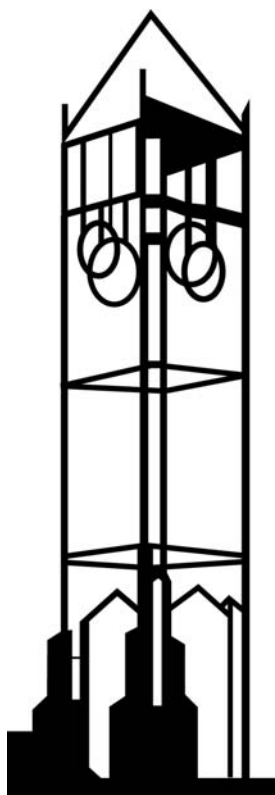


# Does Local School Control Raise Student Outcomes?: Evidence on the Roles of School Autonomy and Parental Participation

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# Does Local School Control Raise Student Outcomes?: Evidence on the Roles of School Autonomy and Parental Participation<sup>1</sup>

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**Abstract**

School autonomy and parental participation have been frequently proposed as ways of making schools more productive. Less clear is how governments can foster decentralized decision-making by local schools. This paper shows that across eight Latin-American countries, most of the variation in local control over school decisions exists within and not between countries. That implies that the exercise of local authority to manage schools is largely a local choice only modestly influenced by constitutional stipulations regarding jurisdiction over school personnel, curriculum and facilities. As a consequence, estimated impacts of local school autonomy, parental participation or school supplies on student performance must account for the endogeneity of local efforts to manage schools. Empirical tests confirm that local managerial effort by the principal and the parents and the adequacy of school supplies are strongly influenced by parental human capital and the size and remoteness of the community, and that these effects are only partially moderated by central policies regarding the locus of control over the schools. Correcting for endogeneity, parental participation and adequacy school supplies have strong positive effects on 4<sup>th</sup> grade test performance, but school autonomy has no discernable impact on school outcomes.

## Does Local School Control Raise Student Outcomes?: Theory and Evidence on the Roles of School Autonomy and Community Participation

“All around the world in matters of governance decentralization is the rage.” (Bardhan, 2005)

As early as 1962, international agencies such as the United Nations and the World Bank were advising that the decentralization of public service delivery could serve as a development strategy. The strategy has become even more prominent over the past 15 years, particularly in education.<sup>2</sup> Decentralization efforts in developed countries include various programs in Australia, Canada, New Zealand, Spain, the United Kingdom, and in at least 44 states in the US. Among the developing countries, Burkina Faso, Brazil, Chile, Colombia, El Salvador, Honduras, India, and Nicaragua have introduced new programs aimed at devolving power to the local schools. Even the autocratic government in Pakistan initiated an effort to devolve responsibility for school management to local authorities, removing a functioning democracy as a necessary precondition for school decentralization.

The move toward more local control is motivated by the belief that decentralized control will result in better school outcomes, holding constant the level of resources devoted to the school. Local decision-makers should have more information on local needs and conditions and can adjust resource allocations accordingly. Central dictates that are aimed at maximizing welfare on average may oversupply the service in some areas and undersupply it in others. Local officials should better respond to local needs because they are more exposed to pressure from constituents and because they may use quality public services to attract or retain residents.

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<sup>2</sup> Bird and Vaillancourt, 1998; Bray and Mukundan, 2003; Fiske, 1996; and Walker, 2002 for reviews of the progress of efforts to decentralize educational service delivery.

Evidence from various countries suggests that decentralized decisions change how resources are allocated. Faguet (2004) found that when Bolivia devolved authority from the center to the municipal level, resources were reallocated away from large-scale projects to smaller education and sanitation projects and from richer to poorer communities. Galasso and Ravallion (2005) found that when local community groups were allowed to identify beneficiaries in a Bangladesh food transfer program, the benefits were better targeted to poorer households. Alderman (2001) reported better targeting from decentralized transfer programs in Albania.

While studies suggest that decentralized authority can alter resource allocations and improve targeting to the needy, there is less evidence that desired outcomes are enhanced by local control. In the case of schooling outcomes, even the most supportive studies tend to argue that decentralization helps some schools but not others. There are numerous reasons why local control may yield poor outcomes. Bardhan (2002, 2005) argues that autonomous decisions are particularly prone to fail in developing countries. First, populations may not be mobile, and so households may not move because of poor quality public services. Second, local officials may be subjected to undue influence by prominent local families seeking to divert public resources towards their private needs. A related problem is that there may be no tradition of monitoring of local officials by local residents, so presumptions of greater accountability with local control may not hold in fact. Finally, local officials may lack the necessary experience or skills to manage resources in countries with few well-educated professionals. Any of these problems could create difficulties for decentralized school systems.

This study examines how local control of schools affects student outcomes across eight Latin American countries. We focus on one possible reason for previous mixed findings regarding the impact of school autonomy and/or community participation on learning: that local

managerial effort is itself a choice. Any effort to devolve authority to the local school level will require that local school principals, teachers, parents or community leaders choose to exert effort to manage the school. This endogeneity of local school managerial effort complicates the interpretation of the cross-sectional pattern of learning outcomes and reported school autonomy or local community school participation. We illustrate the problem using a data set composed of individual child achievement test scores for 3<sup>rd</sup> and 4<sup>th</sup> graders in eight Latin American countries.

Among the findings of this study:

- 1) School autonomy and parental participation vary more within countries than between countries, suggesting that in practice, decentralization depends more on local choice than on nation-wide decree or legislative fiat.
- 2) Empirical results confirm that schools in localities with more educated parents and that are more remotely located are more likely to act autonomously, have parental participation and provide adequate school supplies. National policies mandating central control moderate but do not eliminate these tendencies.
- 3) Schools that practice autonomous decision-making do not generate superior test scores. On the other hand, better equipped schools and schools with more involved parents have better school outcomes. When school resource and parental participation are treated as endogenous, their effects become even more strongly positive and significant.
- 4) Taken as a whole, the study suggests that devolution of power to local schools cannot be accomplished by central mandates alone, but must take into account local incentives to manage schools.

## ***I. Background***

In Latin America, as in many of the developing regions of the world, efforts to encourage school autonomy and/or community participation are aimed at making schools more productive. These efforts have taken numerous forms, including downsizing the central educational bureaucracy and modifying its functions, moving authority and responsibility to local levels of government, introducing school-based management and community-based school financing, performance-based financing schemes, deregulating the choice of school books and materials, and expanding school choice through vouchers, charter schools or open enrollment programs.<sup>3</sup> There is also considerable variation in the person or persons given responsibility for decision-making at the school level (Espínola, 2002). The local decision-maker could be the principal, teachers, parents, members of the community or some combination of the four. The range of local decisions and responsibilities also varies between curriculum planning, setting academic standards, evaluating students, choosing school materials, maintaining the school, and hiring and evaluating personnel.

In this study, we abstract from the particular mechanism used to affect decentralization. We concentrate instead on the degree to which two types of local authority are employed to run the school. The first, school autonomy, is taken as the power accorded the local school administration to make school management decisions. The second, community participation, is taken as the power accorded the local parents and/or community members to affect those same decisions. Our aim is to measure the impact of these two loci of control on student outcomes.

The responsibility for school management rests with the central governments in some countries, regional authorities in others, and local authorities in the rest. Many countries allocate a subset of these decisions to each of these levels (OECD, 1998; 2000; Walker, 2002; Winkler

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<sup>3</sup> For background on these programs, see Bird and Vaillancourt, 1998; Peterson and Campbell, 2001; Lauglo, 1995; Whitty, Power, and Halpin, 1998; and McEwan and Carnoy, 2000.

and Gershberg, 2002). A summary of the government level holding legal responsibility for various school management functions in various Latin American countries is presented in Table 1 (PREAL, 2002).<sup>4</sup> There are substantial differences across countries in how decisions are made regarding teacher hiring, evaluation and compensation. In Argentina and Peru, hiring promotion and salary decisions are made at the state or provincial level, while in Bolivia and in the Dominican Republic, it is the national authorities that manage personnel matters. In Brazil, Chile, Colombia and Honduras, teachers are hired at the state, municipal or even school level but salaries are set at the central level. The loci for decisions regarding school facility maintenance, buying textbooks and setting curriculum also vary both between and within countries. Maintenance of facilities and equipment are taken at the municipal or school level in most countries except in Argentina and Peru where the semi-central level govern. In Bolivia, the Dominican Republic and Honduras, the choice of textbooks and curricula are controlled at the national level while Brazil has devolved these decisions to the state and municipal levels. In Peru, textbooks are selected by families. Overall, the educational systems in Bolivia and the Dominican Republic are highly nationalized; those of Brazil, Chile and Colombia are more locally managed; and those of Argentina and Peru somewhere in between.

Several papers have attempted to assess how changes in the locus of school authority have affected schooling outcomes in Latin America.<sup>5</sup> Jimenez and Sawada (1999) found that

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<sup>4</sup> PREAL based its evaluations on a review of national policies and legislation. The 2002 survey is contemporaneous with our data set, but a more recent update by PREAL showed little change in the locus of control over schools in Latin American countries.

<sup>5</sup> Our emphasis in this paper is on the public school system. There is considerable interest in the use of private school vouchers as a means of decentralizing control of schools, but that process is considerably different than the move toward local control of public schools. Somers et al. (2004) found that across a sample of 10 Latin American countries, students perform systematically better in private than in public schools, but that the effect is driven primarily by differences in peers and, to a lesser extent, socioeconomic status across public and private students. Angrist et al. (2002, 2006) demonstrate that in randomized samples in Colombia, students who obtained private school vouchers in a lottery performed better in school and graduated with greater frequency than did the sample of students who did not get the vouchers.



student attendance and test performance was higher in the EDUCO schools in El Salvador, schools that were managed by local parent committees. Vegas (2002) reports that in Chile, public and private schools that exercise more teacher autonomy and local control have higher test scores. In Argentina, schools that adopted local control earlier in a national decentralization effort appear to have superior student outcomes (Galiani et al., 2008). King and Ozler (2005) found that schools that practiced more autonomy in Nicaragua had improved student test scores compared to schools that were not autonomous. At the aggregate level, Lindaman and Thurmaier (2002) found a positive relationship between fiscal decentralization and improvements in national indices of human development. A general conclusion arising from these studies is that reforms that push the locus of decision-making towards the school tend to produce improved student performance.

However, the relationship between more autonomy and better learning remains far from universal (Coleman, 1990; Hannaway and Carnoy, 1993; Savedoff, 1998; Finn, Manno and Vanourek, 2001; Reinikka and Svensson, 2004). For any of the reasons suggested by Bardhan (2002), local school managers may fail to manage schools as effectively as would central management. However, even in the above cited studies that report positive average impacts of decentralization on student outcomes, the improved results are not found in all schools. In the EDUCO schools, the positive results are concentrated among the schools with the most active community participation and with better school inputs. In Argentina, the benefits are strongest in the wealthier districts and those that decentralized earliest.<sup>6</sup> In Chile and Nicaragua, it was the schools that reported having more autonomy or parental input that had the better student performance, but not all of the schools that had the legal right or obligation behaved

autonomously. In all four country cases, the gains from decentralization come mainly from schools that actually engaged in local school control (*de facto* autonomy) and not from all the schools that had the legal authority to manage schools (*de jure* autonomy).

The contribution of this study is to formally confront the decision by the local authority of whether or not to exercise control over the school. Rather than presuming the local school managerial effort is determined exclusively by legislative fiat, we assume that the local authority can choose how much effort to exert in running the school. As a consequence, the exertion of local authority must be treated as an endogenous variable, and estimates that treat the exercise of local authority as exogenous will be biased.

One example of discretion exercised regarding whether to exert local initiative in school management is the Colombia voucher program. While national in scope, some municipalities opted not to participate. King, Orazem and Wohlgemuth (1999) demonstrate that municipal decisions regarding whether to participate depended on local fiscal capacity and the size of potential local benefits. Even the experiences of localities in an experimental installation of a decentralization program will reflect a local choice of whether to accept responsibility for the school. Of the EDUCO schools in El Salvador and the *Consejos Directivos* (autonomous school boards) program in Nicaragua, only those electing to manage more intensively (*de facto* autonomy) as opposed to just signing the contract (*de jure* or legally scheduled autonomy) had measurable successes. Unclear is whether the success is due to the decentralization or to the local attributes that may have affected willingness to manage.

The next section presents an estimation strategy for measuring the impact of school autonomy and parental participation on schooling outcomes. The data set we use in the

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<sup>6</sup> This last comment is a bit misleading, as the reference group in the Galiani et al. (2008) study is the schools that were always decentralized, and so the gains from decentralization are measured relative to continually autonomous

estimation is described in section III. Section IV discusses the empirical findings and the last section suggests ways that the study could be extended.

## II. Estimation Issues

Past studies of school productivity (Glewwe, 2002; Glewwe and Kremer, 2006) have pointed to child, household, teacher and school characteristics in explaining school performance. This study adds measures of local control over the school as additional inputs into the educational production function. To be precise, the observed test score for child  $i$  in school  $j$  in country  $k$  can be described by an equation of the form

$$q_{ijk} = f(z_{ijk}, x_{jk}, a_{1jk}, a_{2jk}, \eta_{ijk}) \quad (1)$$

where  $q_{ijk}$  is the  $i^{\text{th}}$  child's test score;  $z_{ijk}$  includes attributes of the child's parents, household and community; and  $x_{jk}$  represents the level of educational materials provided in school  $j$ . Local managerial effort in school  $j$  is divided into two components:  $a_{1jk}$  is the autonomous managerial effort exercised by the school principal; and  $a_{2jk}$  is the parental and local community participation in the management of the school. The term  $\eta_{ijk}$  is a random error in the child's test score including, for example, innate ability.

In principle, one could estimate a linearized form of (2) using ordinary-least squares. However, the principal and the parents will be deciding whether to exert managerial effort in the school in part based on their anticipated impacts on school outputs. The level of school inputs will also depend on local provision as well as central distribution of school supplies. As a result,  $x_{jk}$ ,  $a_{1jk}$ , and  $a_{2jk}$  are all jointly selected with  $q_{ijk}$ . If the parents and school officials make these decisions with knowledge of the children's innate abilities  $\eta_{ijk}$ , then least squares estimation of (1) will be biased.

However, we would expect that the  $j^{th}$  school in country  $k$  makes decisions on  $x_{jk}$ ,  $a_{1jk}$ , and  $a_{2jk}$  such that<sup>7</sup>

$$\begin{aligned} x_{jk} &= x(Z_{jk}, A_k, \varepsilon_{xjk}) \\ a_{1jk} &= a_1(Z_{jk}, A_k, \varepsilon_{1jk}) \\ a_{2jk} &= a_2(Z_{jk}, A_k, \varepsilon_{2jk}) \end{aligned} \quad (2)$$

where  $Z_{jk}$  is a vector of community level measures of parent, school and community attributes that could potentially affect the productivity of the school;  $A_k$  is the central authority's rules regulating school authority; and the  $\varepsilon_{ijk}$  are a vector of random error terms. The empirical work that follows exploits the variation across countries in constitutional authority over school resource allocation in order to identify  $x_{jk}$ ,  $a_{1jk}$ , and  $a_{2jk}$  in estimating equation (1). We justify this estimation strategy in greater detail below after we introduce the data set.

#### IV. Data

To investigate the impact of local school management on school outcomes, we use a multi-country survey carried out in 1997 over eight Latin American countries by the Latin-American Laboratory of Quality of Education (LLECE). Our sample includes 3<sup>rd</sup> and 4<sup>th</sup> graders in Argentina, Bolivia, Brazil, Chile, Colombia, the Dominican Republic, Honduras, and Peru.<sup>8</sup> The samples were constructed to include public and private schools and schools in metropolitan, urban and rural areas. The samples are not strictly proportional, noticeably undersampling rural

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<sup>7</sup> An earlier version of the paper (Gunnarsson et al (2007) contains a model in which local school authorities decide how much administrative effort to exert in order to maximize the output of the school, given information on the cost of exerting effort. The model yields reduced from equations consistent with equations (2).

<sup>8</sup> The LLECE also collected data on Costa Rica, Mexico, Paraguay and Venezuela. The LLECE deleted the data for Costa Rica from their public use sample apparently because the data failed their standards for reliability and comparability. We excluded other countries when they lacked information necessary to estimate the models. Paraguay did not include information on school inputs or parents participation for 90% of the schools. Venezuela and Mexico did not include information on child age, a key variable explaining child performance in school. The

children in Brazil and Chile and undersampling urban/metro children in the Dominican Republic.<sup>9</sup> We include only the public schools in this analysis as the private schools would not face the same constraints on local school control.

Children in the selected classrooms were given tests of mathematics and language. The same exam was administered in each country with the exception that the language exam was in Portuguese in Brazil and Spanish elsewhere. The mathematics exam had a maximum score of 32 and the language exam had a top score of 19. We use the raw exam scores as our measure of child schooling outcomes.

In addition to collecting test scores on sampled children in each school, self-applied questionnaires were given to the school principal, to the teachers, to parents (or legal guardians) of the tested children, and to the children themselves. Appendix Table 1 reports the variable definitions and information sources and Appendix Table 2 reports the sample statistics for those variables. For apparently random causes, the number of observations for children taking the mathematics and language exams differed, but sample statistics did not differ much between the groups of students taking the two exams.<sup>10</sup>

We should comment on Cuba, a country included in the LLECE database but which we exclude from our analysis. Cuba's children have test scores that averaged about one standard deviation above the mean across the other countries. Carnoy (2007) attributes the Cuban success to a nondemocratic, centrally dictated and strictly enforced system that removes the ability of local school officials or parents to make choices that could retard a child's academic success.

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Venezuela data also was plagued with missing information, while our Mexico data also did not distinguish between public and private schools.

<sup>9</sup> LLECE (1998) provides a detailed description of the sampling.

<sup>10</sup> Each child was supposed to take both exams, but some only took one. In addition, there were apparently randomly occurring problems with matching test scores to parent, teacher and school variables.

Such a political system is far removed from our maintained hypothesis that local principals or parents decide whether or not to manage the school or accept central authority. As Carnoy (2007, p.43) summarizes, “the degree of political control inherent in the Cuban state over the past 45 years...is far beyond anything but the more extreme versions of social control...currently appearing in democratic country political debates.”<sup>11</sup>

*A. Empirical definitions of school autonomy, community participation and school supplies*

The LLECE survey contains multiple measures of the degree of autonomy exercised by the school. Each school principal<sup>12</sup> answered questions regarding the school’s authority in hiring staff, allocating the budget, designing curriculum, disciplining and evaluating students, and organizing extracurricular activities. As shown in section A of Table 2, schools have the least autonomy in hiring and paying teachers and in allocating budgets while student promotions and extracurricular activities are more typically controlled by the school. Our measure of school autonomy,  $a_{ijk}$ , is the weighted sum of these responses where the weights were generated by estimating the first principal component of the principals’ responses. The first principal component explained 52 percent of the covariation in the eight responses used in the LLECE sample. All responses entered with positive weights, suggesting that the various indicators of school autonomy are mutually reinforcing. None of the later results we report were sensitive to variation in the factors included in the autonomy measure.

In the top panel of Table 3, we report the average weighted autonomy score by country.

It is useful to see how the practice of school autonomy compares to the legal mandates

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<sup>11</sup> There are some peculiarities in the Cuban data that may cause some to question Carnoy’s conclusions regarding the source of the Cuban advantage. Whereas the Cuban system is characterized as overwhelmingly authoritarian, it nevertheless has the highest level of self-reported principal autonomy and parental participation of all the countries in the LLECE sample. Either this indicates that the responses to the LLECE questions may be less than candid, or it means that the source of the Cuban advantage cannot be the strict adherence to the dictates of the education minister.

<sup>12</sup> While the questions are not necessarily reflective of the principal’s own exercise of authority as opposed to that exercised by the school staff as a whole, it is convenient to refer to the principal as the school manager.

summarized in Table 1. Across these countries, the greatest self-reported autonomy is in Brazil and Colombia, countries with relatively decentralized systems in Table 1. The least self-reported autonomy is found in Honduras and the Dominican Republic two of the more centralized systems.

Parental and community participation,  $a_{2jk}$ , is taken as the weighted sum of teacher responses to questions regarding parental participation in the school. As before, the weights are set by principal components analysis. A single factor loading captures virtually all the covariation in the responses as can be seen in section B of Table 2. It is harder to relate parental participation to the constitutionally set locus of control in Table 1. The two countries with the greatest parental participation, Colombia and the Dominican Republic, are at opposite ends of the range of legal centralization.

A weighted sum of teacher responses to questions regarding the inadequacy of the quantity or quality of school supplies is used as an inverse measure of  $x_{jk}$ . Teachers were asked to indicate whether various facilities and academic materials were insufficient for academic purposes. Section C of Table 2 lists the indicators of school facilities and materials. The first principal component explained 54 percent of the covariation across the eight instruments used. As with the other aggregations, all the factor loadings were positive, indicating that shortages in one area typically were accompanied by inadequacies in the other school materials and facilities. The most widespread shortages were the lack of sufficient textbooks per student. Over 40 percent of teachers also complained about classroom temperature and poor acoustics. Shortages are reported most frequently in the most centralized system, Bolivia, and the fewest shortages are reported in the least centralized systems such as Brazil and Chile.

Our use of factor analysis to combine measures is somewhat unusual in the economics literature although it is more commonly employed by other social science researchers. Our use of these combined measures of school management and inputs rather than each individual subcomponent is justified on both pragmatic and statistical grounds. First, when there are multiple measures of the same conceptual variable, each subject to random error, averaged values of the measures are more reliable than are any single measure. This is particularly important in our setting where there is no single agreed upon measure of school autonomy or community participation in the literature. Second, as we saw above, there is a high degree of correlation among the various individual measures of these conceptual variables. Using many coefficients to represent the impact of a single conceptual variable, say school quality, spreads the quality effect across many potentially imprecisely estimated coefficients. Concentrating the impact into a single metric aids both precision and interpretability.<sup>13</sup> Finally, on pragmatic grounds, we do not have enough instruments to separately identify multiple measures of school autonomy, participation and input sufficiency.

*B. Stylized facts regarding Autonomy, Participation and Shortage*

*B1: School Autonomy and Community Participation are different*

One might presume that schools with greater autonomy on personnel, curricular or disciplinary matters would also have more parental or community participation in the school. However, in our sample, the two measures of local effort are virtually independent. The simple correlation between the two measures across countries is only weakly positive (section D in Table 2). While it is possible that other measures of parental participation would be more

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<sup>13</sup>The practice of estimating educational production functions with numerous measures of school quality included as regressors has yielded few consistent results across studies. Multicollinearity and endogeneity are two of the main problems confronting this literature. See Glewwe and Kremer (2006) for a recent discussion of the findings from educational production functions in developing countries.



strongly tied to school autonomy,<sup>14</sup> parental participation and school autonomy are clearly unique empirical constructs in our analysis.

*B2: The exercise of local autonomy is a choice only weakly driven by constitutionally assigned school responsibilities*

We presume that the exercise of local control over the school is subject to local choice, an assumption that would seem at variance with the existence of constitutionally assigned local and central responsibilities for the management of schools. While we will ultimately exploit the correspondence between constitutional responsibilities summarized in Table 1 and the local exercise of school management, the linkage is hardly definitive. Evidence that local autonomy is subject to choice is found in the ANOVA estimates reported at the bottom of Table 2. Efforts to devolve control of schools from central to local authorities have involved the passage of new laws mandating the transference of power from the center to the periphery. If this assignment of responsibility were effectively enforced, we would expect that most of the variation in school autonomy in our data set would be across countries and not within countries. To the extent that the legal environment also dictates parental freedom to participate in local schools or it provides for a level of support for public schools, we might expect that most of the variation in parental participation and in the adequacy of school supplies would also occur across and not within countries. However, only 9 percent of the variation in school autonomy, 6 percent of the variation in participation and 26 percent of the variation in supply shortages could be explained by differences across countries. The great majority of the variation in decentralized school management and school quality occurs within and not between countries.

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<sup>14</sup> Our measure concentrates on parental interest in education and participation in school activities. Questions do not concentrate on parental participation on school committees, fund-raising campaigns or other more formal participation in school management that might be more complementary with the principal's efforts to manage the school.

These findings are striking. Apparently, even in centralized systems, local schools can take the initiative to design or adopt strategies that could alter the effectiveness and/or efficiency of the teaching-learning process. Alternatively, in a decentralized system, schools that do not feel capable of allocating school resources may simply adopt central policies or guidelines as would happen in a centralized system.

*B3: Instruments and other variables*

The apparent endogeneity of local school autonomy,  $a_{1jk}$ ; parental participation,  $a_{2jk}$ ; and school input provision,  $x_{jk}$  will require plausible instruments that would shift the probability of local effort but will not be directly tied to child test scores. We opted to use cross-country variation in measures of  $A_k$ . Even if the constitutionally mandated locus of control over schools resides with the central government, they do not necessarily prevent the exercise of local control over the school, but they will raise the cost of exerting local authority. This strategy is similar in spirit to that used by Angrist and Krueger (1991), Tyler (2003), and Rothstein (2007) who used variation in state truancy laws to identify the amount of time individuals spend in school and/or child labor in studies of returns to schooling. Truancy laws do not prevent children from illegally avoiding school, but they do raise the costs of dropping out in states with stricter laws.<sup>15</sup>

Our measures of  $A_k$  are taken from the information summarized in Table 1. Each type of managerial responsibility was given a value of ‘1’ for local, ‘2’ for state or provincial and ‘3’ for national control. The average score of the first four columns was taken to represent constitutional authority for school personnel (*Hiring & Promotions*); the average of the next two

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<sup>15</sup> Earlier versions of this paper also used variation across schools in the principal’s managerial experience and in the socioeconomic status of the community as additional instruments. Solon et al (2000) and Oreopoulos (2003) found that community attributes had no effect on human capital outcomes once household attributes were controlled, suggesting that the socioeconomic status of the community should be a legitimate instrument for the exercise of local school management. Nevertheless, we agree with the referees that local community attributes could plausibly have a direct effect on school outcomes in this application in addition to its impact on school managerial decisions,

columns reflected authority for school facilities (*Inventory & Maintenance*); and the average of the last two columns represented authority for curriculum (*Books & Curriculum*). Higher values indicate more centralized management is constitutionally mandated. These measures are highly correlated with one another so that countries that have centralized decision making in one area tend to have more centralized control of others. As a consequence, we will be more interested in the joint effect of these three measures of central control as opposed to any one measure.<sup>16</sup>

The remaining variables are largely self-defining. Measures of  $Z_{jk}$  are intended to capture differences in the home and community socioeconomic environment which could affect both the incentives and capacity to support local schools and to affect individual child learning. These measures include parental education; books in the home; an indicator of whether the parents' speak Spanish or Portuguese; and a series of dummy variables indicating community size.

## V. Regression Analysis

### A. Determinants of school autonomy, parental participation and adequacy of school supplies

We begin with the reduced-form representations of equations (2) explaining variation in school autonomy, parental participation, and shortage of school materials. We performed the estimation at the school-level using school-level averages of child and household variables.<sup>17</sup> Estimates correct for clustering at the country level. Results are reported in Table 4.

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invalidating it as an instrument. Although our results are qualitatively similar when we use the principal and community attributes, we focus our attention on the results that use only the constitutional rules as instruments.

<sup>16</sup> Our identifying assumption is that constitutional responsibility for the management of school personnel, curricula, and infrastructure is not assigned in response to student performance on these tests. That assumption seems reasonable in that the legal responsibilities were set across the countries before the tests were conceived.

Nevertheless, it is possible that these constitutional provisions are correlated with excluded factors that affect average performance on tests. We can say that our instruments were not significantly correlated either individually or as a group with cross country variation in per capita income, poverty rates, public debt or income inequality.

<sup>17</sup> We also estimated the autonomy, participation and shortage equations at the individual level correcting for clustering and obtained virtually identical results to those reported in Table 4. Nevertheless, as pointed out by a referee, the school-level estimates are more consistent with the conceptual model that these decisions about local control of the school are being made by the school or community.

Of greatest interest is how the exercise of local public school control is moderated by national policies. The effect of local autonomous decision making is moderated by national policies that place the locus of control at the center. In all cases, the three measures of central authority are jointly significant although not individually significant in the shortage regression. The individual effects have mixed signs, but the summed effect of the three measures consistently show that centralized locus of power is correlated with lower reported local effort to manage schools. Evaluated at sample means for the eight countries, the effect of constitutionally mandated centralized school management is to lower school autonomy by 13%, to lower parental participation by 13% and to increase shortages of school supplies by 25%.

There is strong evidence that local school managerial effort is enhanced when the students have more educated parents. The joint test of the hypothesis that the three measures of parental attributes have no impact is strongly rejected in each equation. Moreover, evaluating the summed effects at sample means, parental education, book ownership and language skills together raise the average index of school autonomy by 36 percent; raise parental participation by 72 percent; and lower the shortage index by 30 percent.

Using schools in metropolitan centers as the reference point, we find that it is the schools in smaller urban and rural areas that are the most likely to exert autonomous effort and to have parental participation. Rural schools are also less likely than metropolitan schools to experience supply shortages, although schools in the central cities are supplied better than those in other urban environs. Apparently, schools in the center are willing (or are compelled) to accept central control while schools on the periphery are allowed to (or have to) develop more local control.

The results from Table 4 show clearly that the local exercise of control over public schools is not a random occurrence but is strongly tied to variables that should indicate local

managerial capacity of the principal, the community and the parents. These efforts are moderated but not reversed by constitutional mandates reserving school management to the central authority. Consequently, it is incorrect to presume that local public school management is exogenous.<sup>18</sup> The next subsections illustrate how conclusions regarding the productivity of local school management are sensitive to assumptions of the exogeneity or endogeneity of measured local managerial effort.

*B. Test score estimation assuming exogenous autonomy, participation, and input shortage*

We first discuss the results from direct estimation of equation (5) without correcting for the endogeneity of autonomy, participation and school inputs. The unit of observation is the individual child, but all estimates correct for clustering at the school level. These results are reported in the columns one and three of Table 5.

The specification may seem sparse compared to other educational production functions that often include many school attributes. However, our three school measures are aggregations of 18 different factors, and so one could view our specification as a restricted form of a more general specification more commonly employed in previous work. The results do accord well with common findings. Boys do better in math while girls do better in language. The various indicators of parental attributes are uniformly positive and jointly significant with the strongest effects for books in the home and parental language ability. The highest scores were in the more urban schools, although the coefficients were not always precisely estimated.

Turning to our main interest, when treated as exogenous, school autonomy has no significant effect on test scores. Parental participation raises language test scores significantly,

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<sup>18</sup> We should reiterate that we do not include private schools in the analysis. Private schools are autonomous by definition and their exercise of autonomy would not be expected to change with the level of centralized authority mandated for public schools. We do note that, consistent with expectations, private school principals included in eth LLECE samples reported higher levels of autonomy than did their public school counterparts.

but does not have a statistically significant effect on mathematics scores. Even when significant, the parental participation effect is small, amounting to less than one more point on the test from a one standard deviation increase in parental participation. Shortages had a significant negative effect on both test scores, but again, the effect was modest. A one standard deviation increase in Shortage resulted in less than a 0.5 point decrease in test scores.

### *C. Estimates controlling for endogeneity*

Results controlling for endogeneity are reported in columns two and four in Table 5. Estimation was complicated by the differences in units of observation: the school-level in the first stage and the child-level in the second. This prevented us from using a joint estimation strategy, so we opted for a two stage estimation procedure and then corrected the standard errors using a bootstrap procedure.<sup>19</sup>

Compared to the least squares estimates, the estimated school autonomy effects turn uniformly negative but remain insignificant for both mathematics and language. The estimated parental participation effect becomes much larger and statistically significant. School supply shortages remain statistically significant and become more important in the case of the mathematics test.

The parental participation result can be rationalized if parents participate more readily in the school when they observe the school performing poorly given its resources. If true, the least squares estimate would be biased downward because of the negative influence of test scores on parental participation. Alternatively, parental participation may be measured with error and so the least squares coefficients are subject to attenuation bias. In either event, the estimates

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<sup>19</sup> The first stage regressions were run on the school level clustering for countries and the second stage regressions were run on the child level clustering for schools. The second stage standard errors were computed by generating 1000 samples of schools with replacement, merging the predicted values into the second stage, and then generating the sampling distribution of the second stage estimates.

suggest that parental participation is more useful for school outcomes than is suggested when the factor is treated as exogenous in least squares regressions. Encouraging parental participation appears to be a more promising avenue for improving school outcomes than mandating school autonomy.

Recall that even when significant, parental participation and supply shortages had a very small impact on student test scores when estimated using ordinary least squares. Correcting for endogeneity, a one standard deviation increase in parental participation raises the mathematics score by 2.4 questions (7.6%) and the language score by 1.6 questions (8.4%). A one standard deviation increase in supply shortages lowers the mathematics test score by 2.7 points (8.5%) and lowers the language score by 0.2 points (1.3%). Although we do not have prior estimates to gauge against our findings, we believe that if parental participation or supply shortages are to have any impact, these estimates seem to be of reasonable magnitudes.

We note again that all of our observations of student outcomes are conditional on the child being in attendance at this particular school. We do not have information on children in the neighborhood who attend private schools or who have dropped out of school. As such, all of our schooling outcomes must be interpreted as conditioned on the choice to attend a public school. If the decision to send a child to public school is influenced by the degree of local autonomy, parental participation or the adequacy of school supplies, the distribution of children in public schools may differ depending on these factors. We have no means of judging the potential impact of such sorting on our results.

### *C. Extensions*

When we began this study, we were concerned that we could not distinguish between management exercised by local school teachers or principals from management exercised by

parents or the community. In practice, the two measures turned out to be nearly uncorrelated, suggesting that our concern was unfounded. Nevertheless, we replicated the analysis using only one local management measure at a time. These results are in the second and third columns of each group of estimates reported in Table 6. When treated as endogenous and parental participation is excluded, school autonomy appears to have a positive and statistically significant impact on test scores. This result suggests that one may be misled about the importance of local school management if the role of parents or the community is not considered jointly with the role of the principal.

A second question concerns the use of country-specific fixed effects. We cannot control simultaneously for country fixed-effects and for endogenous local school management because our source of identification is the country-specific constitutional locus of authority over schools. Nevertheless, we can examine how fixed-effects alter our least squares estimates. Comparing fixed-effect estimates in column 4 with those in column 1, we find that conclusions regarding parental participation and autonomy are the same, but school supplies are no longer statistically significant.<sup>20</sup> We do not know what would happen if we could impose fixed effects on our preferred specification.

Another question concerned our use of the factor-weighted sums of the 8 autonomy, 2 parental participation, and 8 shortage measures instead of adding these 18 variables separately. Again, we cannot perform the analysis correcting for endogeneity because we lack sufficient instruments, but we can compare results under the exogeneity assumption. To make the comparison, we aggregated the individual factor coefficients at their sample means. To be precise, letting  $\theta_k$  be the regression coefficient on the  $k^{\text{th}}$  factor which has mean value  $\mu_k$ ,



column 5 reports the weighted sum  $\frac{\partial q}{\partial w} = \sum_k \theta_k \mu_k$  as well as the standard deviation of the sum for each element of  $w = (x, a_1, a_2)$ . The standard errors are large as one would expect when aggregating across many imprecise parameters.<sup>21</sup> Nevertheless, the signs are similar to what we find using our aggregated management measures, although the estimated coefficients on autonomy are even more negative and those on parental participation more positive than in our preferred specification in column 1. It seems apparent that our use of aggregations of individual management measures is not driving our conclusions.<sup>22</sup>

Finally, we repeated the estimation of the test score equation separately for each country. Again this prevents us from using cross-country variation to identify endogenous local school management decisions, and so we can only perform the least squares analysis. Coefficient estimates for the three variables are reported in the bottom panel of Table 3. The results mimic the mixed findings from earlier studies that treated local school autonomy, parental participation and school inputs as exogenous. Many coefficients are individually insignificant in the country-specific equations and all three variables have instances of sign switching across countries. These results indicate why treating local school management and school inputs as endogenous may be important for correctly assessing their impacts on student outcomes.

## VI. Conclusions

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<sup>20</sup> This is not surprising in that less than 10 percent of the variation in Autonomy and Participation is due to cross-country variation. In contrast, 26 percent of the variation in Shortage occurs across countries. See Table 2 for details.

<sup>21</sup> This demonstrates why our use of principal components to aggregate across similar factors may yield better inferences about the educational production process than would including all of the highly correlated and conceptually similar factors in the regression.

<sup>22</sup> Joint tests of significance of the individual factors failed to reject the null hypothesis that all the coefficients were zero. We also tested whether we could accept the restrictions implied by the use of a weighted average of the factors that translated the 18 factors into three. Restrictions were accepted at the 0.01 level in the case of the 2 participation measures and the 8 shortage factors but rejected for autonomy. We can only perform the test assuming exogeneity, and so these tests are just suggestive.

A sample encompassing eight Latin American countries shows no evidence that more autonomous schools perform better than less autonomous schools. These conclusions are not sensitive to controls for the plausible endogeneity of school autonomy. However, after correcting for endogeneity, the impact of parental participation on student test scores is consistently positive and significant. Reducing shortages in school supplies and infrastructure also improves student outcomes consistently.

Parental participation and school autonomy are not random occurrences. They are positively influenced by parental human capital and the size and remoteness of the community. Whether because of perceived local school needs or the lack of central supervision, it is the schools in less populated and more remotely located areas that are most likely to exert managerial effort. Our finding that local school management is a matter of choice seems to accord well with findings by other researchers. In Colombia, the cities that participated in the voucher program were those with the strongest fiscal standing and that had the administrative capacity to manage the program. In Argentina, the areas that decentralized first were those with the strongest socioeconomic standing. In El Salvador and Nicaragua, positive results from decentralization were concentrated among the schools that actually chose to exert effort and not all that were accorded the right to manage.

These findings should give pause to the widespread clamor for decentralization. It is highly likely that schools that willingly manage schools perform better than if they did not exert that effort. However, it seems clear that the choice to manage is largely a local and not a central decision. Consequently, policies should grant autonomy in circumstances where the local community would willingly exercise local control. For the majority of schools that would

choose not to manage locally, centralized managerial decisions regarding the allocation of school resources and other administrative decisions may yield the best results.

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**Table 1 - Summary of central and local responsibilities in education**

	<b>Hiring</b>		<b>Teacher</b>		<b>Investment</b>	<b>Maintenance</b>	<b>Books</b>	<b>Curriculum</b>
	<b>Hiring Teachers</b>	<b>Principals</b>	<b>Promotions</b>	<b>Salaries</b>				
Argentina	Province	Province	Province	Province	Nat'l/Province	Province	Province	Province
Bolivia	National	National	National	National	National	School	National	National
Brazil	State/Municipal	State/Municipal	State/Municipal	State/Municipal	State/Municipal	State/Municipal	State/Municipal	State/Municipal/School
Chile	Municipal	Municipal	Region	National	Municipal	Municipal	National	National/School
Colombia	Department/School	Department	Department	National	Municipal	Municipal	Municipal	Department
Dominican Republic	National	National	National	National	National	School	National	National
Honduras	Department/School	Department	National	National	National	School	National	National
Peru	State	State	State	National	National	State	Families	National

Source: PREAL, 2002.

Note: For our measure of the degree of centralized control of schools, we use 3 to indicate National control; 2 for State, provincial, departmental or municipal control; and 1 for school level control. When the responsibilities are shared between government levels, the average of the scores was used.

**Table 2 - Summary information on construction of measures of autonomy, participation, and school shortages**

***A. Responses used in the creation of the Autonomy variable***

Asked of principal: With 1= no autonomy; 2 = some autonomy; and 3 = high autonomy; what degree of autonomy does school have in:

hiring personnel? (1.36; 0.26)<sup>a</sup>

allocating budget? (1.66; 0.38)

choosing textbooks and materials? (2.32; 0.42)

admissions, suspensions or expulsions? (2.36; 0.29)

student promotions? (2.78; 0.31)

setting disciplinary regulations? (2.46; 0.49)

setting curricular priorities? (2.50; 0.62)

planning and executing extracurricular activities? (2.67; 0.46)

First factor loading using the iterated principal factor method explained 52 percent of the covariation across the eight autonomy indicators.

***B. Responses used in the creation of the Participation variable***

Asked of the teacher: With 1= low; 2 = medium; and 3 = high; what is the level of parental participation in: school activities? (1.80; 0.65)<sup>a</sup>

interest in the child's development? (1.69; 0.65)

First factor loading using the iterated principal factor method explained 99 percent of the covariation across the three participation indicators.

***C. Responses used in the creation of the Shortage variable***

Asked of the teacher: With 1= adequate and 2 = inadequate; what is the level of:

classroom lighting? (1.31; 0.48)<sup>a</sup>

classroom temperature? (1.49; 0.38)

classroom hygiene? (1.26; 0.49)

classroom security? (1.42; 0.59)

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<sup>a</sup> Average value and factor loading in parenthesis for the mathematics sample.

classroom acoustics? (1.54; 0.38)

Asked of the teacher: With 0 = yes and 1 = no; do the students have:

language textbooks? (0.22; 0.45)

math textbooks? (0.45; 0.50)

Asked of the teacher: With 0 = yes and 1 = no; are there enough textbooks so that the students have:  
one textbook each? (0.57; 0.43)

First factor loading using the iterated principal factor method explained 54 percent of the covariation across the eight inadequacy indicators.

***D. Correlation between aggregate Autonomy, Participation and Shortage measures***

	Autonomy	Participation	Shortage
Autonomy	1.00		
Participation	0.06	1.00	
Shortage	-0.13	-0.21	1.00

***E. ANOVA Evaluation of Autonomy, Participation and Shortage variables***

ANOVA analysis of Autonomy: 91 percent of the variation in Autonomy is within country  
9 percent of the variation in Autonomy is across countries

ANOVA analysis of Participation: 94 percent of the variation in Participation is within country  
6 percent of the variation in Participation is across countries

ANOVA analysis of Inadequacy: 74 percent of the variation in Shortage is within countries  
26 percent of the variation in Shortage is across countries

**Table 3 - Country-Level Means and Regression Coefficients for Autonomy, Participation and Shortage**

	Argentina	Bolivia	Brazil	Chile	Colombia	Dominican Republic	Honduras	Peru
<b>Means<sup>a</sup></b>								
Autonomy	7.19	7.44	7.86	7.30	7.96	7.05	7.04	7.35
Participation	2.32	2.03	2.19	2.29	2.50	2.50	2.12	2.14
Shortage	3.70	4.54	3.19	3.20	3.82	4.18	3.47	4.21
<b>Coefficients<sup>b</sup></b>								
<u>Mathematics</u>								
Autonomy	0.362	-0.013	0.738**	-0.041	-0.541	0.784	0.009	0.639**
Participation	0.939*	0.648	0.520*	0.420	-0.201	-1.062	-3.395	0.809*
Shortage	-0.964**	-0.277	0.025	0.073	-0.418	0.701	-0.512	0.340
<u>Language</u>								
Autonomy	0.023	0.086	0.139	0.086	-0.342	1.057**	-0.959**	0.238
Participation	0.492**	0.394	0.221	0.802**	0.589**	-0.384	-0.591*	0.394
Shortage	-0.174	-0.402	0.191	0.398*	-0.113	0.761**	0.063	-0.125

<sup>a</sup>Country average of school-level measures of the school autonomy, parental participation and inadequacy of school supplies variables defined in Table 2.

<sup>b</sup>Coefficients from country-level regressions comparable to the least-squares specification used in Table 5 that treat autonomy, participation and shortage as exogenous. We reject the null hypothesis that coefficients are equal across countries.

\* indicates significance at the .10 level. \*\* indicates significance at the .05 level.

**Table 4 - Least Squares Regressions Explaining Autonomy, Participation and Shortage**

	<b>Variable</b>	<b>Autonomy</b>	<b>Participation</b>	<b>Shortage</b>
<i>Instruments</i>	Hiring & Promotions	1.748** (0.053)	0.493 (0.403)	1.212 (0.707)
	Books & Curriculum	-1.566** (0.379)	-0.346* (0.176)	-0.699 (0.417)
	Inventory & Maintenance	-0.829** (0.216)	-0.360* (0.162)	-0.058 (0.258)
<i>Child</i>	Age	-0.043 (0.012)	-0.008 (0.070)	0.039 (0.072)
	Boy	0.252 (0.330)	0.021 (0.136)	-0.047 (0.302)
<i>Parent/Household</i>	P Educ	1.664 (1.030)	0.556 (0.552)	0.312 (0.418)
	P Books	0.550** (0.185)	0.379** (0.092)	-0.305 (0.227)
	P Spanish	-0.082 (0.404)	0.259* (0.121)	-0.797** (0.230)
<i>Community</i>	Small urban	0.433** (0.128)	0.040 (0.127)	0.266** (0.068)
	Rural-adj	0.437** (0.071)	0.207** (0.085)	-0.206** (0.080)
	Rural-iso	0.205 (0.234)	0.329* (0.143)	-0.210 (0.168)
	Constant	5.736** (1.591)	0.828 (1.039)	3.508** (1.311)
	R <sup>2</sup>	0.195	0.123	0.277
	N	410	410	410

**Diagnostic tests of the instruments**

F-test <sup>a</sup>	14.05**	7.17**	14.52**
Summed effect { % }	-0.98 {-13%}	-0.29 {-13%}	1.02 {27%}

Cluster corrected standard errors in parenthesis for regression output. P-values in parenthesis for F-tests.

Regressions are run on the school level clustering by country and including dummy variables controlling for missing values. Regressions using the language sample are similar.

\* indicates significance at the .1 level.

\*\* indicates significance at the .05 level.

<sup>a</sup>Test of hypothesis that the coefficients on the instruments are jointly equal to zero.

Table 5 – Least Squares and Two-Stage Least Squares Equations Explaining Test Scores

	Variable	Mathematics		Language		
		Ordinary	Two-Stage	Ordinary	Two-Stage	
		Least Squares (OLS) <sup>a</sup>	Least Squares <sup>b</sup>	Least Squares (OLS) <sup>a</sup>	Least Squares <sup>b</sup>	
<i>Child</i>	Autonomy	0.069 (0.239)	-0.118 (0.153)	-0.101 (0.108)	-0.209 (0.119)	
	Participation	0.221 (0.255)	3.607** (0.422)	0.335** (0.123)	2.395** (0.183)	
	Shortage	-0.457** (0.212)	-2.787** (0.161)	-0.350** (0.116)	-0.249** (0.038)	
	Age	0.059 (0.079)	0.112** (0.038)	0.083 (0.047)	0.137** (0.027)	
	Boy	0.468** (0.153)	0.508** (0.112)	-0.465** (0.097)	-0.402** (0.082)	
	<i>Parent/Household</i>	P Educ	0.600 (0.467)	0.249 (0.367)	0.908** (0.297)	0.626** (0.207)
		P Books	1.177** (0.128)	0.795** (0.081)	0.804** (0.075)	0.638** (0.056)
		P Spanish	1.963** (0.736)	-0.271 (0.306)	1.576** (0.504)	1.020** (0.224)
	<i>Community</i>	Small urban	0.836 (0.707)	1.293** (0.186)	0.159 (0.285)	0.017 (0.116)
		Rural-adj	-1.078* (0.650)	-1.798** (0.169)	-1.527** (0.351)	-1.504** (0.122)
Rural-iso		-0.119 (1.273)	-1.011** (0.355)	0.350 (0.775)	0.338 (0.242)	
Constant		9.518**	15.220**	8.052**	0.208	

	(2.456)	(1.698)	(1.258)	(0.900)
R <sup>2</sup>	0.078	0.120	0.106	0.117
N	10411	10411	11451	11451

Cluster corrected standard errors in parenthesis.

\* indicates significance at the .1 level.

\*\* indicates significance at the .05 level. Regressions also include dummy variables controlling for missing values.

<sup>a</sup> Autonomy, participation and shortage treated as exogenous and controlling for clustering at the school level.

<sup>b</sup> Two-stage least squares estimation treating autonomy, participation and shortage as endogenous, using the instruments listed in Appendix Table 1. Two-stage estimates were obtained from running the first stage estimation on the school level correcting for clustering at the country level and then running the second stage using the first stage predicted level correcting for clustering at the school level. The second stage estimates were bootstrapped to generate correct standard errors.



**Table 6 - Comparison of Regression Coefficients of Different Models of the Effect of Autonomy and Participation on Test Scores.**

<i>Mathematics</i>								
Variable	Ordinary Least Squares (OLS)				Two-Stage Least Squares <sup>a</sup>			
	Autonomy and Participation		Autonomy and Participation <sup>b</sup>		Autonomy and Participation <sup>c</sup>		Autonomy and Participation	
	Participation	Autonomy	Participation	Participation <sup>b</sup>	Participation <sup>c</sup>	Participation	Autonomy	Participation
Autonomy	0.069 (0.239)	0.076 (0.239)	0.001 (0.233)	-0.706 (1.770)	-0.118 (0.153)	0.398** (0.150)		
Participation	0.221 (0.255)		0.227 (0.252)	0.258 (0.249)	0.708 (0.560)	3.607** (0.422)		3.493** (0.394)
Shortage	-0.457** (0.212)	-0.492** (0.214)	-0.465** (0.218)	-0.103 (0.198)	-0.554 (0.840)	-2.787** (0.161)	-3.206** (0.161)	-2.759** (0.164)
<i>Language</i>								
Variable	Ordinary Least Squares (OLS)				Two-Stage Least Squares <sup>a</sup>			
	Autonomy and Participation		Autonomy and Participation <sup>b</sup>		Autonomy and Participation <sup>c</sup>		Autonomy and Participation	
	Participation	Autonomy	Participation	Participation <sup>b</sup>	Participation <sup>c</sup>	Participation	Autonomy	Participation
Autonomy	-0.101 (0.108)	-0.094 (0.109)	-0.056 (0.103)	-1.340 (0.890)	-0.209 (0.119)	0.656** (0.114)		

Participation	0.335**		0.331**	0.339**	0.949**	2.395**		2.504**
	(0.123)		(0.124)	(0.106)	(0.310)	(0.183)		(0.178)
Shortage	-0.350**	-0.408**	-0.338**	0.016	-0.378	-0.249**	-0.329**	-0.254**
	(0.116)	(0.117)	(0.117)	(0.110)	(0.530)	(0.038)	(0.039)	(0.039)

Regressions also include all other variables reported in Table 4. Cluster corrected standard errors in parenthesis.

\* indicates significance at the .05 level.

<sup>a</sup>Two-stage estimates were obtained from running the first stage estimation on the school level correcting for clustering at the country level and then running the second stage using the first stage predicted values on the child level correcting for clustering at the school level. The second stage estimates were bootstrapped to generate correct standard errors. Bootstrapped and cluster corrected standard errors in parenthesis.

<sup>b</sup>These estimates were generated from regressions including country dummy variables.

<sup>c</sup>These estimates were generated from regressions using the individual autonomy, participation and shortage measures listed in Table 2 rather than their factor-weighted aggregate values. The reported effects are the summed weighted coefficients in each group where the weights are the sample means of the factors.

**Appendix Table 1 - Variable Description***Endogenous variables*

Math Score ( $q$ )	Mathematics test score out of 32 possible (C)
Language Score ( $q$ )	Language test score out of 19 possible (C)
Autonomy ( $a_1$ )	Composite variable measuring the level of school autonomy (Pr)
Participation ( $a_2$ )	Composite variable measuring the level of parental participation (T)
Shortage ( $x$ )	Composite variable measuring the inadequacy of school supplies and facilities (T)

*Exogenous variables***Child**

Age	Student age (years) (C)
Boy	Dummy if student is a boy (C)

**Parent/Household**

P Educ	Average education of parent(s) or guardian(s) (P)
P Books	Number of books in student's home (P)
P Spanish	Dummy if parents speak Spanish (Portuguese) with their children (P)

**Community**

(Reference: Urbanized zone in the capital area)

Small urban	Dummy indicating if school is located in a marginal zone in the capital or in a large city or town with more than 100,000 people (S)
Rural-adj	Dummy indicating if school is located in a town/village with less than 100,000 people or in a rural area in close proximity close to a town (S)
Rural-iso	Dummy indicating if school is located in a rural area with less than 500 people and located more than 50 km from a town (S)

*Instruments*

Hiring & Promotions Average of the level of centralization of decision making in hiring staff and regulating salaries and promotions (1=school control, 3=national control) (PREAL)

Books & Curriculum Average of the level of centralization of decision making in buying textbooks and setting curriculum (1=school control, 3=national control) (PREAL)

Inventory & Maintenance Average of the level of centralization of decision making in school supply inventory and building maintenance (1=school control, 3=national control) (PREAL)

Sources: C: Child survey or test; Pr: Principle's survey; T: Teacher's survey; P: Parent's survey; S: Survey Designer's observation; PREAL: Estimate taken from Partnership for Educational Revitalization in the Americas (PREAL) (2002).

Notation in parentheses shows the link between the conceptual variable and its empirical construct. Subscripts are suppressed for notational convenience.

**Appendix Table 2 - Summary Statistics<sup>a</sup>**

<b>Variable</b>	<b>N</b>	<b>Mean</b>	<b>Std. Dev</b>	<b>Min</b>	<b>Max</b>
<i>Endogenous variables</i>					
Math score ( $q$ )	10411	14.76	6.04	0.00	32.00
Language score ( $q$ )	11451	11.34	4.29	0.00	19.00
Autonomy ( $a_1$ )	10411	7.50	1.10	4.00	9.68
Participation ( $a_2$ )	10411	2.25	0.67	1.30	3.90
Shortage ( $x$ )	10411	3.76	0.98	2.33	6.04
<i>Exogenous variables</i>					
<i>Child</i>					
Age	10411	9.94	1.63	6.00	18.00
Boy	10411	0.50	0.50	0.00	1.00
<i>Parent/Household</i>					
P Educ	10411	0.93	0.22	0.00	1.00
P Books	10411	2.26	0.85	1.00	4.00
P Spanish	10411	0.93	0.25	0.00	1.00
<i>Community</i>					
Small urban	10411	0.30	0.46	0.00	1.00
Rural-adj	10411	0.47	0.50	0.00	1.00

Rural-iso	10411	0.04	0.19	0.00	1.00
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*Instruments*

Hiring & Promotions	10411	2.12	0.54	1.50	3.00
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Books & Curriculum	10411	2.08	0.61	1.50	3.00
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Inventory & Maintenance	10411	1.72	0.51	1.00	2.50
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<sup>a</sup> These are the sample statistics from the group for which we have mathematics test scores.

Sample statistics for the language test sample are almost identical.

Notation in parentheses shows the link between the conceptual variable and its empirical construct.

Subscripts are suppressed for notational convenience.