] Some schools are excluded from the SIMCE measurement, but these usually account for no more than 10% of enrollments. Since they are usually located in rural areas, however, it is possible that they contain a relatively higher proportion of indigenous students.

if a student's mother identifies herself as indigenous, and zero otherwise. MAPUCHE and OTHINDIG separately identify students with mothers who are Mapuche or of another indigenous group. The remaining variables are similar to those described for Bolivia. They also include measures of books in the home, a proxy for the educational environment in the home, and family income. PRIVSUB indicates that a student attends one of the private subsidized schools, while PRIVPD indicates attendance at an elite private school where tuition is paid.[11]

C. Descriptive Statistics

Tables 5 and 6 report descriptive statistics that are divided by country, grade, and indigenous status. The discussion of test score gaps is reserved for Section VI. Among the remaining variables, there are large differences across indigenous and nonindigenous students that, with only a few exceptions, are also statistically significant. They indicate that indigenous students are of lower socioeconomic status, on average, than nonindigenous students. Furthermore, indigenous students attend school with peers who have less-educated mothers and who are likely to be indigenous themselves. Finally, indigenous students are more likely to attend a rural school, particularly in Bolivia, and they are less likely to attend a tuition-charging private school (although indigenous students have a similar likelihood of attending government-subsidized private schools). Differences in the endowments of such variables might explain an indigenous test score gap, although we first require a method to draw such inferences.

V. Method

The analysis begins by estimating an education production function for each combination of country, grade level, and dependent variable,

$$A_{ij} = \beta_0 + \beta_1 \mathrm{INDIG}_{ij} + F_{ij}\beta_2 + P_{ij}\beta_3 + S_{ij}\beta_4 + \varepsilon_{ij},$$

where A_{ij} is the achievement test score of student i in school j, $INDIG_{ij}$ is a dummy variable equal to one if the student is indigenous, F_{ij} is a vector of family variables, P_{ij} is a vector of peer-group variables, and S_{ij} is a vector of school variables. The βs are coefficients to be estimated via least squares regression, and ε_{ij} is an error term.

[11] The SIMCE data include relatively few school-level variables.

To decompose the test score gap, note that the mean achievement of indigenous and nonindigenous students is given by

$$\bar{A}^{I} = \hat{\beta}_0 + \hat{\beta}_1 + \bar{F}^{I}\hat{\beta}_2 + \bar{P}^{I}\hat{\beta}_3 + \bar{S}^{I}\hat{\beta}_4$$

and

$$\bar{A}^{NI} = \hat{\beta}_0 + \bar{F}^{NI}\hat{\beta}_2 + \bar{P}^{NI}\hat{\beta}_3 + \bar{S}^{NI}\hat{\beta}_4,$$

where the *I* and *NI* superscripts indicate indigenous and nonindigenous students, respectively, and a bar indicates a mean. The mean difference can be written as

$$(\bar{A}^{I} - \bar{A}^{NI}) = \hat{\beta}_1 + (\bar{F}^{I} - \bar{F}^{NI})\hat{\beta}_2 + (\bar{P}^{I} - \bar{P}^{NI})\hat{\beta}_3 + (\bar{S}^{I} - \bar{S}^{NI})\hat{\beta}_4.$$

In this formulation, the coefficient on INDIG ($\hat{\beta}_1$), provides an estimate of the unexplained portion of the gap. Successive terms denote the portions attributable to differing endowments of family, peer, and school variables.

The previous coefficient estimates, and hence the decomposition results, are potentially subject to biases. For example, the effect of attending a private school may be biased, perhaps upward, if private school attendance is positively correlated with unobserved family determinants of achievement (e.g., parental motivation).[12] Similarly, suppose that families choose schools partly on the basis of observed peer-group characteristics. If such families have unobserved attributes that positively influence achievement (e.g., greater wealth), then the impact of observed peer variables is confounded with these family unobservables.[13] Finally, it is possible that coefficients of family variables such as parental schooling are biased. For example, if more educated parents choose schools based upon unobserved school attributes (e.g., a good principal), then the impact of parental education is confounded with school unobservables.

Because there are multiple observations of indigenous and nonindigenous students within most schools, a modified specification can be estimated,

$$A_{ij} = \beta_1 \text{INDIG}_{ij} + F_{ij}\beta_2 + \mu_j + \varepsilon_{ij},$$

where μ_j represents fixed effects for each school. Because peer and school variables are constant across schools, those coefficients cannot be separately estimated. However, the inclusion of fixed effects controls for all variables that are constant across schools, whether observed or unobserved, potentially re-

[12] For an analysis of this issue with Chilean data, see McEwan (2001).

[13] For a general discussion, see Evans, Oates, and Schwab (1992). For an analysis of peer-group effects in Chile, see McEwan (2003).

TABLE 5
DESCRIPTIVE STATISTICS FOR BOLIVIA

Variable	Third Grade (1997)				Sixth Grade (1997)			
	Full Sample	Nonindigenous	Indigenous	Difference	Full Sample	Nonindigenous	Indigenous	Difference
SPANISH	.00	.10	−.23	−.33**	.00	.10	−.37	−.48**
	(1.00)	(.99)	(.98)		(1.00)	(1.00)	(.92)	
MATH	.00	.08	−.19	−.27**	.00	.07	−.27	−.35**
	(1.00)	(.98)	(1.01)		(1.00)	(1.01)	(.92)	
INDIG	.30	…	…	…	.22	…	…	…
QUECHUA	.19	…	.64	…	.15	…	.69	…
AYMARA	.12	…	.41	…	.08	…	.37	…
FEMALE	.52	.54	.49	−.04**	.50	.51	.48	−.03
EDMTH1	.41	.34	.55	.21**	.33	.30	.46	.16**
EDMTH2	.16	.18	.13	−.05**	.21	.22	.19	−.03*
EDMTH3	.16	.20	.06	−.14**	.17	.20	.08	−.12**
EDMTH4	.10	.13	.03	−.10**	.12	.14	.04	−.10**
EDMTH5	.04	.05	.01	−.04**	.04	.05	.01	−.04**
EDFTH1	.32	.27	.44	.17**	.26	.22	.40	.18**
EDFTH2	.21	.20	.23	.03**	.24	.23	.28	.05**
EDFTH3	.21	.24	.14	−.10**	.22	.24	.15	−.09**

EDFTH4	.12	.14	.06	−.08**	.13	.15	.07	−.08**
EDFTH5	.08	.10	.02	−.08**	.09	.11	.02	−.09**
SEWER	.30	.35	.17	−.18**	.38	.41	.26	−.15**
ELECT	.62	.70	.44	−.26**	.73	.78	.56	−.21**
PHONE	.17	.22	.06	−.16**	.22	.27	.07	−.19**
M(INDIG)	.31	.17	.63	.46**	.22	.14	.51	.37**
	(.31)	(.19)	(.30)		(.25)	(.16)	(.30)	
M(EDMTH)	.29	.36	.15	−.21**	.34	.38	.19	−.19**
	(.28)	(.29)	(.17)		(.27)	(.28)	(.18)	
CSIZE	32.71	34.23	29.20	−5.03**	34.57	35.31	31.92	−3.38**
	(9.62)	(9.13)	(9.80)		(9.26)	(8.90)	(10.02)	
PRIVATE	.11	.14	.03	−.11**	.15	.18	.03	−.15**
CONVENIO	.06	.07	.05	−.02	.05	.05	.04	−.01
RURAL	.39	.28	.64	.35**	.25	.19	.47	.28**
Observations	10,954	7,649	3,305		11,469	8,981	2,488	

Sources. SIMECAL 1997; and author's calculations.
Note. Standard deviations for nondichotomous variables are in parentheses. Standard errors used in hypothesis tests are adjusted for clustering at school level.
* Indicates statistical significance at 5%.
** Indicates statistical significance at 1%.

TABLE 6
DESCRIPTIVE STATISTICS FOR CHILE

Variable	Fourth Grade (1999)				Eighth Grade (1997)			
	Full Sample	Nonindigenous	Indigenous	Difference	Full Sample	Nonindigenous	Indigenous	Difference
SPANISH	.00	.03	−.37	−.39**	.00	.02	−.44	−.47**
	(1.00)	(1.00)	(.95)		(1.00)	(.99)	(1.00)	
MATH	.00	.02	−.35	−.37**	.00	.02	−.38	−.40**
	(1.00)	(1.00)	(.95)		(1.00)	(1.00)	(.93)	
INDIG	.07	…	…	…	.05	…	…	…
MAPUCHE	.05	…	.81	…	.04	…	.80	…
OTHER	.01	…	.19	…	.01	…	.20	…
FEMALE	…	…	…	…	.52	.52	.51	−.01
EDMTH	10.19	10.34	7.96	−2.38**	9.75	9.87	7.50	−2.36**
	(3.57)	(3.52)	(3.54)			(3.75)	(3.62)	
EDFTH	10.54	10.68	8.4	−2.26**	10.16	10.27	7.94	−2.33**
	(3.75)	(3.72)	(3.57)		(4.06)	(4.04)	(3.76)	
BOOKS	…	…	…	…	4.11	4.17	3.01	−1.16**
					(2.47)	(2.47)	(2.11)	
INCOME	2.63	2.72	1.40	−1.32**	2.99	3.06	1.66	−1.40**
	(3.79)	(3.87)	(1.97)		(3.98)	(4.04)	(2.29)	
M(INDIG)	.07	.06	.20	.15**	.05	.04	.21	.17**
	(.10)	(.07)	(.23)		(.09)	(.06)	(.25)	
M(EDMTH)	10.09	10.19	8.71	−1.47**	9.72	9.79	8.24	−1.55**
	(2.29)	(2.29)	(1.89)		(2.41)	(2.41)	(2.06)	
CSIZE	36.41	36.55	34.41	−2.14**	34.23	34.36	31.73	−2.63**
	(8.28)	(8.12)	(10.05)		(8.53)	(8.41)	(10.22)	
PRIVSUB	.38	.38	.32	−.06**	.34	.34	.30	−.04**
PRIVPD	.08	.09	.01	−.08**	.09	.09	.01	−.08**
RURAL	.13	.13	.24	.11**	.07	.07	.18	.11**
Observations	196,167	183,404	12,763		163,061	155,127	7,934	

Sources. SIMCE 1997, 1999; and author's calculations.
Note. Standard deviations for nondichotomous variables are in parentheses. Standard errors used in hypothesis tests are adjusted for clustering at school level.
* Indicates statistical significance at 5%.
** Indicates statistical significance at 1%.

ducing biases in other coefficient estimates. The new decomposition can be written as

$$(\bar{A}^{I} - \bar{A}^{NI}) = \hat{\beta}_1 + (\bar{F}^{I} - \bar{F}^{NI})\hat{\beta}_2 + \left(\frac{1}{N^{I}}\sum_{j=1}^{J}\sum_{i=1}^{I_j}\mathrm{INDIG}_{ij}\hat{\mu}_j - \frac{1}{N^{NI}}\sum_{j=1}^{J}\sum_{i=1}^{I_j}(1-\mathrm{INDIG}_{ij})\hat{\mu}_j\right),$$

where N^{I} and N^{NI} are the total number of indigenous and nonindigenous students in the sample, respectively (also see Cook and Evans 2000). The total number of schools is J, and I_j is the total number of students in school j.

The variable $\hat{\beta}_1$ is again interpreted as the unexplained portion of the gap, though with a twist. It now measures the test score gap that remains within each school after controlling for parental education and other family variables. The second term is the portion of the gap attributable to differing endowments of family variables. The third term captures differences that are due to the varying fixed effects of the schools that indigenous and nonindigenous students happen to attend. It can be interpreted, roughly, as the portion of the gap attributable to differences in observed and unobserved school quality. However, it should be emphasized that this subsumes the effect of any variable that is constant across schools, including school resources or peer groups.

Because the Bolivian and Chilean data contain observations for multiple classrooms within each school, the preceding exercise can be repeated with classroom fixed effects. Doing so permits an assessment of the added importance of classroom quality in explaining the gap. This might be the case, for example, if indigenous students are assigned—within a given school—to less able teachers than nonindigenous students or to classrooms with less privileged peers.

VI. The Magnitude of Test Score Gaps

Figure 1 summarizes the mean differences in test scores across countries, grade levels, and subjects. The results are obtained from achievement regressions, reported in tables 7, 8, 9, and 10, that control only for INDIG. In every case, the coefficient on INDIG is statistically significant at 1%.

The results support four generalizations. First, the test score gap ranges between 0.3 and 0.5 standard deviations, despite widely varying proportions of indigenous students in each country.[14] Interestingly, the same patterns are

[14] In a sample of Bolivian fourth graders from 1992, Vera (1998) found a test score gap of 0.7 standard deviations (see app. 2, model 1). The sample was drawn from the cities of La Paz and El Alto, where indigenous students are mainly Aymara. The World Bank (2001) analyzes Quechua

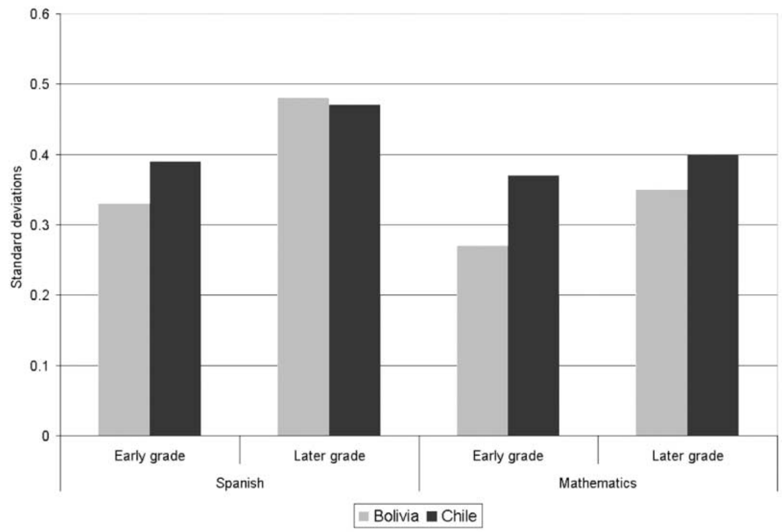

Figure 1. Indigenous test score gaps in Bolivia and Chile. Source: Cols. 1 and 5 in tables 7–10. In Bolivia and Chile, "early grade" refers to third and fourth grade, respectively, while "later grade" refers to sixth and eighth grade, respectively.

reflected within each country's data, despite varying proportions of indigenous students across Bolivian departments and Chilean regions. For three out of four dependent variables, one cannot reject the null at a 5% significance level that the test score gap is the same in Bolivia's nine departments (the full results are omitted). In contrast, the null is consistently rejected across Chile's 13 regions, perhaps unsurprisingly, given the larger sample sizes. However, the magnitude of Chile's regional gaps is consistent with countrywide results.

The size of these gaps is not overwhelming, at least in comparison to minority test score gaps in other contexts. For example, the black-white gap in the United States is about one standard deviation (Jencks and Phillips 1998). The existing gaps are also comparable to the effect sizes of common educational interventions. For example, Urquiola (2003) finds—using the same 1997 SIMECAL data—that a reduction in class size by 8–9 students may raise achievement by 0.17–0.45 standard deviations.

Second, the size of the gaps is uniformly larger in Spanish than in mathematics, but the magnitude of these differences is small, usually around 0.1 standard deviations.

Third, the gaps are relatively larger in the later grades, although grade-level differences should be interpreted cautiously. One tempting explanation

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and Aymara test score gaps in Peru, but the study does not report a standard deviation of the dependent variable, making it difficult to meaningfully assess the magnitude of the gap.

is that the test score gap widens over time because families and schools have different effects on the growth of indigenous and nonindigenous achievement. However, the data do not follow a single cohort of students. Rather, the earlier grade's results are drawn from younger cohorts of students—particularly in Chile where the earlier grade's sample is collected at a later date. These students might have received greater exposure to incipient school reforms, for example. In this case, the putative widening of the test score gap could indicate that reforms are successfully diminishing the gap among younger students.[15] This article will refrain from drawing conclusions about the evolution of test score gaps across time, instead focusing upon cross sections.

Fourth, the magnitude of the test score gap is similar for different indigenous groups within each country. In other regressions, not reported here, the variable INDIG was replaced with AYMARA and QUECHUA (in the Bolivian data) and MAPUCHE and OTHINDIG (in the Chilean data). In the Bolivian regressions, one cannot reject the null hypothesis that coefficients on AYMARA and QUECHUA are equal at the 5% level of statistical significance. In the data on Chilean fourth graders, one also cannot reject the null hypothesis that coefficients on MAPUCHE and OTHINDIG are equal. The null is rejected in the eighth-grade data, but the two coefficients are similar in magnitude.

VII. Explaining Test Score Gaps

A. Regression Results

Tables 7, 8, 9, and 10 report estimates of achievement regressions for each country, grade level, and subject. The specifications in columns 2 and 6—including family, peer, and school variables—are broadly consistent with those of other education production functions. In both countries, female students obtain lower mathematics achievement than males, although the gap never exceeds 0.1 standard deviations. In contrast, the Spanish achievement of females is higher on average, by as much as 0.2 standard deviations among Chilean eighth graders.

Among family variables, parental schooling, especially that of mothers, is strongly correlated with achievement. Other important family variables include the availability of books in Chile, and the availability of household services such as telephone, sewer, and electricity in Bolivia. Rather than ascribe causal meaning to the coefficients, these variables are perhaps best interpreted as proxies of family income, wealth, and the home educational environment. The

[15] Another explanation—less consistent with the data—is that changes are driven by the dropout behavior of students. If indigenous students, especially low-achieving ones, are more likely to drop out of school early, then one would predict a shrinking test score gap in higher grades. The opposite is observed in the data.

TABLE 7
BOLIVIAN ACHIEVEMENT REGRESSIONS, GRADE 3

	Dependent Variable: SPANISH				Dependent Variable: MATH			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
INDIG	−.333**	−.088**	−.082**	−.059**	−.274**	−.078**	−.080**	−.055*
	(.058)	(.023)	(.021)	(.020)	(.054)	(.023)	(.023)	(.022)
FEMALE	…	.040	.033*	.021	…	−.039	−.043**	−.050**
		(.023)	(.016)	(.016)		(.022)	(.016)	(.017)
EDMTH1	…	−.066	−.001	.009	…	−.082*	−.029	−.017
		(.039)	(.026)	(.026)		(.039)	(.026)	(.026)
EDMTH2	…	−.061	.013	.017	…	−.065	−.021	−.015
		(.045)	(.032)	(.031)		(.045)	(.035)	(.034)
EDMTH3	…	−.009	.063	.061	…	−.023	.032	.040
		(.048)	(.038)	(.037)		(.044)	(.034)	(.034)
EDMTH4	…	.123*	.183**	.174**	…	.108*	.135**	.133**
		(.054)	(.045)	(.044)		(.053)	(.042)	(.041)
EDMTH5	…	.212**	.242**	.214**	…	.134*	.144**	.133*
		(.065)	(.057)	(.058)		(.064)	(.055)	(.055)
EDFTH1	…	−.055	.030	.028	…	−.085	.014	.005
		(.048)	(.035)	(.033)		(.050)	(.034)	(.034)
EDFTH2	…	−.093	.046	.043	…	−.087	.059	.047
		(.052)	(.040)	(.038)		(.057)	(.039)	(.037)
EDFTH3	…	−.037	.075	.062	…	−.036	.089*	.076*
		(.052)	(.041)	(.040)		(.057)	(.041)	(.038)
EDFTH4	…	.002	.117*	.115*	…	−.039	.097*	.085*
		(.061)	(.049)	(.048)		(.061)	(.044)	(.041)

EDFTH5	…	.039	.152**	.151**	…	−.014	.108*	.094*
		(.066)	(.053)	(.052)		(.065)	(.048)	(.045)
SEWER	…	.072	.006	.009	…	.092*	.029	.029
		(.044)	(.024)	(.022)		(.041)	(.023)	(.023)
ELECT	…	.118**	.096**	.093**	…	.081*	.076**	.071**
		(.037)	(.020)	(.020)		(.037)	(.021)	(.020)
PHONE	…	.151**	.050	.031	…	.136**	.043	.022
		(.037)	(.027)	(.027)		(.034)	(.025)	(.024)
M(INDIG)	…	.054	…	…	…	.111	…	…
		(.124)				(.123)		
M(EDMTH)	…	.571**	…	…	…	.519**	…	…
		(.180)				(.178)		
CSIZE	…	−.011**	…	…	…	−.013**	…	…
		(.004)				(.004)		
PRIVATE	…	.388**	…	…	…	.373**	…	…
		(.124)				(.120)		
CONVENIO	…	.079	…	…	…	.163	…	…
		(.129)				(.117)		
RURAL	…	−.153	…	…	…	−.186*	…	…
		(.092)				(.082)		
Observations	10,954	10,954	10,954	10,954	10,954	10,954	10,954	10,954
R^2	.02	.17	.51	.56	.02	.14	.47	.52
School effects?	No	No	Yes	No	No	No	Yes	No
Classroom effects?	No	No	No	Yes	No	No	No	Yes

Sources. SIMECAL 1997; and author's calculations.
Note. Huber-White standard errors, adjusted for school-level clustering, are in parentheses.
* Indicates statistical significance at 5%.
** Indicates statistical significance at 1%.

TABLE 8

BOLIVIAN ACHIEVEMENT REGRESSIONS, GRADE 6

	Dependent Variable: SPANISH				Dependent Variable: MATH			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
INDIG	−.475**	−.064**	−.066**	−.052*	−.345**	−.036	−.030	−.025
	(.059)	(.023)	(.023)	(.022)	(.057)	(.022)	(.022)	(.021)
FEMALE	…	.028	.029	.022	…	−.098**	−.075**	−.087**
		(.028)	(.017)	(.017)		(.030)	(.018)	(.017)
EDMTH1	…	−.061	−.080**	−.071**	…	−.094*	−.088**	−.079**
		(.032)	(.027)	(.027)		(.037)	(.028)	(.029)
EDMTH2	…	−.082*	−.081*	−.080**	…	−.111**	−.083*	−.080*
		(.038)	(.032)	(.031)		(.042)	(.033)	(.033)
EDMTH3	…	−.073	−.058	−.055	…	−.102*	−.077*	−.073
		(.041)	(.037)	(.036)		(.043)	(.038)	(.037)
EDMTH4	…	.083	.085*	.089*	…	.007	.018	.029
		(.045)	(.040)	(.039)		(.047)	(.041)	(.040)
EDMTH5	…	.137*	.099	.111*	…	.116	.078	.090
		(.058)	(.051)	(.051)		(.065)	(.053)	(.055)
EDFTH1	…	.076	.093**	.089**	…	.069	.081*	.067
		(.045)	(.035)	(.035)		(.050)	(.037)	(.038)
EDFTH2	…	.052	.071	.070	…	.030	.040	.028
		(.050)	(.037)	(.037)		(.053)	(.039)	(.039)
EDFTH3	…	.115*	.133**	.123**	…	.067	.102*	.087*
		(.056)	(.040)	(.040)		(.056)	(.040)	(.040)
EDFTH4	…	.164**	.185**	.188**	…	.076	.126**	.124**
		(.058)	(.043)	(.042)		(.058)	(.043)	(.042)

EDFTH5	…	.247**	.231**	.215**	…	.160*	.156**	.138**
		(.061)	(.050)	(.051)		(.063)	(.050)	(.050)
SEWER	…	.098**	.039	.037	…	.063	.024	.018
		(.035)	(.023)	(.023)		(.037)	(.021)	(.021)
ELECT	…	.218**	.232**	.217**	…	.168**	.184**	.175**
		(.033)	(.021)	(.021)		(.036)	(.023)	(.024)
PHONE	…	.123**	.077**	.086**	…	.104**	.040	.042
		(.028)	(.023)	(.023)		(.032)	(.025)	(.025)
M(INDIG)	…	−.213	…	…	…	−.256	…	…
		(.138)				(.155)		
M(EDMTH)	…	.793**	…	…	…	.630**	…	…
		(.148)				(.186)		
CSIZE	…	.001	…	…	…	−.001	…	…
		(.003)				(.003)		
PRIVATE	…	.342**	…	…	…	.369**	…	…
		(.102)				(.132)		
CONVENIO	…	.366**	…	…	…	.292**	…	…
		(.079)				(.086)		
RURAL	…	.015	…	…	…	.141	…	…
		(.080)				(.087)		
Observations	11,469	11,469	11,469	11,469	11,469	11,469	11,469	11,469
R^2	.04	.29	.47	.52	.02	.18	.42	.47
School effects?	No	No	Yes	No	No	No	Yes	No
Classroom effects?	No	No	No	Yes	No	No	No	Yes

Sources. SIMECAL 1997; and author's calculations.
Note. Huber-White standard errors, adjusted for school-level clustering, are in parentheses.
* Indicates statistical significance at 5%.
** Indicates statistical significance at 1%.

TABLE 9
CHILEAN ACHIEVEMENT REGRESSIONS, GRADE 4

	Dependent Variable: SPANISH				Dependent Variable: MATH			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
INDIG	−.392**	−.041**	−.040**	−.032**	−.374**	−.055**	−.054**	−.047**
	(.013)	(.009)	(.009)	(.009)	(.013)	(.009)	(.010)	(.010)
EDMTH	…	.042**	.041**	.038**	…	.038**	.038**	.035**
		(.001)	(.001)	(.001)		(.001)	(.001)	(.001)
EDFTH	…	.028**	.028**	.026**	…	.025**	.026**	.024**
		(.001)	(.001)	(.001)		(.001)	(.001)	(.001)
INCOME	…	.007**	.008**	.007**	…	.012**	.010**	.009**
		(.001)	(.001)	(.001)		(.001)	(.001)	(.001)
M(INDIG)	…	−.061	…	…	…	−.049	…	…
		(.048)				(.048)		
M(EDMTH)	…	.128**	…	…	…	.110**	…	…
		(.004)				(.004)		
CSIZE	…	−.001*	…	…	…	−.002**	…	…
		(.001)				(.001)		
PRIVSUB	…	.039**	…	…	…	.032*	…	…
		(.013)				(.013)		
PRIVPD	…	−.065*	…	…	…	−.002	…	…
		(.025)				(.026)		
RURAL	…	.109**	…	…	…	.081**	…	…
		(.016)				(.016)		
Observations	196,167	196,167	196,167	196,167	196,167	196,167	196,167	196,167
R^2	.01	.24	.32	.36	.01	.21	.29	.33
School effects?	No	No	Yes	No	No	No	Yes	No
Classroom effects?	No	No	No	Yes	No	No	No	Yes

Sources. SIMCE 1999; and author's calculations.
Note. Huber-White standard errors, adjusted for school-level clustering, are in parentheses.
* Indicates statistical significance at 5%.
** Indicates statistical significance at 1%.

TABLE 10

CHILEAN ACHIEVEMENT REGRESSIONS, GRADE 8

	Dependent Variable: SPANISH				Dependent Variable: MATH			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
INDIG	−.468**	−.096**	−.097**	−.085**	−.397**	−.068**	−.068**	−.056**
	(.017)	(.011)	(.011)	(.011)	(.017)	(.011)	(.010)	(.010)
FEMALE	…	.203**	.176**	.167**	…	−.027*	−.068**	−.076**
		(.008)	(.005)	(.005)		(.011)	(.005)	(.005)
EDMTH	…	.025**	.025**	.022**	…	.020**	.019**	.016**
		(.001)	(.001)	(.001)		(.001)	(.001)	(.001)
EDFTH	…	.013**	.014**	.012**	…	.007**	.010**	.008**
		(.001)	(.001)	(.001)		(.001)	(.001)	(.001)
BOOKS	…	.049**	.044**	.040**	…	.040**	.036**	.032**
		(.001)	(.001)	(.001)		(.002)	(.001)	(.001)
INCOME	…	−.007**	−.006**	−.006**	…	−.001	−.003**	−.003**
		(.001)	(.001)	(.001)		(.002)	(.001)	(.001)
M(INDIG)	…	−.327**	…	…	…	−.258**	…	…
		(.060)				(.072)		
M(EDMTH)	…	.120**	…	…	…	.131**	…	…
		(.005)				(.008)		
CSIZE	…	.002*	…	…	…	.000	…	…
		(.001)				(.001)		
PRIVSUB	…	.020	…	…	…	−.004	…	…
		(.018)				(.025)		
PRIVPD	…	.026	…	…	…	.073	…	…
		(.040)				(.058)		
RURAL	…	.130**	…	…	…	.290**	…	…
		(.021)				(.026)		
Observations	163,061	163,061	163,061	163,061	163,061	163,061	163,061	163,061
R^2	.01	.23	.34	.38	.01	.20	.39	.44
School effects?	No	No	Yes	No	No	No	Yes	No
Classroom effects?	No	No	No	Yes	No	No	No	Yes

Sources. SIMCE 1997; and author's calculations

Note. Huber-White standard errors, adjusted for school-level clustering, are in parentheses.

* Indicates statistical significance at 5%.

** Indicates statistical significance at 1%.

coefficients may also reflect the influences of unmeasured school and peer variables that are correlated with these family characteristics. Some evidence of this is provided in columns 3 and 7. These regressions further control for school fixed effects, and any unobserved variables that are constant across schools. Their inclusion leads to declines in the coefficients of family variables, especially in Bolivia.

Among peer-group variables, school-level measures of EDMTH have positive and large effects on achievement in all samples. In Chile, for example, a one-standard-deviation increase in M(EDMTH) produces a 0.3 standard deviation increase in fourth-grade Spanish scores. The other measure, M(INDIG), has less robust links to achievement in both Bolivia and Chile. Even when negative coefficients are statistically significant, the magnitude of the effects is not large.

Despite these findings, it is possible that the nominal influence of peers is spuriously reflecting the influence of unmeasured family or school characteristics. This has been explored in previous analyses of Chilean data that compared the achievement of twins and sibling pairs that attend classrooms with different peer groups (McEwan 2003). These analyses suggested that coefficients on peer variables are not biased by the exclusion of family variables and, hence, may have a causal interpretation. However, it is still possible that peer variables are correlated with unobserved school variables that influence achievement (e.g., more privileged peer groups are taught by better teachers).

Class size generally has small or statistically insignificant links to achievement. However, in a separate analysis of the Bolivian SIMECAL data, Urquiola (2003) suggests that class size is endogenously determined and that the coefficient on class size in simple regressions is biased. Using several empirical approaches to identify exogenous variation in class size, he finds that reducing class size generally leads to increases in achievement, at least in Bolivian primary schools.

In Bolivia, private school attendance is generally associated with higher mean achievement, all else being equal. The usual caveats about omitted variables bias again apply here. In contrast, private school coefficients are small in magnitude or statistically insignificant in Chile, a finding that is consistent with previous analyses of Chilean data (McEwan 2001).

Across all countries and dependent variables, the inclusion of family, peer, and school variables greatly diminishes the size of coefficients on INDIG, suggesting that differing endowments of these variables can partially explain the test score gap. The further inclusion of school and classroom fixed effects increases the amount of variance in achievement that is explained, while only reducing the magnitude of INDIG by a small amount. Without further anal-

TABLE 11
ACHIEVEMENT DECOMPOSITIONS

	Dependent Variable: SPANISH			Dependent Variable: MATH		
	(1)	(2)	(3)	(4)	(5)	(6)
Bolivia, third grade, 1997:						
Unexplained	−.08	−.08	−.06	−.08	−.08	−.06
Family variables	−.11	−.10	−.09	−.09	−.08	−.07
Peer variables	−.09	…	…	−.05	…	…
School variables	−.04	…	…	−.05	…	…
School fixed effects	…	−.15	…	…	−.11	…
Classroom fixed effects	…	…	−.18	…	…	−.14
Total	−.33	−.33	−.33	−.27	−.27	−.27
Bolivia, sixth grade, 1997:						
Unexplained	−.06	−.07	−.05	−.04	−.03	−.03
Family variables	−.13	−.12	−.11	−.08	−.07	−.07
Peer variables	−.23	…	…	−.21	…	…
School variables	−.05	…	…	−.01	…	…
School fixed effects	…	−.30	…	…	−.25	…
Classroom fixed effects	…	…	−.31	…	…	−.25
Total	−.48	−.48	−.48	−.35	−.35	−.35
Chile, fourth grade, 1999:						
Unexplained	−.04	−.04	−.03	−.05	−.05	−.05
Family variables	−.17	−.17	−.16	−.16	−.16	−.15
Peer variables	−.20	…	…	−.17	…	…
School variables	.02	…	…	.01	…	…
School fixed effects	…	−.18	…	…	−.16	…
Classroom fixed effects	…	…	−.20	…	…	−.18
Total	−.39	−.39	−.39	−.37	−.37	−.37
Chile, eighth grade, 1997:						
Unexplained	−.10	−.10	−.09	−.07	−.07	−.06
Family variables	−.14	−.14	−.12	−.11	−.10	−.09
Peer variables	−.24	…	…	−.25	…	…
School variables	.01	…	…	.03	…	…
School fixed effects	…	−.24	…	…	−.22	…
Classroom fixed effects	…	…	−.26	…	…	−.25
Total	−.47	−.47	−.47	−.40	−.40	−.40

ysis, little more can be said about which variable endowments are most responsible for explaining the test score gap.

B. Achievement Decompositions

Table 11 reports the results of the achievement decompositions. To illustrate their interpretation, consider column 1 as an example. It decomposes the overall gap in Bolivian third-grade Spanish scores (−0.33) into four components: (1) an unexplained component (which is simply the coefficient on INDIG), (2) the component due to varying endowments of family variables, (3) the component due to peer variables, and (4) the component due to school variables. In this case, −0.08 is unexplained. Family, peer, and school variables explain −0.11, −0.09, and −0.04, respectively, of the gap. That is, indigenous students generally have smaller endowments of family, peer, and school variables that improve achievement; hence, their mean achievement is lower. The relative importance of families and peers is particularly striking.

However, the decomposition results could be misleading because they are based on regressions that control for a limited set of peer and school variables. As discussed previously, omitted variables may be correlated with achievement and with the independent variables, thus biasing coefficients. One method of reducing such bias is to base decompositions on fixed-effects specifications. These specifications have one obvious drawback in that they do not allow for detailed inferences about which school and peer variables are most important. However, the school fixed effects control for all variables, observed or unobserved, that are constant across schools.

Columns 2 and 3 apply the decomposition to regressions that include school and classroom fixed effects, respectively. Focusing on third-grade Spanish scores, the unexplained gap and the portion due to family variables are little changed in column 2. Differences in school fixed effects explain -0.15 of the gap, similar to the combined -0.13 that was previously explained in column 1 by observed peer and school variables. Note that school fixed effects subsume the observed school variables, as well as any unobserved ones.

The further addition of classroom fixed effects in column 3 controls for observed and unobserved variables that are constant across schools and classrooms. The classroom fixed effects can explain -0.18 of the overall gap, a small increment. This suggests that indigenous students, beyond attending poor schools with less privileged peer groups, also disproportionately attend classrooms within schools that produce lower achievement. For example, indigenous students might be tracked into classes with worse peers, or they may be assigned to lower-quality teachers within schools.

Figure 2 provides a visual summary of the classroom fixed-effect decompositions reported in table 11 across all countries and dependent variables. The most striking result is that the differences in classroom fixed effects across indigenous and nonindigenous students can consistently explain 50%–70% of the total test score gap.[16] The differences in endowments of family variables explain a further 20%–40% of the gap. Even when controlling for these variables, however, between 10% and 20% of the gap cannot be explained.

[16] Similarly, a decomposition conducted with U.S. data suggests that school quality (proxied by school fixed effects) accounts for approximately half of the black-white test score gap (Cook and Evans 2000)

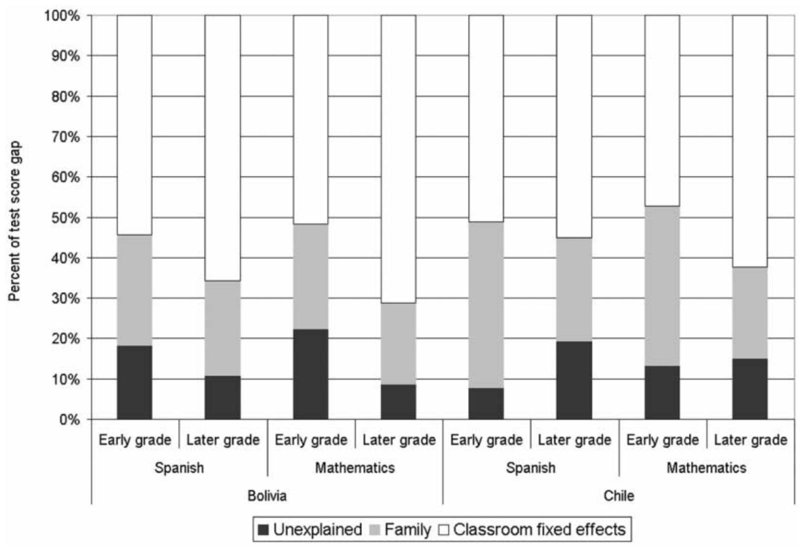

Figure 2. Decomposition of indigenous test score gaps in Bolivia and Chile. Source: Cols. 3 and 6 in table 11. Note: In Bolivia and Chile, "early grade" refers to third and fourth grade, respectively, while "later grade" refers to sixth and eighth grade, respectively.

C. Interpreting the Unexplained Portion of the Gap

The unexplained portion of the test score gap has at least three interpretations. First, it may indicate the presence of unobserved family and student variables that are correlated with achievement and indigenous status, such as wealth or parenting behaviors.

Second, it may indicate that indigenous and nonindigenous students, even within the same classroom, receive different amounts of classroom resources. This might occur because of overt discrimination, which leads school personnel to restrict the quantity and quality of instruction received by indigenous pupils. Another explanation, less overt, is that teachers maintain less rigorous expectations for the success of indigenous students and therefore teach with less exacting standards. This has been a frequently asserted cause of the black-white test score gap in the United States, although there is less evidence in Latin America. Ferguson (1998, p. 313) reviews the U.S. evidence and concludes that "teachers' perceptions, expectations, and behaviors probably do help to sustain, and perhaps even to expand, the black-white test score gap."

Third, it may indicate that indigenous and nonindigenous students reap different outcomes from equivalent school and classroom resources. One possibility is that indigenous students benefit from being taught by an indigenous teacher, while nonindigenous students benefit from instruction by nonindigenous teachers. This has long been hypothesized about black and white students in U.S. classrooms (though again, the evidence in Latin America is limited). Relying upon experimental data from Tennessee, Dee (2001) has shown that student achievement rises when students are randomly paired with teachers of their own race.[17] If there is a similar technology of production in Latin American classrooms, then it could explain some portion of the within-class test score gap.

It is also possible that indigenous and nonindigenous students reap different outcomes from an equivalent curriculum or instructional method. For example, traditional instructional approaches—relying on monolingual Spanish instruction—could produce relatively less mathematics and Spanish achievement among bilingual indigenous students. Alternatives such as bilingual instruction have rarely been implemented as formal instructional strategies, although Bolivia has moved decisively in recent years to institute such reforms.[18] There are still no rigorous evaluations of how Bolivia's nascent reforms have affected the Spanish and mathematics achievement of students, as well as other outcomes such as native language proficiency.

D. Interpreting Other Portions of the Gap

Even allowing for the ambiguous interpretation of the unexplained portion, it accounts for a small portion of the gap. A much larger portion is accounted for by differing endowments of family variables, a conclusion that is robust across all regression specifications and decompositions. These results imply a substantial role for differences in poverty and the home educational environment in explaining the lower achievement of indigenous pupils. However, the family variables do not always have a plausible causal interpretation, since they likely proxy other family unobservables. In any case, these variables do not lend themselves to easy manipulation by policy makers.

The initial decompositions, relying on regressions without fixed effects, suggested an important role for peer groups in explaining lower indigenous achievement. There was, moreover, a small role for observed school variables, especially in Chile. However, these results were based on regressions that controlled for an admittedly small number of peer and school variables. The decompositions based on fixed-effects specifications reinforced the notion that differences in school, classroom, and peer quality contribute to lower indigenous

[17] The analysis is based on data from the Tennessee STAR experiment, in which students and teachers were randomly assigned to classrooms.

[18] It may, of course, be implemented in a less formal capacity by teachers who speak an indigenous language. There is no empirical evidence of how frequently this might occur. Note that it could provide one reason to hypothesize that indigenous students will benefit from being paired with indigenous teachers.

achievement. However, the substantial importance of classroom and school differences in these decompositions could easily reflect the importance of any classroom- or school-level variable that is correlated with achievement. This could include peer-group quality, teacher quality, instructional materials, private school management, and so on.

The present results cannot distinguish among these explanations, but it would be necessary to do so in order to draw clear policy implications. Suppose that the test score gap is largely explained by differences in the availability of instructional resources like textbooks across schools that are attended by indigenous and nonindigenous students. Such a gap can be addressed in a straightforward manner by compensatory policies that target indigenous students. Indeed, both Bolivia and Chile have made redistributive policies a hallmark of their education reforms (see Sec. III).[19]

However, suppose that the test score gap is mainly the result of differential exposure to worse peer groups. In that case, one policy would be to encourage indigenous students to attend schools with better peer groups. In practice, it appears that some policies may have encouraged the opposite. For example, Chile's national voucher plan has allowed unrestricted school choice across public and private schools since 1980.[20] Other research suggests that "the first-order consequence of vouchers in Chile was a massive exodus from public schools by families from higher socioeconomic backgrounds" (Hsieh and Urquiola 2003). In short, sorting induced by school choice altered the distribution of peer-group characteristics across schools, perhaps increasing segregation by socioeconomic status. However, there is no evidence on how sorting altered ethnic segregation.

The question remains whether policy can be modified to improve the peer-group characteristics to which the average indigenous student is exposed. The United States has a long history of busing and other attempts to use carrots and sticks to encourage mixing of minority and majority students.[21] In Chile, for example, one might provide larger school subsidies for children of indigenous parents as an incentive for more privileged schools to admit them. However, one must keep in mind that a legislated goal of the Bolivian reform (and, less explicitly, the Chilean one) is to aid indigenous groups in preserving their native languages and cultures. A policy that transfers indigenous students

[19] An evaluation of Chile's P-900 program, which targets resources and training at low-achieving primary schools, suggests that achievement rises by 0.2 standard deviations (Chay et al. 2003).

[20] In Bolivia's public schools, there is a de facto rather than a de jure system of school choice, in which students sometimes choose public schools outside their enrollment areas (Urquiola 2003).

[21] On the existence of peer effects in Boston's long-running busing program, see Angrist and Lang (2002).

to largely nonindigenous schools—via financial incentives or more coercive means—could have the opposite effect. That is, gains in Spanish achievement might be traded off against losses in native language proficiency and traditional culture.

VIII. Conclusions

This article has provided new evidence on indigenous test score gaps in Bolivia and Chile. The magnitude of the gaps in both countries is between 0.3 and 0.5 standard deviations, depending on grade level and test. The results of a decomposition procedure suggest that between 50%–70% of these gaps are attributable to differences in the quality of schools and classrooms that are attended by indigenous and nonindigenous students. A smaller proportion (20%–40%) is attributable to varying endowments of family variables like parental education. An even smaller proportion of the gap (10%–20%) remains unexplained, though several possibilities were forwarded, ranging from unobserved family variables to unequal treatment of indigenous students within schools and classrooms.

Although the analysis has shown that school and classroom quality is important, the best evidence from fixed effects regressions does not indicate which differences in school and classroom quality are most responsible for the test score gap. The gap may be the result of an unequal distribution of school and classroom resources, such as instructional materials or teacher quality. It may also be the result of an unequal distribution of peer-group characteristics (some evidence provided suggestive, but hardly conclusive, evidence that peer effects are important). As the previous section emphasized, policy conclusions hinge vitally on the distinction.

There are a number of avenues along which future researchers might proceed. First, there is a scarcity of basic data on indigenous status, the sine qua non of studies like these. It is necessary to ensure that data sources like the census, household surveys, school-based surveys, and administrative data collect comparable measures of indigenous status. Some countries, especially Bolivia, are a fine example in this regard. Second, there is a scarcity of basic research that describes the distribution of variables like student outcomes across indigenous and nonindigenous students. Despite Chile's leadership in equity-based education reforms in the 1990s, for example, indigenous status is given short shrift in data reporting and, consequently, in policy discussions. Third, there is a need for empirical research that ascertains the causal impact of education reform—as well as other inputs like peers, teachers, and families—on the outcomes of indigenous and nonindigenous students. An emerging body of research in developing countries, particularly Latin America, has sought to apply experimental and quasi-experimental methods to this end, but its application to indigenous populations is limited.[22]

Appendix

TABLE A1
VARIABLE DEFINITIONS

	Bolivia	Chile
Dependent variables:		
SPANISH	Spanish test score	Spanish test score
MATH	Mathematics test score	Mathematics test score
Independent variables:		
INDIG	1 = parent or guardian reports that indigenous languages are used to communicate in the home, 0 = not	1 = mother self-identifies as member of an indigenous group, 0 = not
QUECHUA	1 = parent or guardian reports that Quechua is used to communicate in the home, 0 = not	
AYMARA	1 = parent or guardian reports that Aymara is used to communicate in the home, 0 = not	
MAPUCHE		1 = mother self-identifies as Mapuche, 0 = not
OTHINDIG		1 = mother self-identifies as member of a non-Mapuche indigenous group, 0 = not
FEMALE	1 = female, 0 = male	1 = female, 0 = male
EDMTH	Five categorical variables ranging from EDMTH1 (1 = mother completed primary education, 0 = not) to EDMTH5 (1 = mother completed higher education, 0 = not), Excluded variable is EDMTH0 (1 = mother did not complete primary education, 0 = not).	Years of mother's schooling
EDFTH	Five categorical variables ranging from EDFTH1 (1 = father completed primary education, 0 = not) to EDFTH5 (1 = father completed higher education, 0 = not); excluded variable is EDFTH0 (1 = father did not complete primary education, 0 = not).	Years of father's schooling
SEWER	1 = student's family has a sewer connection, 0 = not	
ELECT	1 = student's family has electricity, 0 = not	
PHONE	1 = student's family has a telephone, 0 = not	

[22] On the emerging use of randomized experiments, see Duflo and Kremer (2003). For recent applications of regression-discontinuity analysis, a quasi-experimental method, to the evaluation of education reforms in Bolivia and Chile, see Chay et al. (2003) and Urquiola (2003).

TABLE A1 (*Continued*)

	Bolivia	Chile
BOOKS		Number of books in the home, ranging from 1 (5 or fewer books in home) to 8 (more than 95 books in home)
INCOME		Family income
M(INDIG)	School-level mean of INDIG	School-level mean of INDIG
M(EDMTH)	Percent of children in school that have mothers with secondary school complete or higher	School-level mean of EDMTH
CSIZE	Number of students in class	Number of students in class
PRIVATE	1 = student attends private school that does not receive government subsidies and charges tuition, 0 = not	
CONVENIO	1 = student attends a private school that receives government subsidies, 0 = not	
PRIVSUB		1 = student attends a private school that receives government subsidies, 0 = not
PRIVPD		1 = student attends private school that does not receive government subsidies and charges tuition, 0 = not
RURAL	1 = rural school, 0 = not	1 = rural school, 0 = not

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