

# **Determinants of Student Achievement and School Effects in Bolivia**

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## **SUMMARY**

Improving the quality of education is a priority task for Latin America, especially in countries like Bolivia where education has become a crucial issue on the public agenda, the subject of particular concern from 1994 on, when a new Educational Reform began.

The purpose of this paper is to examine the factors that influence student performance, identifying factors associated with children and their families, along with those associated with schools and, in addition, to compare the performance of public and private schools, according to analysis of standardized performance tests.

Our statistical analysis relies on information from the System for Measuring and Evaluating the Quality of Education ((*Sistema de Medición y Evaluación de la Calidad de la Educación*, *SIMECAL*) for 6<sup>th</sup> grade students at over 500 schools.

## 1. Introduction

Bolivia has advanced significantly toward meeting the primary goal of its educational policy: universalizing educational coverage. Currently, primary education covers 90% of urban areas and 85% of rural areas. The main challenge and concern facing public policy today is how to improve the quality of education. Although it's difficult to find comparative statistics for the quality of education, a series of indicators point to problems within the Bolivian educational system: poor results obtained in a school performance study carried out by UNESCO; high failure rates among students entering the Bolivian university system<sup>1</sup>; problems with workers' qualifications; significant performance differences between elite schools and other educational institutions<sup>2</sup>.

With the 1994 Educational Reform Law, Bolivia took the first steps toward improving education quality: in the past two years, 47,919 library collections were distributed to schools;<sup>3</sup> curricula underwent modification; bilingual school texts were developed using Aymara, Guarani and Quechua; efforts have been made to improve learning processes; and, in 1997, the first standardized testing of all grade three and grade six students at 549 schools was carried out, using the Ministry of Education's System for Measuring and Evaluating the Quality of Education (*Sistema de Medición y Evaluación de la Calidad de la Educación, SIMECAL*).

The main purpose of this paper is to analyze the quality of education in Bolivia, examining factors associated with school performance and comparing performance gaps between private and public schools, as measured by the SIMECAL data.

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<sup>1</sup> Historical figures indicate that 23% of students entering a university degree program actually complete it, while those receiving degrees reaches just 14%. Although the high failure rate reflects a system in which entry into the public universities is unrestricted, as well as free (for example, in 1993, 37,131 students completed highschool and of these 27,226 went on to university), university authorities believe that deficiencies in prior education lie at the root of students' failure in post-secondary education.

### 1.1. *Quality of Education*

The educational process involves a set of inputs: students' innate ability, family, teacher, director and community characteristics, and the resources assigned to education in order to generate an educational product.

Discrepancies, however, exist, in terms of both the definition and the methods for measuring the quality of a specific educational product, given that education is a process of very low specificity.<sup>4</sup> Empirical studies measure educational quality basically by looking at indicators including student attitude, retention or drop-out rates, and the results of standardized performance tests applied to students.<sup>5</sup> Other studies offer evidence that education quality affects individual income and conclude that success in the job market is the best indicator for determining the performance of an educational system (Card and Krueger, 1990).

In this research in Bolivia, we defined the educational product as the student's individual achievement or performance, as measured by standardized tests used in the SIMECAL.<sup>6</sup> Standardized testing is the instrument of choice for most research into the educational process.

International studies indicate that differences in educational quality don't necessarily reflect differences in educational spending, class size or other school-related factors or available inputs. In terms of the impact of financial aspects in particular, for example spending per student, it has been said that there is no strong or systematic relationship between educational spending and

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<sup>2</sup> The following section refers to the UNESCO study, while Chapter III presents information on performance differences by type of school.

<sup>3</sup> Library collections included books for pre-school through grades one to eight of primary education.

<sup>4</sup> Neither the process, nor the product are clearly defined, thus making them difficult to identify and quantify.

<sup>5</sup> For a discussion of the concept "quality of education in Latin America", see UNESCO-OREAL (1994); for empirical studies, see Hanushek (1994).

<sup>6</sup> As defined by the SIMECAL, "school achievement" is a set of learning skills acquired or achieved by students, as compared to proposed educational goals. Educational Reform publications (1997).

school performance (Hanushek, 1986, 1989). With regard to other factors, there's considerable literature and research suggesting the greater importance of one factor or another, without providing a categorical answer on behalf of any one factor in particular.

### *1.2. School Performance in Latin America and the Caribbean*

Considerable international literature deals with factors affecting school performance. It's widely recognized that one of the essential factors influencing performance is family: particularly educational level and socio-economic characteristics.<sup>7</sup> As mentioned above, there is more controversy about the specific impact of other factors: spending levels, teacher and school characteristics, or other elements generally referred to as inputs into the educational process.

Over the past 25 years, researchers have carried out around a hundred projects to try to pinpoint the decisive factors influencing school performance in Latin America and the Caribbean. However, only recently do we find a few studies that specifically examine production functions, which provide a more objective base for analyzing factors influencing the quality of learning. These studies highlight educational inputs that contribute to acquiring cognitive skills, independently of the characteristics of the family medium.

Some of this research emphasizes that the availability of texts and the provision of basic infrastructure show a high correlation with performance, and they confirm the importance of preschool education to performance in primary school. Other positive relationships include: more personalized and flexible teaching methods, initial teacher training, teacher experience, teacher's presence in class, time dedicated to learning, homework, parents' participation and curriculum coverage. On the other hand, one factor that shows no consistent correlation is class size (See

study by Heyneman and Loley (1983) oriented to developing countries and Wolff, Shiefelbein and Valenzuela (1993) for Latin America).

In comparative terms, although there is little data on school performance in Latin America, what there is tends to clearly indicate that the performance of the countries of Latin America and the Caribbean tends to be significantly lower than that of the developed world and most Asian countries.

In 1992, five of the region's countries participated in a pilot study called "Third International Mathematics and Science Study (TIMSS)" carried out by the IEA<sup>8</sup>. Participating countries were Argentina, Colombia, Costa Rica, the Dominican Republic and Venezuela. Results placed public schools below the averages obtained in the United States, with the exception of Costa Rica, due to the relatively better performance of its rural public schools.

For its part, UNESCO carried out the First Comparative International Study of Language, Mathematics and Associated Factors (*Primer Estudio Internacional Comparativo de Lenguaje, Matemática y Factores Asociados*) in 1997. Grade three and grade four students were tested for language and mathematics skills in thirteen Latin American countries (UNESCO, 1998).<sup>9</sup> The study found significant differences between countries, both in performance levels and distribution of achievements. Results for Bolivia in general placed it below the regional average. Results of differences by type of school, that is, private vs. publicly owned, found that in Argentina, Bolivia

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<sup>7</sup> The importance of these factors, which are independent of the school establishment, are highlighted in a pioneering study by Coleman et. al. (1966).

<sup>8</sup> A TIMSS Pilot Study tested 13-year-old students for science and mathematics, with the sample stratified according to elite private schools, other private schools or better quality public schools, lesser public schools and rural public schools. We should note that the size of the sample was not reached using scientific methods so these results are therefore considered only for illustrative effect. *The Economist*, March 29<sup>th</sup> 1997.

<sup>9</sup> Argentina, Bolivia, Brazil, Colombia, Cuba, Chile, Honduras, Paraguay, Dominican Republic, Venezuela, Costa Rica, Mexico and Peru. We should note that results in the last three countries aren't included in the report.

and Chile private schools fared better in language testing, but this was not the case for the rest of the region's countries.<sup>10</sup>

For countries like Bolivia, whose educational performance lags behind the average for Latin America (a region that in itself lags behind international levels), improving the quality of education is crucial.

In Bolivia, few studies examine the issue of educational quality, partly because the first nation-wide standardized testing took place just recently, in 1997 (SIMECAL). The best-known study is by Morales and Pinell (1977), who analyzed school performance-related factors and found that male students on average scored better; children's age did not affect performance, and mother's education level positively influenced school results. Among school-related factors, variables including cost-per-student and the average number of students per teacher correlated negatively with performance; classes with male teachers scored better on average; and per hour salaries of teachers had no positive impact on performance.

## **2. The Bolivian Educational System**

### *2.1. Background*

Universal access to education began in Bolivia with the passing of the Agrarian Reform Law on August 2<sup>nd</sup>, 1953, when a major barrier to access to schools was finally eliminated. From the creation of the Bolivian State until 1953, the indigenous population was treated as tenant farmers

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<sup>10</sup> In Chile's case, there are significant differences between gross performance of students at private (paid) schools and subsidized schools (be these public or private), Mizala and Romaguera (1998).

or serfs, banned from education and deprived of political representation, because only literate people enjoyed the right to vote.

Once the Law was passed, the educational system expanded, particularly after the establishment of the Bolivian Educational Code of 1955. However, until 1993, there was no trustworthy information available on fundamental aspects, among them, school registration, number of teachers, administrative personnel, number of schools and conditions in which schools functioned.

Given the lack of information and the need for same in order to carry out educational reforms, in 1993, the Technical Support Team for the Educational Reform made the effort to develop a Basic Educational Map (*Mapa Educativo Básico*, BEM). The BEM consisted of a survey of each and every school in the country. This was the first effort to have real information on the number of educational units, infrastructure, equipment, students registered, teachers and administrative personnel.

Similarly, until late 1994 on, the payment system consisted solely of the accumulation of the information necessary for payment and completely lacked any control mechanisms, both for capturing information and processing payrolls. In February 1994, salary payrolls were brought up to date and standardized as part of the Registry of Teaching and Administrative Personnel (*Registro de personal Docente y Administrativo*, RTA). This process brought to light inconsistent information affecting about 60% of the payroll and duplications affecting some 15%. Among the anomalies detected were: duplication of identity cards, teachers with over 97 years on the payroll, the same person holding positions in two or more distant cities, inconsistencies in seniority and/or age, falsification of teaching degrees and inconsistencies between the program studied and

classes taught. The disorder in existence until then had permitted the existence of “ghost items”, exploited by functionaries in the administrative network involved in salary payments.

In 1994, the Educational Reform Law 1565 was passed in order to bring about the wholesale transformation of the National Educational System, both at the institutional and technical-pedagogical levels. Among its goals: to improve the quality and efficiency of education using a participatory, bilingual-intercultural system that guarantees all Bolivians equal access to education with no discrimination whatsoever.

With the Educational Reform, the concept of educational equity expanded to include not only the principals of universality and gratuity for all public schools, but also a variety of learning contexts that respected the multiple socio-cultural realities of the country’s population.

From the educational point of view, the reforms also dealt with providing support to teaching, developing guidelines for teachers, and including courses for upgrading teaching skills, along with adding pedagogical advisors to provide technical assistance to educational units.

Four years later, four positive aspects of the Educational Reform Process stand out: education has become a priority on the public agenda; intercultural issues are being addressed in Bolivia; the reform process has continued throughout the periods of different governments; a debate of technical issues has been successfully generated and institutional structures have been developed to provide educational policy with a certain level of continuity.<sup>11</sup> In spite of all this, the Educational Reform process has moved forward very slowly, partly for lack of political willpower and partly due to changes in the reform’s technical team.

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<sup>11</sup> See interviews with Amalia Anaya, Undersecretary of Education, and Víctor Hugo Cárdenas, formerly vice-president of the Republic. *Presencia*, 19/07/98.

According to information from the Basic Educational Map, as of 1993 there were 12,270 public schools, of which 81% were in rural areas. Registration had reached 1,634,260 students, of which 8% attended preschools, 78% primary schools and 14% secondary schools.<sup>12</sup> Rural registration accounted for 48% while urban registration accounted for 52% of the total.

There's also a private school system, financed directly by registration and monthly fees paid by parents, with little regulation by the Ministry of Education. In 1993, there were 840 private schools countrywide; four years later, in 1994, there were 905 private schools.<sup>13</sup> These private schools looked after 96,367 students in 1997 (about 6% of the total). By level, 5% of private school students were in preschool, 64% in primary and 31% in secondary schools.

We should point out that in the past decade, the dropping quality of public education has contributed to increased interest in private schools. Parents able to assume the cost of a private school prefer to move their children from the public to the private system, under the assumption that this way they will receive a better education. Among the factors influencing this decision are frequent strikes by the Teachers' Union, which often interrupt public school activities. Thus, private education, while still serving a small fraction of students, has grown significantly in Bolivia.

## 2.2. *Institutional Structure*

Traditionally, public education has been centralized in the national Ministry of Education; only with the reform has there been some decentralization of educational administration, with

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<sup>12</sup> Formal education in Bolivia is organized in four levels: preschool, primary, secondary and post-secondary. Preschool education lasts at least one year; primary school takes eight years and secondary education takes four years.

<sup>13</sup> Source: Department of Educational Information (*Departamento de Información Educativa*), Ministry of Education, 1995.

some activities now handled by nine Regional (*Direcciones Departamentales*) and 37 District Offices (*Direcciones Distritales*) throughout the country.

Currently, teachers are contracted at these levels, the school calendar decided, technical supervision takes place, as does monitoring of attendance and teacher and school accreditation, along with the administration of human, financial and material resources. Public school buildings were transferred to Municipal (local city) governments, which have assumed responsibility for physical infrastructure.<sup>14</sup>

Other functions of the educational system remain centralized, among them financing and distribution of resources, decisions about wage scales, upgrading programs, curricular administration, choice of school texts and their distribution, along with the System for Measuring and Evaluating the Quality of Education (*Sistema de Medición y Evaluación de la Calidad de la Educación, SIMECAL*).

The People's Participation Law, passed on April 21<sup>st</sup>, 1994 set out levels of community organization and the instances for participation in the educational system. Based on this, people are organized into Local, Sub-district and District School Boards (*Juntas Escolares, de Núcleo, Subdistritales y Distritales*); and Municipal Councils and Boards, which participate in planning, management and control of educational activities. As well, Inter-ethnic Educational Councils were set up to encourage the integration of indigenous communities into education processes.

The concrete results of these reforms remain ambiguous.

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<sup>14</sup> Note that Administration is the responsibility of the Chief Administrator of each Region (*Prefecturas de Departamento*).

### 2.3 *The Remuneration System*

All processes of the public Education Service's Remuneration System (*Sistema de Remuneraciones del Servicio de Educación Pública*) are highly centralized: salary levels (wage scale) and the number of teachers are decided centrally. However, hiring and actual payment processes are carried out in Regional or District Offices.

According to data for 1997, the number of teachers in the public Education Service reached 85,814, 34% of these in rural areas, 25% in provinces and 41% in urban areas; 58% are women and 31% of rural teachers are "temporary", that is they don't have a Normal School degree.<sup>15</sup>

The education budget is based on the total budget assigned by the Finance Ministry. Depending on the overall amount, the Ministry of Education decides the new Salary Scale for teachers. Total annual increases in the Ministry's budget and indexing of the salary scale are calculated and from there, the number of additional hours available per Department, with the Departmental Director responsible for distributing these hours among different educational establishments.

Another factor influencing salaries are negotiations between the Bolivian Workers Center (*Central Obrera Boliviana, COB*) and the government to set the national minimum wage. Based on this amount, the Teachers' Union negotiates an additional increase for the public Education Service, to be applied to the Salary Scale from the previous management period. They thus define the Teachers' Salary Scale, which every year establishes the "base salaries" for sixteen positions on the scale in each of three areas, urban, provincial and rural.

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<sup>15</sup> Normal Schools for teachers are the only higher education institutes offering teacher training in Bolivia. For 1999, the government has proposed transferring this activity to universities.

As a result, base salaries are relatively rigid. Base salaries, as they figure in the Salary Scale, correspond to 72 hours per month; that is, the number of hours per week worked is much lower on average than for other sectors in the economy, which according to the Labor Code normally assume a 40-hour week.<sup>16</sup>

When it comes to teacher hiring, the practice of selection or “competency examinations” does not exist. In general, the only requirement is experience in the position or a graduation certificate from a Normal School. Although in theory the supply of teachers should be composed of Normal School graduates, in practice another category known as “temporary teachers” exists, consisting of people who are hired to work as teachers without having the relevant studies, nor specific training to serve as teachers. Due to the shortage of Normal School teachers, provincial and rural communities often hire high school or worse, primary school graduates to teach.

The teacher who enters the public Education Service enjoys tenure status, known as *inamovilidad funcionaria*, that is, she or he cannot be removed from a posting; the National Registry Regulation (*Reglamento de Escalafón Nacional*) establishes that once teachers have registered they cannot be removed from their positions; that is, they cannot be fired, suspended or transferred from their positions, unless a trial has demonstrated that they have committed immoral, criminal or undisciplined actions worthy of suspension<sup>17</sup>. In contrast, teachers working in the private system are covered by the private sector work code and do not enjoy this particular benefit peculiar to the public sector.

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<sup>16</sup> At this point, we should explain why Bolivian teachers work only 72 hours. In the past, teachers worked 48 hours by the clock per month, divided into two shifts (morning and evening). With Supreme Decree #10704, February 1973, class hours were reduced to 72 “pedagogical hours”, that is 40-minute periods. So in effect, they work 72 pedagogical hours, the equivalent of 48 hours by the clock. This measure made it possible to organize most schools to receive two shifts (morning and evening) of four hours apiece, or 6 periods. This measure was adopted due to lack of school buildings.

<sup>17</sup> There is no evidence that a process of this kind has taken place in the past 40 years. Legal Department (*Asesoría Legal*), Ministry of Education.

Another problem evident in the public sector is the high turnover rate of teachers: about 30% of the payroll between February and April.<sup>18</sup> During this period, vacancies occur that cannot be covered immediately by other teachers. As a result, the school year gets held up. Turnover is higher in rural areas, given that many rural teachers hope to migrate to the city; when this happens, they leave their position and hiring a new teacher may take weeks or even months.

The delay between the moment in which a vacancy occurs and the hiring of a new teacher is basically due to the lengthy and bureaucratic process involved in hiring; there's no unemployment office where teachers can register and be assigned to a school according to distance or other personal preferences. Nor is there a computerized system registering teacher supply and demand so, as a result, the process for replacing a teacher is slow and takes weeks. As well, a teacher's appointment often depends on the regional supervisor, whose decision may not reflect technical concerns.

Retirement is voluntary and is an unattractive alternative for eligible teachers, given that pension levels are considerably lower than salaries for active teachers. Also, indexing for pensioners is lower than for active workers. According to the Ministry of Education, in 1997, 3,005 people retired, that is, 3.5% of the payroll.

Other factors also influence the decision to pursue a teaching degree and enter the public Education Service. In the first place, the Bolivian Educational Code forces the government to hire everyone who graduates from a Normal School indefinitely. Secondly, the system provides substantial benefits to all employees and their dependents, the most important being health insurance: the National Health Plan covers all medical costs for the teacher's family group. Thirdly, as we mentioned above, teachers can't be removed from their posts. Finally, retirement

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<sup>18</sup> The school year is from February to November.

is covered by a Teachers' Basic Fund and Complementary Fund that guarantees pensions to all teachers who have completed 25 years of service and reached retirement age.

In contrast with the above, salary levels seem to act as a disincentive, both for entering the public Education Service and remaining in it.<sup>19</sup> Low salary levels would explain the tendency for teachers to work at evening schools and thus maintain their seniority in the system at the same time as they carry out other, better remunerated work during the day.

As well, in spite of the fact that rural salaries are higher than urban salaries<sup>20</sup>, it has been observed that rural teachers systematically abandon their rural positions. This seems to indicate that the gross difference in salaries does not compensate enough for the higher cost in terms of opportunities entailed in staying in rural areas, among these, for example, access to electricity, sanitary services, better transport and infrastructure, possibilities for ongoing training, and access to extra jobs offering better wages.

### 3. *Educational Quality and Associated Factors*

We will use an empirical analysis of the System for Measuring and Evaluating the Quality of Education (*Sistema de Medición y Evaluación de la Calidad de la Educación, SIMECAL*) as the basic information in our examination of educational performance in Bolivia. As we mentioned, SIMECAL was applied for the first time in 1997, testing grade three and grade six students' language and mathematics skills.<sup>21</sup> Surveys were applied as well to students, parents of each

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<sup>19</sup> However, Piras and Savedoff (1998) estimate that no negative differential exists for salaries for Bolivian teachers.

<sup>20</sup> The difference amounts to about 20% (US\$25).

<sup>21</sup> Formal primary education was chosen because this is the main way that the National Educational System proposes to ensure students obtain basic learning from grades three to six, achieving functional ability in reading comprehension, verbal and written language ability and notions of mathematical thought. (Publications, Educational Reform, 1997c). It has been demonstrated that learning acquired in language and mathematics during primary education is the main instrument to gain access to any other learning-related skills.

student, teachers of mathematics and language, school directors and the respective community leaders.

In the US, a number of studies have examined the factors influencing students' performance, along with the relative performance of public vs. private schools (see Coleman (1985), and Levin (1998), among others). In Latin America's case, the only similar studies are for Chile, based on the national school performance test known as SIMCE (Aedo and Larrañaga (1994), Aedo (1997), Carnoy and McEwan (1997) and Mizala and Romaguera (1998)).

In this paper, we will analyze the quality of education in Bolivia, comparing public and private sector performance on the basis of SIMECAL results. We'll start by presenting overall gross performance scores of public and private sector students, followed by an econometric analysis, to be carried out on the language test results for Grade Six.<sup>22</sup>

Table 2 shows that the differences between public and private school student performance is 7.92 points (24.95 vs. 17.03).

Table 2. SIMECAL Test Results Performance, by Parents' Educational Level. Grade 6 (maximum score = 35)

Parents' educational Level (a)	Schools	
	Private	Public
No education	--(b)	15.28
Primary	20.74	16.37
Secondary	23.05	17.22
Technical	24.84	18.09
Normal School	25.18	17.41
University	26.61	18.16
<b>Total</b>	<b>24.95</b>	<b>17.03</b>

(a) Identifies the parent with the highest educational level.

(b) Number of observations too low.

<sup>22</sup> We used this test because we believed that the information thus obtained was of better quality for the purposes of this study. We must remember that this was the first time a test of this kind was applied in Bolivia.

We found that as expected, students performance increased with parents' educational level. However, differences previously apparent between public and private schools remain, independently of the parents' education level. As well, private schools seem to obtain higher returns with respect to parents' educational levels.

As well, public school students' performance is, on average, poorer than private school students'.<sup>23</sup> In the next section, we will evaluate whether these differences are statistically significant.

## 1. **Associated Factors**

This study on Bolivia allows us to examine the impact of several variables, including the student, the home, the teacher and the school, on performance. The appendix includes a more detailed description of the variables used.

One of the main variables associated with students' performance is the family's socio-economic level and specifically, parents' education level: This last variable was considered to be the most significant in 60% of the studies done in Latin America and the Caribbean (Wolff, Shiefelbein and Valenzuela, 1993).

The literature also identifies another problem affecting performance: lack of support in the home, a characteristic of the homes of lower-income groups. These children lack reading material in their homes and may even be the children of illiterate parents; similarly, their mother tongue may be a native language, but they are nonetheless taught in Spanish.

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<sup>23</sup> These differences are higher if we only consider elite private schools.

Some studies demonstrate that teachers' experience and training have a significant bearing on students' performance (Costa, 1977). But other studies suggest that teaching upgrades, by service training, don't seem to improve the academic results of students (Harbison and Hanushek, 1992). In contrast, the knowledge that teachers have of their subject, their experience in the use of didactic material and their expectations in terms of students' are variables associated with improved student performance (Purves, 1973).

Another variable for which research provides no conclusive answer is the student-teacher relationship, given that, in spite of expectations to the contrary, there have been cases where larger class size was associated with improved performance (Hanushek, 1992). In Bolivia during the eighties, policy called for increasing the number of students per teacher from 20 to 25 and, according to SIMECAL data for 1997, there were 28 students per professor.

With regard to the characteristics of each teacher, pedagogical practices including availability of time and home work are positively associated with students' performance (Psachropoulos, 1993). Teachers' absenteeism is associated with poorer performance and, on the contrary, the more the hours (the more teaching time), the more positive student performance (Avellar-Flemin, 1989).

In terms of school characteristics, most infrastructure indicators consider not only building quality, but also the presence of furniture, equipment and access to electricity and water. The effect of this variable is ambiguous, with some studies finding a positive correlation and others finding none at all (Arriagada, 1983; Sanguinety, 1983; and Harbison and Hanushek, 1992). Some studies conclude that these factors have more impact on performance when students are from low-income families.

There is also a positive relationship between availability of didactic material and student performance (Purves, 1973; Shiefelbein and Clavel 1977). Access to other didactic material, like globes, maps, etc. has a combined, positive effect on performance (Costa, 1977; Husen 1978; and Jamison 1981). Studies underline the importance of didactic material and libraries as crucial elements contributing to improved performance in primary school. In this regard, in spite of the fact that Bolivia took an enormous step forward, given that as part of the Reform, collections of books and didactic materials have been distributed to many schools, according to the SIMECAL survey, 50% of teachers say that have no library at school and 34% say they have no texts for students.

Finally, we find urban schools, schools with one shift, schools with one gender, and morning schools enjoying better results (Wolff, Shiefelbein and Valenzuela 1993).

### **3. Educational Performance Results**

Our analysis of the factors influencing student performance follows. We rely on an estimate for the production function using a cross-section model, given the limited data – there has only been one SIMECAL test, that of 1997 – which don't allow added value estimates. Further along, we'll elaborate on the specific impact of schools on student performance.

#### *3.1. Estimate for the Educational Production Function*

The general model is as follows:

$$T = X \alpha + Y \delta + Z \partial + \mu \quad (1)$$

T= Score on Grade 6 language test, 1997

X = matrix of student and family characteristics

Y = matrix of teacher and teaching method characteristics

Z = matrix of school characteristics

Table 3 presents the results for the four models, all based on the same general specification. Columns 1 and 3 provide OLS estimation, using different values for the variable parents' educational level. As detailed in the appendix, the SIMECAL survey identifies the parents' educational level. Model 1 includes an additional eight categories for parental educational level that are pretty common in these kinds of specifications. However, this classification requires adding information using certain post-survey criteria, so we maintained the initial definition of educational level in Model 3. Columns 2 and 4 give the results when corrected for selection bias. As is well-known, selection bias can be a problem when it comes to educational results.<sup>24</sup> To correct this, we use a model similar to treatment effects, where Z – the binary variable – is independent of the equation for student performance. In both models, the lambda variable that identifies selection bias is positive and significant.

The results of these estimates indicate that both home and school-related variables have a significant impact on students' performance in Bolivia.

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<sup>24</sup> See several studies by J. Heckman in this regard. The appendix includes results from the probit model used to correct selection-related bias.

**Table 3. Factors Influencing Student Performance  
Grade Six Language Test, Bolivia, 1997**

Variables	All Schools			
	OLS (1)	Selection (2)	OLS (3)	Selection (4)
Constant	14.412 (34.565)	16.289 (26.794)	13.928 (21.212)	15.305 (18.815)
Mother tongue (native)	-1.251 (-8.913)	-1.242 (-8.854)	-1.160 (-8.279)	-1.160 (-8.305)
<i>Parents' Education:</i>				
Primary	0.390 (1.326)	0.368 (1.246)	(a)	(a)
Incomplete Studies	-0.472 (-1.175)	-0.494 (-1.223)		
Secondary	0.597 (1.967)	0.433 (1.412)		
Incomplete Technical	0.422 (1.224)	0.330 (0.953)		
Normal School	0.979 (2.897)	0.785 (2.293)		
Post-Secondary Technical	2.132 (6.496)	1.488 (4.105)		
University	2.811 (7.998)	1.898 (4.596)		
Child lives with parents	0.666 (5.892)	0.651 (5.759)	0.698 (6.189)	0.690 (6.134)
N° books in home	0.015 (11.134)	0.015 (11.124)	0.014 (10.324)	0.014 (10.389)
Mother helps with homework	0.746 (6.658)	0.737 (6.588)	0.564 (4.997)	0.562 (4.996)
<i>Teacher category:</i>				
Fourth	2.948 (13.644)	2.910 (13.460)	2.855 (13.376)	2.840 (13.338)
Third	2.843 (12.203)	2.800 (12.014)	2.816 (12.230)	2.795 (12.167)
Second	3.459 (16.603)	3.447 (16.549)	3.334 (16.190)	3.339 (16.258)
First	4.418 (21.864)	4.370 (21.602)	4.300 (21.524)	4.281 (21.477)
Higher	5.969 (26.950)	5.895 (26.555)	5.853 (26.682)	5.811 (26.509)
Merit	4.375 (15.427)	4.291 (15.107)	4.247 (15.082)	4.197 (14.919)
Homework every day	1.006 (6.823)	1.004 (6.817)	1.027 (7.062)	1.025 (7.070)
Public school	-3.626 (-17.958)	-5.423 (-11.564)	-3.260 (-15.886)	-4.566 (-9.116)
Infrastructure Index	0.341 (5.148)	0.323 (4.866)	0.330 (5.030)	0.320 (4.880)
Special Rooms Index	0.647 (10.530)	0.643 (10.477)	0.601 (9.940)	0.597 (9.905)
Class Size	-0.010 (-1.814)	-0.011 (-2.032)	-0.010 (-1.766)	-0.011 (-1.982)
School Size	0.008 (8.467)	0.078 (8.213)	0.008 (8.414)	0.008 (8.308)
School shifts (+1 shift)	-0.502 (-4.612)	-0.501 (-4.605)	-0.475 (-4.400)	-0.472 (-4.387)
Urban	0.231 (1.535)	0.217 (1.444)	0.213 (1.428)	0.216 (1.453)
Lambda		1.106 (4.251)		0.793 (2.860)
N	12,362	12,362	12,138	12,138
R2 adj.	31.41%	31.50%	31.64%	31.04%
F	227.40	219.65	75.96	71.95

(a) Includes 34 education dummy variables for mother and 26 for father as detailed in Appendix.

Table 4  
Factors Influencing Student Performance Private and Public Schools  
Grade Six Language Test, Bolivia, 1997

Variables	Public Schools		Private Schools	
	OLS (1)	Selection (2)	OLS (3)	Selection (4)
Constant	10.694 (16.491)	10.692 (16.535)	11.726 (10.328)	15.606 (10.530)
Mother tongue (native)	-1.173 (-8.083)	-1.173 (-8.112)	-1.722 (-3.191)	-1.780 (-3.353)
Parents' Education:	(a)	(a)		(b)
Child lives with parents	0.800 (6.448)	0.801 (6.471)	-0.019 (-0.072)	©
N° books in home	0.014 (9.066)	0.014 (9.097)	0.013 (4.962)	0.013 (4.953)
Mother helps with homework	0.724 (5.712)	0.724 (5.733)	-0.264 (-1.097)	-0.278 (-1.183)
<i>Teacher category:</i>				
Fourth	2.629 (11.612)	2.631 (11.648)	5.736 (7.740)	5.669 (7.803)
Third	2.721 (10.772)	2.722 (10.810)	5.552 (7.873)	5.201 (7.463)
Second	3.004 (13.644)	3.004 (13.691)	6.673 (9.621)	6.408 (9.381)
First	4.277 (20.173)	4.278 (20.230)	6.024 (8.833)	5.797 (8.646)
Higher	5.709 (23.872)	5.710 (23.928)	8.261 (12.116)	7.868 (11.646)
Merit	3.972 (13.019)	3.973 (13.048)	7.804 (9.379)	7.534 (9.175)
Infrastructure Index	0.327 (4.451)	0.327 (4.467)	0.492 (2.804)	0.435 (2.502)
Class size	-0.098 (-1.303)	-0.010 (-1.292)	-0.017 (-1.880)	-0.016 (-1.889)
School Size	0.011 (8.702)	0.011 (8.734)	0.051 (3.432)	0.004 (2.769)
Special Rooms Index	0.489 (6.230)	0.488 (6.241)	0.516 (3.888)	0.542 (4.129)
School shifts (+1 shift)	-0.417 (-3.517)	-0.416 (-3.527)	-0.612 (-2.037)	-0.398 (-1.322)
Lambda		-0.035 (-0.083)		1.699 (3.913)
N	10,625	10,625	2,011	2,011
R2 adj.	16.74%	16.73%	27.46%	26.99%
F	29.11	28.73	12.35	11.93

(a) Includes 34 education dummy variables for mother and 26 for father.

(b) Includes 30 education dummy variables for mother, and 22 for father.

(c) This variable excluded due to problems of multicollinearity for private schools.

As far as home-related variables go, the first thing that stands out is the negative coefficient for mother tongue, that is, where the language spoken at home is native, reflecting the problem that children from indigenous homes continue to face, even in sixth grade.<sup>25</sup>

Variables associated with parents' education levels are highly significant in all models. Children's performance is negative where they come from homes where parents are illiterate and performance is highest where parents' educational level is Post-Secondary Technical and University. Other very significant home variables, although the coefficient is lower: if the child lives with parents<sup>26</sup>, the number of books in the home, and if the mother helps with homework.

In terms of teacher-related variables, the powerful impact of the teachers' category (a classification associated with years of experience) is remarkable, particularly given that this variable isn't always significant in international studies. In Bolivia's case, there's a strong difference between teachers with no experience (the dummy variable omitted corresponds to Fifth Category and "Temporary" teachers) and those with degrees and over four years working experience; a situation that we believe is directly related to teacher training problems mentioned above. As well, if students have homework everyday there's a significant improvement in their performance.<sup>27</sup>

Finally, there's a whole set of school-related variables that are also significant. In the first place, the public school dummy variable is both negative and significant. The different variables associated with the quality of the school's physical infrastructure are also significant: the school

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<sup>25</sup> The main native languages are Quechua, Aymara, and Guaraní.

<sup>26</sup> In Bolivia's case, a significant percentage of children don't live with their parents for economic reasons or because of the distance between home and school.

<sup>27</sup> This is the only teaching-method-related variable that was significant in our models. The SIMECAL survey included other questions on teaching methodologies, among them: how material was presented in class (teacher's exposition, student groups, etc.); how teacher reacts to anger in class; emphasis on rigor rather than patience, etc. Nonetheless, the ambiguous way in which these concepts are measured can also affect statistical results.

infrastructure index measures the quality of the building, bathrooms, electricity, sewage and drinking water; the special rooms index – which is even more influential – measures the quality of the library, the laboratory and the computer room. Variables for class size and school size must be considered together: school size is highly significant, with students averaging better performance rates in larger schools (as has been observed in Chile as well<sup>28</sup>); while, given school size, class size also tends to have a negative impact on performance, although only in some models does it reach a significant level (5%). The school size issue has not been studied in depth, but in our judgment is related to aspects that favor administration and economies of scale.<sup>29</sup>

If the school works on a double shift system, with classes in the morning and the afternoon, that also has a negative effect; in contrast, one-shift schools, which can therefore have longer school days, have better performance rates.

Thus, although home-related variables are, as usually believed, very significant in influencing students' performance at school, a series of school-related variables are also very significant.

Table 4 includes the performance equation for each sector (public and private schools), corrected for Selection bias.<sup>30</sup> In the case of private schools, the selection variable is positive, indicating that these schools receive children with relative advantages from the point of view of parents' education and the home's socio-economic indicators.

Home-related variables tend to be more significant in the case of public rather than private schools, although the impact of mother tongue and number of books at home remains.

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<sup>28</sup> See Mizala and Romaguera (1998).

<sup>29</sup> For example, in Chile's case, there's a significant trend among private schools financed with state subsidies to increase their size and merge into corporations. See *El Mercurio*, October 15<sup>th</sup>, 1999.

<sup>30</sup> In this case, we only developed estimates for this model by breaking down educational information to identify the most relevant factors, especially in the case of private schools.

Teacher-related variables, particularly experience and homework assigned daily, are significant in both types of schools. Variables associated with school size and infrastructure also remain significant.

### 3.2. *Schools' Impact on Students' Performance Rates*

To further examine the school's impact on students' performance rates, we developed a new model including dummy variables by school and control variables for student and family characteristics. In spite of the fact that the literature has tended to emphasize families' and particularly socio-economic conditions' impact on students' performance rates, school-related impacts (associated with these dummy variables) are highly significant in Bolivia's case, confirming a hypothesis developed as well in Chile, in which – at least in Latin America – we find significant performance differences among schools serving very similar students.<sup>31</sup>

The model follows:

$$T = X \alpha + S \beta + \mu \quad (2)$$

and, for the sake of comparing results, we also estimate the gross effects of schools (without controls) as:

$$T = S \gamma + v \quad (3)$$

$\beta$  coefficients were normalized as differences with regard to the mean, weighted by school size (number of students). Thus, the reported betas are:

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<sup>31</sup> See Mizala and Romaguera (1998).

$$\hat{\mathbf{b}}_i = \hat{\mathbf{b}}_i - \sum_{j=1}^{s-1} \hat{\mathbf{b}}_j * \frac{n_j}{N} \quad (4)$$

Where  $s$  is the number of schools,  $n_j$  the number of students at the school,  $j$ , and  $N$  is the total number of Grade 6 students who sat for the SIMECAL examination.<sup>32</sup>

Table 5 provides the results from the three equations specified:

Table 5. Summary of Students' Performance Regression

Independent variables and equations	R <sup>2</sup> Adjusted	Standard Deviation	N
Equation 1: X, Y, Z	31.41%	5.78	12,362
Equation 2: X, S	44.40%	5.18	13,194
Equation 3: S	43.20%	5.24	13,481

*Range of School Impacts*

	Minimum	Maximum	Standard Deviation	N
Equation 2: X, S	-17.40	9.95	5.04	342

Note: Matrix X includes parents' education, by most educated parent. By including matrices with teacher and school characteristics (Y, Z) some observations are lost, given that we don't have complete information for all schools.

The first thing that stands out is the enormous explanatory power of school impacts: the R<sup>2</sup> of Equation 3 is higher than Model 1. This could indicate that schools are important to explaining student performance differentials. However, the independent variables used so often in the

literature may not be appropriate, or to express this differently: schools are important to explaining performance, but we can only partially identify the factors behind these effects.<sup>33</sup>

Graphs 7 and 8 provide school-related effects, by public and private school systems. We can see that the median of the school effect is lower for public than for private schools, reflecting the difference in quality between the two. It's interesting to note that in both cases we have schools with very high scores, however, the main difference is to be found in the left column. Private schools are more homogenous. In contrast, public schools show a wide range of results, with a minimum reported beta of  $-17.40$  and a maximum of  $9.95$ . In summary, our estimates underline the importance of the school effect in explaining differences in the quality of the educational process and the relatively poorer performance of a segment of public schools.

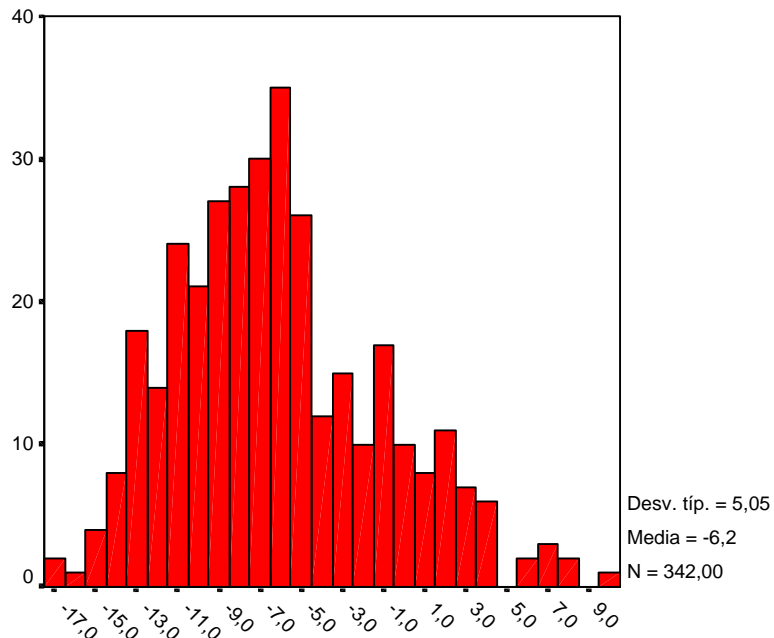
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<sup>32</sup> This methodology is similar to that used to estimate interindustry salary differentials. See Krueger, A., and L. Summers (1998) and Gatica J.; Mizala A.; Romaguera P., (1995).

<sup>33</sup> Although we must note that unlike most of the international literature, results for Bolivia identify a larger number of school characteristics as statistically significant. One explanation could be the greater variance in these characteristics.

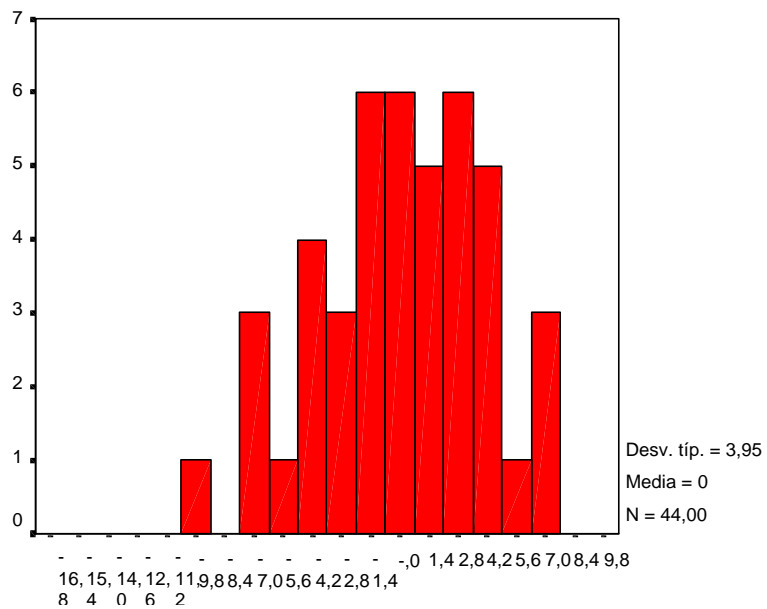
Graph 7: School Effect on Students' Performance. Public Schools

(reported beta coefficients)



Graph 8: School's Effect on Student Performance. Private Schools

(reported beta coefficients)



Nota: La regresión incluye la matriz X como variables de control.

Note: Regression includes x matrix as control variables.

## 5. Conclusions

In recent years, Bolivia has begun a reform process whose goal is to improve the quality of education. As part of this reform process it has measured student performance using standardized tests of educational achievement (SIMECAL).

This study uses the results from the first of these tests to be applied in Bolivia to examine the factors that influence student performance rates.

Estimates based on a function of educational production reaffirm the importance of home-related variables to children's school results, a hypothesis that has been confirmed by numerous international studies. In Bolivia's case, not only parental education level is crucial to determining student results, but also other variables that reflect the specific context of a developing country, including the disadvantages faced by the indigenous population, children who for study or economic reasons don't live with their parents, and whether or not the mother helps with her children's homework.

However, this study demonstrates that school and teacher-related variables are also very important. Previous studies have shown a tendency to indicate that educational inputs were more important in developing than developed countries. This study reaffirms this hypothesis. Variables, including teacher's experience, daily homework assignments, infrastructure indicators and school size are statistically significant. Possibly the greater variance within the school systems of developing countries would allow us to better test the influence of this kind of input into the educational process.

As well, public schools show a poorer student performance rate than do private schools. These results remain constant when controlled for socio-economic and educational levels of the home. This constitutes a significant challenge for educational policy in developing countries like Bolivia, given that it will be necessary to reduce the student performance gap so that education really becomes a genuine vehicle for social mobility and improved income distribution, as the Bolivian government's programs and international organizations' recommendations propose.

Schools' incidence can be appreciated more clearly in the regressions for *school effect* via dummy variables, using much the same methodology as that used to estimate interindustry salary differentials. These school effects, at least in Bolivia's case, are not only significant, they're of considerable magnitude. This suggests that these effects have been underestimated in the literature on determinants within the educational process, because it has not been possible to find an appropriate way to identify specific variables (inputs) that reflect this school effect.

If the results indicated in Bolivia's case recur in other developing countries, this would imply new challenges to educational policy, in the sense of emphasizing schools' responsibility. Since the pioneering study by Coleman *et. al.* (1966), in the case of the United States, the results of studies of educational production functions have emphasized the influence of family and context on school performance. Our study, without neglecting the importance of these factors, also underlines the impact that school-related factors have on the educational performance rates of our children.

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## **Appendix A: Definition of Variables**

### **1. Child and Home-Related Variables**

#### **Child lives with parents:**

Dummy variable assumes value of 1 if the answer to the question “Who does the child live with?”, is “both parents”. It takes value 0 in the case of: “father only, mother only, grandparents only, brothers and sisters only”.

#### **Home’s socio-cultural level:**

Discrete variable. Response options are: high, medium, low, very low.

#### **Information at Home, based mainly on:**

Each family is asked about the main source of information; alternative answers include: newspaper, radio, television, or they don’t stay informed because they don’t have time, or they receive their information from other media or people. Based on this information, we built the dummy variables:

**Newspaper:** Dummy = 1 if this is the family’s main source of information; = 0 if the reply is other;

**Radio:** Dummy = 1 if this is the family’s main source of information; = 0 if the reply is other;

**Television:** Dummy = 1 if this is the family’s main source of information; = 0 if the reply is other.

#### **Language score:**

Results on the language test for grade six students, 1997.

#### **Mother helps with homework:**

Dummy = 1 if the answer to the question: Who helps the child with homework? is “Both parents” or “Just the mother”; = 0 if the answer is: “just the father”, “just brothers and sisters”, “others” or “no one”.

#### **Mother language:**

Dummy = 1 if mother language is other than Spanish (Quechua, Aymara, Guaraní, Other); = 0 if the reply is Spanish.

#### **Number of books in home:**

Continuous variable measuring the number of books in home.

#### **Parental education:**

Information on parents’ educational levels is classified by level and grades, according to the following definitions:

Level: None, Primary, Intermediate, Secondary, and Information not available;

Degree: No Degree, High School, Secondary Technical, Post-Secondary Technical, Normal School, University Graduate, Full Honors Degree, Post-Graduate.

So there are 40 alternatives for classification.

Educational information was processed in two ways:

- (i) Disaggregated, establishing a dummy variable for each combination of level and degree. Given that some classifications contain no information, in total we obtained 35 education dummy variables for the mother and 27 education dummy variables of the father. The regression included both father’s and mother’s educational dummy variables.
- (ii) We added information, combining classifications of level and degree for the following categories: no education, incomplete studies, primary education, secondary education, incomplete technical, normal school, post-secondary technical and university. The regression took into account the highest educational level (whether for father or mother).

Given that this aggregation was to some degree arbitrary in its classification, we present results using both forms of classification.

## 2. School and Teacher Variables

### **Class size:**

Number of students per class.

### **Daily homework**

Dummy variable = 1 if the answer to the question: “Do you get homework?”, is “every day”; dummy variable = 0 if homework assigned less often.

### **Public school:**

Dummy variable = 1 if the school is public; dummy variable = 0 if the school is private.

### **Region (Department):**

Corresponds to the school’s geographic location. The Regions are: Chuquisaca, La Paz, Cochabamba, Oruro, Potosi, Tarija, Santa Cruz, Beni, Pando.

### **School infrastructure index:**

Variable constructed using the multiple correspondence analysis (MCA) method, using information from questions about the quality of the school building, bathrooms, electricity, sewage and drinking water. Each of these aspects was graded from 1 to 5.

### **School shifts**

Dummy variable = 1 if the school has morning and afternoon shifts; that is, more than one shift; dummy variable = 0 if the school has just one shift (morning, afternoon or evening).

### **School size:**

Number of students per school.

### **Special rooms index:**

Variable constructed using MCA, based on information from questions about the following: library, laboratory and computer room. Each aspect was graded from 1 to 5.

### **Teacher categories:**

Correspond to the teacher’s classification within the national teachers’ registry, which varies according to recognized years of experience and degree; promotions occur every four years. Categories are as follows:

**Merit:** 24 years or more experience

**Higher or Zero:** 20 to 24 years of experience

**First:** 16 to 20 years of experience

**Second:** 12 to 16 years of experience

**Third:** 8 to 12 years of experience

**Fourth:** 4 to 8 years of experience

**Fifth:** under four years of experience

**Temporary:** no category

The Fifth and Temporary classifications are identified in the survey as 0 years of experience and we have used them as the omitted dummy variable.

### **Urban:**

Dummy variable = 1 if school in an urban area; dummy variable = 0 if in a rural area.

APPENDIX B  
 Probit Estimate for Public or Private School Attendance  
 (Public School dependent variable = 1)

Variables	Models	
	(1)	(2)
Constant	2.496 (11.613)	2.251 (8.240)
<i>Parents' Education:</i>		
Primary	-0.252 (-1.266)	(a)
Incomplete Studies	-0.209 (-0.884)	
Secondary	-0.835 (-4.220)	
Incomplete Technical	-0.626 (-3.043)	
Normal School	-1.022 (5.049)	
Post-Secondary Technical	-1.573 (-7.923)	
University	-2.008 (-10.038)	
High socio-economic level	-1.100 (-7.315)	-1.030 (-6.708)
Medium socio-economic level	-0.688 (-6.510)	-0.542 (-5.220)
Low socio-economic level	-0.455 (-4.725)	-0.294 (-3.207)
<i>Home stays informed primarily via:</i>		
Newspaper	-0.161 (-1.512)	0.017 (0.158)
Radio	0.430 (10.276)	0.449 (10.379)
Television	-0.199 (-3.387)	-0.068 (-1.124)
<i>Regions (Departamentos):</i>		
Chuquisaca	-0.283 (-4.872)	-0.230 (-3.755)
Cochabamba	0.886 (1.882)	0.095 (1.960)
Oruro	0.863 (12.454)	0.920 (12.742)
Potosi	1.262 (11.753)	1.395 (12.424)
Tarija	0.308 (5.104)	0.277 (4.412)
Santa Cruz	0.538 (9.588)	0.581 (9.993)
Beni	0.354 (5.657)	0.406 (6.272)
N	13,194	13,481
- 2 Log likelihood	7,627.62	7,248.16
Chi-squared	3,674.57	4,217.56
% correct classification	87.87%	89.26%

(a) Includes 32 education dummy variables for mother and 23 education dummy variables for father, classified by type and level as detailed in Appendix.