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

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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 in eight Latin-American countries, the great majority of the variation in local control over school decisions exists within and not between countries. Local authority to manage schools is largely a local choice only modestly influenced by central policies regarding jurisdiction over school personnel, curriculum and facilities. A simple model of local managerial effort demonstrates that local school management and provision of school materials will be jointly determined with student academic performance. This means that estimated impacts of local school autonomy or school supplies on student performance must account for the endogeneity of local school management. Empirical tests confirm that local managerial effort by the principal and the parents and the adequacy of school supplies are strongly influenced by the principal's experience, parental human capital, the socioeconomic status 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 school supplies have strong positive effects on 4th grade test performance, but school autonomy has no discernable impact on school outcomes.

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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)
> "Decentralization has almost become a mantra among policy makers and international agencies." (Bray and Mukundun, 2003)

As early as 1962, international agencies such as the United Nations and the World Bank were forwarding decentralization of public service delivery as a development strategy, but the strategy has become even more prominent over the past 15 years. A primary focus of the decentralization effort is in education.[1] 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 autocratic governments such as the military regimes in Argentina and Pakistan have initiated decentralization efforts in their school systems, 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 have an incentive to act on local needs because they are more prone to pressure by their constituents and they also need to compete against other communities to attract or retain residents.

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 similarly 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) finds better targeting from decentralized transfer programs in Albania.

While studies suggest that decentralized authority can alter resource allocations and improve targeting the needy, there is less evidence that desired outcomes are enhanced by local control. In the case of schooling outcomes, even the more 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, so inter-jurisdictional competition in quality of public services is unlikely to be a source of new migrants. Second, local officials may be subjected to undue influence by prominent local families for the allocation of public resources towards their 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 in fact be true. Finally, local officials may lack necessary experience or skills to effectively manage resources in countries with few well-educated professionals. Any of these problems alone could create difficulties for decentralized school systems.

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[1] 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.

This study examines how local control and parental participation affect student outcomes across eight Latin American countries. We focus on one reason for the 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 exert effort to manage the school. Such effort will most likely be exerted in settings where it will lead to better outcomes than would occur from implementing centrally dictated pedagogies or learning approaches. 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 use a simple model of distributed authority to illustrate why the local school managerial efforts must be determined simultaneously with schooling outcomes. We illustrate the problem using a data set composed of individual child achievement test scores for 3rd and 4th 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 decentralization in practice depends more on local choice than on nation-wide decree or legislative fiat.

2) Theory suggests that the only schools that would exert autonomous managerial effort are those with the capacity to manage and that could improve educational outcomes relative to what would occur by accepting central control. Consequently, school management practices and supplies must be treated as endogenous.

3) Empirical results confirm that schools in localities with more experienced principals, more educated parents, and better socioeconomic standing 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.

4) Schools that practice autonomous decision-making do not generate superior test scores. On the other hand, parental participation and school supplies have a positive effect on school outcomes. When these are treated as endogenous, their effects become even more strongly positive and significant.

5) Taken as a whole, the study suggests that devolution of power to local schools cannot be accomplished by central mandates, but must take into account local incentives and local capacity to manage schools.

I. Background

In Latin America, as in much 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.[2] 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, the 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

[2] 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.

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, but rather concentrate on how they are manifested in two measures of the degrees of freedom accorded to the local authority to run the school. The first, school autonomy, is taken as the power accorded the local school administration to make these 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.

There is no *a priori* reason for these two decisions to be located at one level or another of the education bureaucracy. In fact, these decisions are the responsibility of 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 and Gershberg, 2002). As shown in Table 1, in Latin America, legal responsibility for managing schools differs across countries and across aspects of school decisions within countries, reflecting variation in how each country structures its respective service provision networks and aligns them with the education legislation in force.

For example, in Argentina and Peru decisions on hiring, promotions and salaries are taken on a semi-central level (state or provincial), while in Bolivia and in the Dominican Republic, it is the national authorities that manage hiring, promotions and salaries. 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 four countries, Bolivia, Chile, Dominican Republic and Honduras, the choice of textbooks and setting of curriculum are controlled at the national level (shared with the schools in Chile) 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, Dominican Republic and Peru are highly nationalized; those of Chile and Colombia are more locally managed; and those of Argentina and Chile somewhere in between.

Several papers have attempted to assess how changes in the locus of school authority have affected schooling outcomes in Latin America.[3] Jimenez and Sawada (1999) found that 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., 2005). King and Ozler (2001) 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

[3] 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.

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. But even within a decentralization effort that successfully raises student outcomes on average, there may be considerable variation between the level of decentralization and autonomy stipulated and codified by law (*de jure* autonomy) and what is actually practiced in schools (*de facto* autonomy).

In all of the above cited studies that find positive average impacts of decentralization on student outcomes, the results are not universal. 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.[4] 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 have both the legal right and that have the capacity and will to manage the school and not from the legal authority *per se.*

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 a theory describing the options available to a local school authority facing an infusion of resources from the central government and a legal structure that sets the decision-making parameters within which the school or the parents must operate in allocating those resources. This theory is then used to guide the estimation strategy for measuring the impact of school autonomy and parental participation on schooling outcomes. The data set we use in the estimation is described in section IV. Section V discusses the empirical findings and the last section suggests ways that the study could be extended.

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[4] This last comment is a bit conclusion is a bit misleading, as the reference group in the Galiani et al. (2005) study is the schools that were always decentralized, and so the gains from decentralization are measured relative to continually autonomous schools rather than nonautonomous schools.

II. Theoretical Model

In this section, we present a simple model that describes how the central and local authorities divide responsibility for managing public schools.[5] The model captures the stylized features of a multi-level school system: the central authority allocates resources to each school and sets rules on how they can be spent. The local authority has the option of expending effort to allocate the resources more efficiently, or it could just accept the central dictates without modification. The local decision regarding whether to exercise more control depends on the cost of exerting effort versus the potential gain from that effort in the form of improved student outcomes. The model highlights why *de facto* local control must be treated as endogenous and also identifies exogenous factors that can be used to identify the endogenous exercise of local administrative effort.

Local school decision-making will only be productive if the school has access to the necessary managerial skills, whether embodied in the school board, the principal, the head teacher, or the parents. These decisions can affect employment, retention and motivation of teachers, access to and quality of learning materials and facilities, and learning norms, all of which influence student achievement (Rodríguez and Hovde, 2002; Borden, 2002). In our context, the local school managers get no individual reward for improving school outcomes, an assumption that accords well with actual practice. In none of the countries studied is there an

[5] While private schools can potentially be incorporated into the analysis as well, the linkage between central and local control differs greatly between public and private schools. A model of central and local control of private schools would involve regulatory decisions at the central level rather than the shared central and local resource allocation decisions we employ here.

incentive mechanism whereby public school principals, teachers or other authorities receive pecuniary rewards based on school performance.[6]

Many factors can and do compromise the potential efficiency of local school management. Foremost among these is the differential prices that local jurisdictions face in accessing school inputs of equal quality. Poor, rural or otherwise socially or geographically isolated schools or those with difficult-to-serve populations find it difficult to attract qualified teachers, access timely school materials, receive in-service training, or obtain other academic support. Therefore, the price of an equal quality basket of school inputs is assumed to rise with physical and socio-economic distance from the center. These differential prices affect the ability of local authorities to effectively run the schools. On the other hand, it is more difficult for central authorities to enforce mandates on remotely sited schools, and so isolated schools may feel freer to initiate actions that could not be attempted in more easily monitored locations.

Suppose that a school system consists of a central authority and a finite number of schools *N*. Each school's inputs, outputs and prices are denoted by the subscript *j*. Local schools are heterogeneous in two dimensions: managerial ability $h_j > 0$ and distance to the central authority $d_j > 0$. Given its type, each school j chooses its level of autonomous effort $a_j \geq 0$.

The local school manager[7] maximizes a measure of quality of learning, q_j, by investing their school inputs x_j into one of two alternative technologies denoted by superscripts c (centralized) and a (autonomous), where the a technology requires the input of the local

[6] It is possible that local authorities could profit from corrupt practices such as embezzlement or nepotism that drain resources from the school. We do not have a means of assessing the importance of local corrupt behavior in this study. Bardhan and Mookherjee (2006) present a model of local public service delivery that allows for corrupt behavior at both the central and local levels.

manager's ability and autonomous effort. The application of local ability in using the a technology bears a cost, $w(a_j, d_j, A)$. This managerial cost is assumed to be rising in managerial effort ($w_a(a_j, d_j, A) > 0$) at an increasing rate ($w_{aa}(a_j, d_j, A) > 0$), but it decreases with distance from the center ($w_d(a_j, d_j, A) < 0$). The cost of effort also rises in A, an index of the authority that resides in the center. The distance effect presumes that the value of time is lower in less densely populated areas, but also that it is more difficult for the center to place restrictions on local effort in those markets. In contrast, the c technology only requires the implementation of the central authority's suggested resource allocation which can be accomplished without exerting effort.

The central authority chooses a distribution rule that allocates resources or inputs across schools, given a fixed budget equal to X. The price faced by the central authority in purchasing one quality-constant unit of school input x^c is assumed to be $p^c = 1$. For simplicity, we assume that the central authority can distribute school inputs costlessly to the N local schools. The central authority's price is no higher and typically is lower than the price p^j that a local school would pay to purchase x_j directly so that $p^j \geq 1$. The local price is an increasing function of the school's distance from the center, so $p_d^j(d_j) > 0$.

The central and local school technologies are given by:

$$\begin{aligned} &\text{Central technology: } q_j^c = x^c, \text{ and} \\ &\text{Local technology: } q_j^a = h_j x_j a_j - w(a_j, d_j, A) \end{aligned} \qquad (1)$$

[7] This can be a principal or head teacher acting as agent for the local community or it can be a school board or parents' committee. We do not have information on explicit incentive based contracts that would reward the local authority for performance, and so we can only assume the agent acts on behalf of the principals.

Which technology is selected by the j^{th} school manager depends on the relative return to local autonomy which depends on h_j, d_j, a_j and their related impacts on q_j^a, p^j and $w(a_j, d_j, A)$. In our stylized school system, the central authority allows schools to choose freely between technologies. It allocates x^c to those schools that opt for the central technology, and makes a nominal cash transfer equal to x^c to those schools that choose the autonomous technology. Notationally, the school chooses a_j to solve:

$$\underset{a_j}{Max}\left\{q_j^c, q_j^a\right\} = \underset{a_j}{Max}\left\{x^c, \frac{x^c h_j}{p^j} a_j - w(a_j, d_j, A)\right\} \tag{2}$$

When the locally autonomous technology is selected, the first-order condition setting the optimum local effort, a_j^*, is

$$\frac{x^c h_j}{p^j} = w_a(a_j^*, d_j, A) \tag{3}$$

where $\frac{x^c}{p^j}$ is the real value of inputs purchased by the local authority using the revenue transfer. If the local school authority decides to exert effort, it will set the marginal product of effort equal to its marginal cost.[8] Notice that even though $x^c \geq \frac{x^c}{p_j}$, the local authority may still decide to choose the autonomous technology if local effort is sufficiently productive.

The local school authority's effort allocation is

[8] The second order condition, $\frac{\partial^2 q_j^a}{\partial a_j^2} = w_{aa}(a_j, d_j, A) < 0,$ so the solution is always a maximum.

$$a_j = 0 \text{ if } \frac{x^c h_j}{p^j} a_j - w(a_j, d_j, A) \leq x^c \forall a_j$$
$$a_j = a_j^* > 0 \text{ if } \frac{x^c h_j}{p^j} a_j - w(a_j, d_j, A) > x^c \quad (4)$$

If every school adopted the centrally dictated technology, each would set $a_j = 0$, produce $q_j^c = x^c$, and the aggregate production level would be Nx^c. If schools exert autonomous effort, aggregate output will be greater. Denote the first m^1 public schools as those for which $q_j^a = \frac{x^c h_j}{p^j} a_j - w(a_j, d_j, A) > x^c$. Total output for the school system, $q = (N - m^1)x^c + \sum_{j=1}^{m^1} \frac{x^c h_j}{p^j} a_j - w(a_j, d_j, A)$. By revealed preference, $q > Nx^c$.

Note that if the central authority mandated that all schools apply autonomous effort, aggregate school output could fall below Nx^c. Schools that would optimally accept the central technology and produce $q_j^c = x^c$ would instead produce $q_j^a \leq x^c$ if they used their autonomous local technology. The lost school output in these schools lacking local managerial capacity could outweigh the gains from the schools capable of exerting local managerial effort. Consequently, centrally mandated autonomy could lower aggregate school output in the country. However, as we show below, even countries with constitutionally mandated local effort have a high proportion of schools that do not exercise local control.

Which schools will decide to exert autonomous effort? From equations (4), the probability that the local authority will set $a_j > 0$ increases in h_j and falls in A. However, distance from the center has an uncertain effect on local effort. It raises the price of accessing inputs through $p^j(d_j)$ but also lowers the cost of effort through $w(a_j, d_j, A)$. If the transfer from the center adjusts for local prices so that each school receives x^c in real rather than nominal

terms, then it will be the more remote schools that will have the highest probability of exercising local autonomy.

The theory demonstrates that q_j, x_j and a_j are all chosen by the local school managers, even if they ultimately set $a_j = 0$ and $q_j = q_j^c = x^c$. Consequently, we cannot obtain the true impact of local managerial effort or of school inputs on school outcomes by regressing q_j on x_j and a_j. However, the theory also suggests possible avenues for solving the endogeneity problem, in that h_j, d_j and the institutional rules, A that affect $w(a_j, d_j, A)$ will influence school choices regarding x_j and a_j.

III. 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

$$q_{ijk} = f(z_{ijk}, x_{jk}, a_{1jk}, a_{2jk}, \eta_{ijk}) \qquad (5)$$

where q_{ijk} is the i^{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 η_{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 (5) using an ordinary-least squares. However, the theory suggests that $x_{jk,}$ $a_{1jk,}$ and a_{2jk} are all chosen in part based on their anticipated impacts on school outputs, and so all are jointly selected with $q_{ijk.}$ However, equation (4) indicates that reduced form representations of decisions on $x_{jk,}$ $a_{1jk,}$ and a_{2jk} will be of the form:

$$\begin{aligned} x_{jk} &= x(Z_{jk}, A_k, h_{jk,}, d_{jk}, \varepsilon_{xjk}) \\ a_{1jk} &= a_1(Z_{jk}, A_k, h_{jk}, d_{jk}, \varepsilon_{1jk}) \\ a_{2jk} &= a_2(Z_{jk}, A_k, h_{jk}, d_{jk}, \varepsilon_{2jk}) \end{aligned} \qquad (6)$$

where Z_{jk} is a vector of parent, school and community attributes in the local jurisdiction; A_k is the central authority's rules regulating school authority; $h_{jk,}$ is the managerial capacity of the local school authorities and the surrounding community; d_{jk} is a vector of measures of the physical distance from the center; and the ε_{ijk} are a vector of random error terms. Because student outcomes depend on $x_{jk,}$ $a_{1jk,}$ and a_{2jk}, the error terms ε_{ijk} in (6) will be correlated with the error term η_{ijk} in (5), and least squares estimation of (5) will yield biased coefficients. However, A_k, h_{jk} and d_{jk} offer potential instruments for the endogenous variables because they shift the probability of local autonomous effort exercised by the principal or the local community and the level of school inputs used in the school. The empirical work that follows uses a subset of these variables to identify $x_{jk,}$ $a_{1jk,}$ and a_{2jk} in estimating equation (5). We review the 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 3rd and 4th graders

in Argentina, Bolivia, Brazil, Chile, Colombia, the Dominican Republic, Honduras, and Peru.[9] The samples were stratified to conform roughly to the distribution of children in public and private schools and in urban and rural areas in each country.[10] We include only the public school students in this analysis as the theoretical model would not apply to private schools.

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. In addition, surveyors collected information on the socioeconomic characteristics of the community. 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.[11]

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

[9] The LLECE also collected data on Costa Rica, Cuba, Mexico, Paraguay and Venezuela. The LLECE did not include the Costa Rica observations in the data set because they felt the data were unreliable. We excluded Cuba from the main analysis because some of the information on child and household attributes appeared to be unreliable. Information on child age was missing from the Mexico, Paraguay and Venezuela data sets, necessitating their exclusion.

[10] For a detailed description of the a priori exclusions in each country, consult Table 6 of the Technical Bulletin of the LLECE.

[11] 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.

The LLECE survey contains multiple measures of the degree of autonomy exercised by the school. Each school principal[12] answered questions regarding the school's authority in hiring staff, allocating the budget, designing curriculum, disciplining and evaluating students, and organizing extra curricular 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, $a_{1jk,}$ 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 58 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 find that 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. The two countries with the greatest parental participation, Colombia and the Dominican Republic, are at opposite ends of the range of centralization reported in Table 1.

[12] 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.

A similarly weighted sum of teacher responses to questions regarding the inadequacy 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 principal component vector explained 60 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. The greatest shortages are in reported in the most centralized system, Bolivia, and the least shortages are found 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 participation in the literature. Second, as we saw above, there is a high degree of correlation among the various individual measures of the 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.[13] 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 strongly tied to school autonomy,[14] parental participation and school autonomy are clearly unique empirical constructs in our analysis.

B2: Local autonomy is only weakly driven by constitutionally assigned school responsibilities

The theory presumes 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. If mandated responsibilities for managing the school were rigorously enforced, one would expect that measures of school autonomy or community participation would be driven by fiat. As the comparison between Tables 1 and 3 suggest, there is some correspondence between constitutional responsibilities and average self-reported authority to make decisions, but the linkage is not perfect. The best

[13]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.

[14] 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

example of the degree to which local autonomy is at variance with legal mandates is in Cuba; the most centrally directed, undemocratic system of the countries in our sample also has the highest reported levels of local school autonomy and parental participation.

Further 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 truly effective, 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 occur across and not within countries. However, only nine percent of the variation in school autonomy, six 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.

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

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participation in school management that might be more complementary with the principal's efforts to manage the school.

The apparent endogeneity of local decisions regarding local effort to exert school autonomy, $a_{1jk;}$ local parental effort to participate in the school, a_{2jk}; and the adequacy of local school inputs, x_{jk} we will require plausible instruments that would shift the probability of local effort but not be directly tied to child test scores. We opted to use local measures of A_{jk} and h_{jk} aggregated to the level of the school.

Our measure of A_k is taken from the desk survey of the laws governing responsibility for school management as reported in Table 1. Each type of managerial responsibility was given a value of '1' for local, '2' for regional and '3' for national control. The average score of the first four columns was taken to represent constitutional authority for school personnel; the average of the next two columns reflected authority for school facilities; and the average of the last two columns represented authority for curriculum. The sum of these measures, *Center,* can vary from one to nine. Higher values indicate that more centralized management is constitutionally mandated across these various aspects of school decision-making, while lower values indicate more local mandated locus of control. There is a concern that national policies will reflect local tastes so that *Center* cannot be used as a legitimate instrument. In practice, specifications that included *Center* as a separate instrument failed overidentification tests, although conclusions were not altered when it was included or excluded. We present the results that only use *Center* interacted with other measures.

Variation in local school managerial capacity h_{jk} is captured by two measures. The first is the principal's experience as a principal. The presumption from the theory is that more able principals have a higher probability of exerting effort to allocate resources effectively, to raise local support for school supplies, or to sidestep restrictive national policies. The second measure is the socioeconomic level of the community surrounding the school. This measure is a six point

scale that varies from extremely poor or marginalized to high. Because the principal's or the community's ability potentially moderates the impact of the constitutionally mandated locus of control, we also included interaction terms of the form $A_k * h_{jk}$. Our conclusions were not sensitive to the inclusion or exclusion of subsets of these variables from the instrument set, although we required at least three to identify a_{1jk}, a_{2jk} and x_{jk} in (5).

The remaining variables are largely self-defining. Measures of Z_{jk} include measures of parental education, books in the home and a dummy variable indicating if the parents' speak Spanish or Portuguese. Our measures of d_{jk} are a series of dummy variables indicating community size. Variation in prices faced by local schools in accessing school inputs are expected to differ by the remoteness of the community.

V. Regression Analysis

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

We begin with the reduced-form representations of equations (6) 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.[15] Results are reported in Table 4.

Of greatest interest is how these indicators of school management responded to our measures of local managerial capacity and how the exercise of local capacity is moderated by national policies. More experienced principals are more likely to make autonomous decisions, but the effect is moderated by national policies that place the locus of control at the center. The

[15] 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 theoretical model.

joint test that principal experience matters is significant in the autonomy equation, but principal experience is not important for either parental participation or shortages.

The latter two are strongly influenced by the socioeconomic status of the community surrounding the school. More affluent communities have more parental participation and fewer supply shortages. Again, national policies that mandate more central authority over schools tend to moderate the influence of local socioeconomic status. The joint test of the hypothesis that socioeconomic status does not enter the three equations is strongly rejected for participation and shortages but cannot be rejected for school autonomy. Nevertheless, across all three equations, the set of four instruments is jointly significant in each instance.

There is strong evidence that local school managerial effort is enhanced by more educated parents. The joint test of the significance of the three measures parental attributes is highly significant. Moreover, evaluating the summed effects at sample means, parental education, book ownership and language skills together raise the average index of school autonomy by 28 percent; raises parental participation by 61 percent; and lowers the likelihood of shortages by 41 percent. These effects are larger at sample means than those of the school principal's experience or the socioeconomic status of the community.

The series of dummy variables on the type of community use schools in metropolitan centers as the reference point. It seems that it is the metropolitan schools that practice the least managerial effort. Both schools in smaller urban areas and those in rural areas adjacent to metropolitan areas are more likely to exert autonomous effort compared to schools in the center. Rural schools are more likely to have parental participation and are less likely to have shortages of supplies or facilities. Apparently, central control works best on schools near the center, 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 the school 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 school management is exogenous. 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 in from previous studies. 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,

but does not have a statistically significant effect on mathematics scores. In neither case was the effect large, regardless of significance, amounting to less than one point on a test score on average. Shortages had a significant effect on test scores also, but the effect also was somewhat modest. A one standard deviation increase in Shortage resulted in less than a 0.5 question decrease in test scores.

C. Estimates controlling for endogeneity

Results controlling for endogeneity are reported in the columns two and four in Table 5. To improve efficiency, we estimated the equation simultaneously with the three first stage equations correcting for clustering.[16] Of the child, parent and community variables, the most notable change is that parental language skills are no longer important. The remaining coefficients retain signs.

The local school management measures are more sensitive to the treatment for endogeneity. Our school autonomy measure turns uniformly negative on both mathematics and language. The effect suggests that the least squares estimate is biased upward as suggested by the theory, although the lack of significance suggests that the more appropriate conclusion us that school autonomy has negligible effects on student performance regardless of estimation method. The estimated impacts of parental participation and shortages of school supplies become stronger after controlling for endogeneity. One interpretation of these findings is that parents are more prone to participate in the school when the school is doing poorly, and that where shortages are observed, they would be even larger in the absence of local efforts to resolve them. It is also possible that the variables are just measured with error and the uncorrected coefficients are subject to attenuation bias. In either event, the estimates suggest that both parental participation

[16] The cluster-corrected first stage regressions yielded virtually identical results to the school level regressions, and so we could estimate the four equation system jointly at the individual level using the cluster correction.

and school facilities are more useful for school outcomes than is suggested when those factors are treated as exogenous in least squares regressions.

We simulate the impacts of school autonomy and parental participation over the range of observed values in Figures 1 and 2. These simulations show how predicted test scores vary according to measures of school autonomy or parental participation, holding all other child, parent, household, school and community variables fixed at their sample means. Figure 1 shows that when school autonomy is treated as exogenous, the most autonomous schools score about 3 percent higher than the least autonomous schools on the mathematics exam but 5 percent worse on the language exam. Correcting for the endogeneity, the most autonomous schools now score around 3 percent lower on both exams compared to the least autonomous schools. None of these differences are statistically significant. In other words, whether decentralized schools also choose to make use of their autonomy does not matter for student performance.

Figure 2 shows that encouraging parental participation may be a more promising avenue for improving school outcomes than mandating school autonomy. Treating parental participation as exogenous, the schools with the greatest parental input have 5 percent higher mathematics scores and 9 percent higher language scores than do otherwise identical children in schools lacking parental involvement. Controlling for endogeneity, the productivity differential associated with having parental involvement rises to 38 percent in mathematics and 36 percent in language compared to schools without parental involvement.

C. Robustness

Tests of the overidentification restrictions implied by the exclusion restrictions on the instruments utilized in Table 5 are reported at the bottom of the table. All test statistics are well

below the critical values.[17] Nevertheless, we tried several alternative specifications to examine how sensitive our conclusions are to alternative assumptions regarding identification or the measurement of the key variables of interest.

When we began the 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 were nearly uncorrelated, suggesting that the 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. Conclusions regarding the sign and significance of autonomy and participation were not affected compared to the estimates from Table 5 (shown in the first column of Table 6).

We rely on measures of local capacity to manage schools in identifying local managerial effort. While our measures pass overidentification tests, it is useful to examine how our results change when subsets of the identifiers are dropped. In the last column, we report the results from dropping principal's experience as an instrument. In that case, our endogenous variables are just identified. While our standard errors increase in size, the conclusions that parental participation and adequate school supplies raise test scores but that autonomy does not are unaffected.

Some of the specification checks cannot be repeated using instrumental variables methods. Our identification strategy relies on differences in constitutional locus of control to affect the probability of local management effort across countries. When we add dummy variables for each country, we can only estimate the relationship by assuming that autonomy,

[17] The Davidson-MacKinnon (1993, pp. 237-240) variant of the Hausman-Wu test failed to reject the overidentification restrictions at the 10th percentile in both the language and mathematics test samples.

participation and supply shortages are exogenous. Results from this specification (column four in the OLS section) indicate that the conclusions regarding parental participation and autonomy are the same as from column 1, but school supplies are no longer statistically significant. This leaves open the possibility that our inability to impose country fixed effects may be causing us to exaggerate the role of school supplies, but it does not appear to be driving our findings of parental participation or school autonomy.[18]

A second robustness check used, respectively, the 8, 2 and 8 individual components listed in Table 2 in place of their factor-weighted sums used to measure Autonomy, Participation, and Shortage. As discussed above, these components are highly intercorrelated which leads to many imprecise coefficients when all the elements are included separately into the regression. Furthermore, there are so many that we cannot provide sufficient instruments to use IV methods. Nevertheless, we can compare the results of OLS regressions that include all of the measures to our more restricted results which aggregate these factors into just three variables. To make the comparison, we aggregated the individual factor coefficients at their sample means. To be precise, letting θ_k be the regression coefficient on the k^{th} factor which has mean value μ_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 very large as one would expect when aggregating across many imprecise parameters.[19] Moreover, 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 we

[18] This is not surprising in that less than 10% of the variation in Autonomy and Participation is due to cross-country variation. In contrast, 26% of the variation in Shortage occurs across countries. See Table 2 for details.

[19] 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.

obtained using the aggregations. These findings suggest that our use of aggregations of individual management measures are not driving our conclusions.[20]

Finally, we repeated the estimation of the test score equation separately for each country. Because our identification relied on differences in constitutionally mandated locus of power, we can only estimate these country-specific equations assuming autonomy, participation and shortage are exogenous. Coefficient estimates for the three variables are reported in the bottom panel of Table 3. All three variables have instances of sign switching across countries, illustrating why earlier studies that treated these variables as exogenous may have generated mixed findings. Nevertheless, we cannot reject the null hypothesis that the coefficients are equal across countries for parental participation and for shortages. Only for autonomy do we reject the null hypothesis that the coefficients are the same across countries. Unfortunately, we cannot perform the comparable test of equality of coefficients across countries from the IV specification.

VI. Conclusions

There is no evidence that more autonomous schools perform better. Over many different specifications, the consistent finding is that local practice of school autonomy does not yield a significant effect on student performance. Furthermore, local exercise of autonomy is only loosely related to national policies regarding local responsibility for control of schools.

The case for parental participation in schools is more promising. Cross sectional regressions of student academic performance on parental participation are biased against finding

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[20] 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 relationship, apparently because parents are more likely to intervene when the school is performing badly. Correcting for endogeneity, the impact of parental participation on student test scores is consistently positive and significant, raising mathematics and test scores by over one-third evaluated at sample means. This suggests that policies that increase incentives for parents to participate in schools can have a significant positive effect on their children's achievement. Unfortunately, central mandates are no more successful in inducing parental participation than they are at inducing autonomous effort on the part of school principals.

Parental participation and school autonomy are not random occurrences. They are positively influenced by principal's experience, parental human capital, and the socioeconomic status of the community surrounding the school. Interestingly, local autonomy or participation are more common in smaller or remote communities, not in the central cities. 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 findings 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, central mandates will not result in local autonomous decisions when schools are populated by inexperienced principals, low socioeconomic status communities, and illiterate parents. More promising would be policies that grant autonomy where the local community would willingly exercise it, and offer centralized administrative support for the majority of schools that would choose not to manage.

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Figure 1: Predicted test scrores by level of school autonomy based on OLS and IV estimates from Table 4 evaluated at sample means

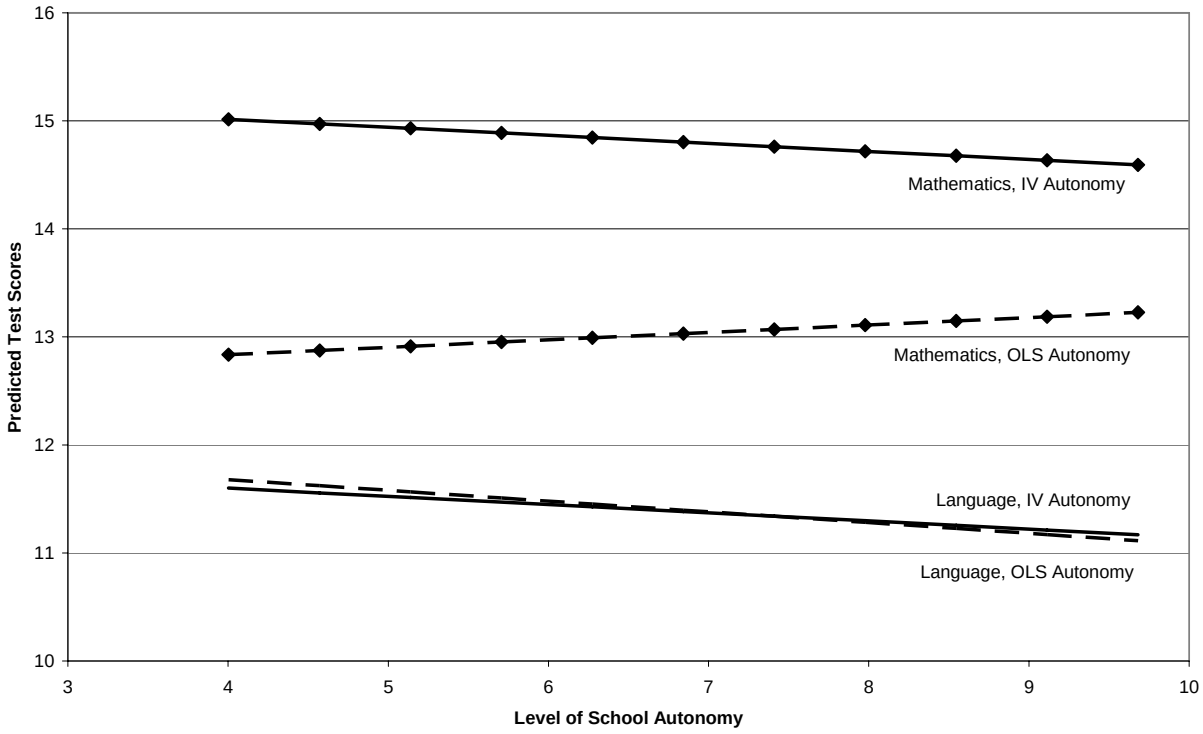

Figure 2: Predicted test scrores by level of parental participation based on OLS and IV estimates from Table 4 evaluated at sample means

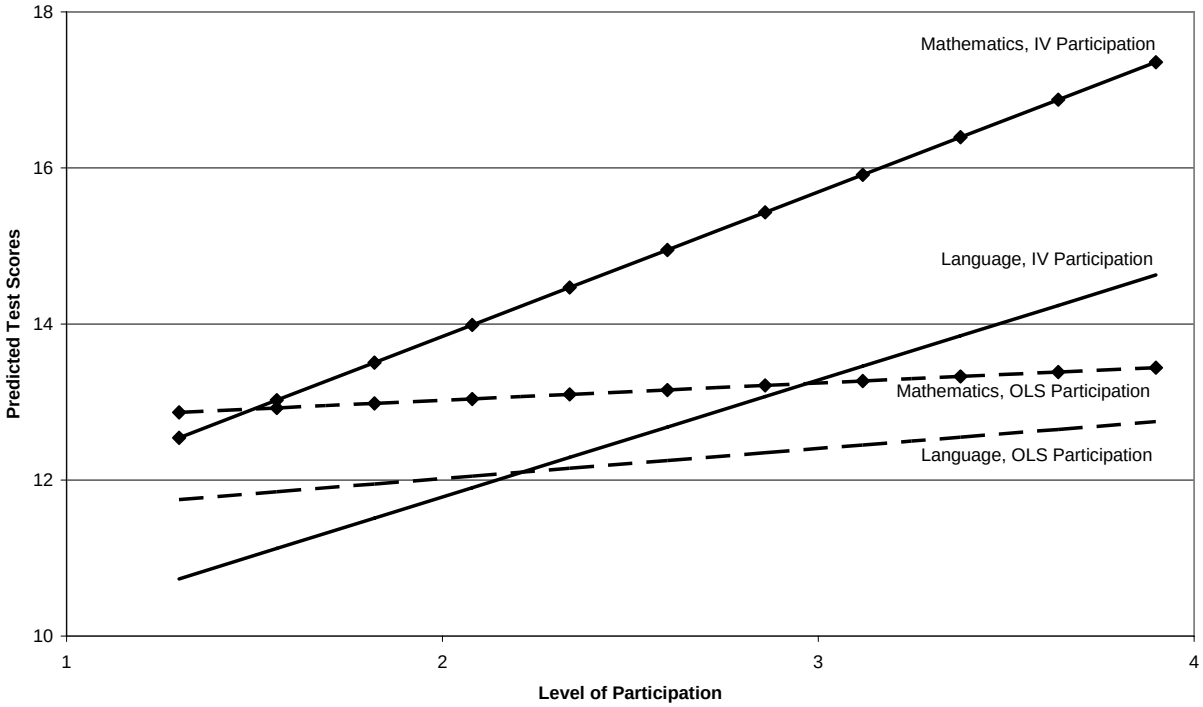

Table 1 - Summary of central, regional and local responsibilities in education

	Hiring Teachers	Hiring Principals	Teacher Promotions	Salaries	Investment	Maintenance	Books	Curriculum
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/Sc
Chile	Municipal	Municipal	State	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

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 the levels, the average of the two 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)[a]
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)[a]
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)[a]
classroom temperature? (1.49; 0.38)
classroom hygiene? (1.26; 0.49)
classroom security? (1.42; 0.59)
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 Inadequacy measures

	Autonomy	Participation	Inadequacy
Autonomy	1.00		
Participation	0.06	1.00	
Inadequacy	-0.13	-0.21	1.00

E. ANOVA Evaluation of Autonomy, Participation and Inadequacy 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 Inadequacy is within countries
26 percent of the variation in Inadequacy is across countries

[a] Average value and factor loading in parenthesis for the mathematics sample.

Table 3 - Country-level means and regression coefficients for autonomy, participation and shortage								
	Argentina	Bolivia	Brazil	Chile	Colombia	Honduras	Peru	Dominican Republic
Means								
Autonomy	7.19	7.44	7.86	7.3	7.96	7.04	7.35	7.05
Participation	2.32	2.03	2.19	2.29	2.5	2.12	2.14	2.5
Shortage	3.7	4.54	3.19	3.2	3.82	3.47	4.21	4.18
Coefficients[a]								
Language								
Autonomy[b]	0.02	0.09	0.14*	0.09	-0.34**	-0.96**	0.24**	1.06**
Participation[c]	0.49**	0.39**	0.22**	0.80**	0.59**	-0.59**	0.39**	-0.38
Shortage[c]	-0.17	-0.39**	0.19*	0.40**	-0.11	0.06	-0.13	0.76**
Mathematics								
Autonomy[b]	0.36*	-0.01	0.74**	-0.04	-0.54**	0.01	0.64**	0.78**
Participation[c]	0.94**	0.65**	0.52**	0.42	-0.20	-3.40**	0.81**	-1.06**
Shortage[c]	-0.96**	-0.28	0.03	0.07	-0.42**	-0.51*	0.34**	0.70**

[a] Coefficients from country-level regressions comparable to the least-squares specification used in Table 4 that treat Autonomy, Participation and Shortage as exogenous.

[b] Can reject the null hypothesis that coefficients are equal across countries

[c] Cannot 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 Inadequacy

	Variable	Autonomy	Participation	Shortage
Instruments	Pexp	0.057**	-0.011	-0.016
		(0.025)	(0.013)	(0.020)
	Pexp*Center	-0.010**	0.003	0.002
		(0.004)	(0.002)	(0.003)
	Socecon	0.141	0.359**	-0.344**
		(0.182)	(0.092)	(0.142)
	Socecon*Center	-0.016	-0.039**	0.054**
		(0.028)	(0.014)	(0.022)
Child	Age	0.034	0.026**	0.044*
		(0.068)	(0.034)	(0.053)
	Boy	0.235	-0.005	0.041
		(0.355)	(0.179)	(0.276)
Parent/Household	P Educ	1.633	0.722	0.429
		(1.101)	(0.556)	(0.857)
	P Books	0.353*	0.193*	-0.411**
		(0.206)	(0.104)	(0.161)
	P Spanish	-0.227	0.292*	-1.105**
		(0.463)	(0.234)	(0.360)
Community	Citytown	0.380**	-0.011	0.204
		(0.166)	(0.084)	(0.129)
	Rural-adj	0.329**	0.166**	-0.299**
		(0.159)	(0.080)	(0.124)
	Rural-iso	0.056	0.296**	-0.371*
		(0.264)	(0.133)	(0.205)
	Constant	4.987**	0.197	5.225**
		(1.499)	(0.757)	(1.167)
	R^2	0.156	0.145	0.251
	N	410	410	410
F-tests[a]				
All instruments		5.49**	6.48**	6.07**
		(0.000)	(0.000)	(0.000)
Just the instruments including Pexp		2.78*	1.46	1.14
		(0.063)	(0.232)	(0.322)
Just the Instruments including Socecon		0.37	10.28**	3.11**
		(0.691)	(0.000)	(0.000)
Just the Instruments including Center		10.83**	5.42**	11.08**
		(0.000)	(0.000)	(0.000)

Standard errors in parenthesis for regression output. P-values in parenthesis for F-tests. Regressions also include 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.
[a] Test of hypothesis that the coefficients on the instruments are jointly equal to zero.

Table 5 – Least Squares and Instrumental Variables Equations Explaining Test Scores

		Mathematics		Language	
	Variable	**Least Squares[a]**	**Instrumental Variables[b]**	**Least Squares[a]**	**Instrumental Variables[b]**
	Autonomy	0.069	-0.162	-0.101	-0.188
		(0.239)	(1.490)	(0.108)	(0.936)
	Participation	0.221	4.230*	0.335**	2.684**
		(0.255)	(2.165)	(0.123)	(1.073)
	Shortage	-0.457**	-2.083**	-0.350**	-1.791**
		(0.212)	(1.651)	(0.116)	(0.743)
Child	Age	0.059	0.135	0.083	0.221**
		(0.079)	(0.113)	(0.047)	(0.085)
	Boy	0.468**	0.552**	-0.465**	-0.420**
		(0.153)	(0.209)	(0.097)	(0.136)
Parent/Household	P Educ	0.600	0.170	0.908**	0.602
		(0.467)	(0.754)	(0.297)	(0.578)
	P Books	1.177**	0.775**	0.804**	0.401**
		(0.128)	(0.185)	(0.075)	(0.122)
	P Spanish	1.963**	-0.214	1.576**	-0.100
		(0.736)	(1.331)	(0.504)	(0.934)
Community	Citytown	0.836	1.156	0.159	0.204
		(0.707)	(1.119)	(0.285)	(0.606)
	Rural-adj	-1.078*	-1.869**	-1.527**	-1.880**
		(0.650)	(0.841)	(0.351)	(0.501)
	Rural-iso	-0.119	-1.316	0.350	0.068
		(1.273)	(2.154)	(0.775)	(1.326)
	Constant	9.518**	11.425	8.052**	9.948
		(2.456)	(17.545)	(1.258)	(9.284)
	R^2	0.078	0.078[c]	0.106	0.106[c]
	N	10411	10411	11451	11451
Overidentification test					
	$\chi^2(3)$		1.44		0.75
	$\chi^2(3)$ critical value[d]		7.81		7.81

Cluster corrected standard errors in parenthesis. IV estimates were obtained from joint estimation of the first stage coorecting for clustering at the school level.

* indicates significance at the .1 level.

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

[a] Autonomy, participation and shortage treated as exogenous and controlling for clustering at the school level.

[b] Instrumental variables estimation treating autonomy, participation and shortage as endogenous, using the instruments listed in Appendix Table 1 and controlling for clustering at the school level.

[c] R-square from two-stage estimation.

[d] χ^2 critical value at the .1 level.

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

	Mathematics								
	Ordinary Least Squares (OLS)					**Instrumental Variables (IV)**			
Variable	**Autonomy and Participation**	**Autonomy**	**Participation**	**Autonomy and Participation[a]**	**Autonomy and Participation[b]**	**Autonomy and Participation**	**Autonomy**	**Participation**	**Autonomy and Participation[c]**
Autonomy	0.069	0.076		0.001	-0.706	-0.162	0.090		-1.485
	(0.239)	(0.239)		(0.233)	(1.77)	(1.490)	(1.496)		(1.662)
Participation	0.221		0.227	0.258	0.708	4.230*		4.198**	5.252**
	(0.255)		(0.252)	(0.249)	(0.56)	(2.165)		(2.138)	(2.613)
Shortage	-0.457**	-0.492**	-0.465**	-0.103	-0.554	-2.083**	-3.736**	-1.981	-2.885
	(0.212)	(0.214)	(0.218)	(0.198)	().84)	(1.651)	(1.416)	(1.454)	(2.067)
	Language								
	Least Squares					**Instrumental Variables**			
Variable	**Autonomy and Participation**	**Autonomy**	**Participation**	**Autonomy and Participation[a]**	**Autonomy and Participation[b]**	**Autonomy and Participation**	**Autonomy**	**Participation**	**Autonomy and Participation[c]**
Autonomy	-0.101	-0.093		-0.056	-1.34	-0.188	-0.126		0.312
	(0.108)	(0.109)		(0.103)	(0.89)	(0.936)	(0.847)		(0.916)
Participation	0.335**		0.331**	0.339**	0.949**	2.684**		2.677**	2.129**
	(0.123)		(0.124)	(0.106)	(0.31)	(1.073)		(1.060)	(0.889)
Shortage	-0.350**	-0.408**	-0.338**	0.016	-0.378	-1.791**	-2.750**	-1.693**	-1.864**
	(0.116)	(0.117)	(0.117)	(0.110)	(0.53)	(0.743)	(0.630)	(0.695)	(0.899)

Cluster corrected standard errors in parenthesis. IV estimates were obtained from joint estimation of the first stage coorecting for clustering at the school level. Regressions also include all other child, parent/household and community variables listed in Table 4.

* indicates significance at the .05 level. Regressions also include all other variables reported in Table 4.

[a] These estimates were generated from regressions including country dummy variables.

[b] 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.

[c] These estimates were generated from regressions excluding principal attributes from the instruments.

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* (z)**	
Age	Student age (years) (C)
Boy	Dummy if student is a boy (C)
***Parent/Household* (z)**	
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* (d)** (*Reference:* Urbanized zone in the capital area)	
Citytown	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	
Pexp (h)	Years of experience the principal has as a principal at current school (Pr)
Center (A)	Summation of level of centralization across three broad areas of school management encompassing staffing, evaluation, compensation, investment, maintenance and choosing curriculum and textbooks. (1 = all three local, 9 = all three central) (Table 1)
Pexp*Center ($h*A$)	Years of experience the principal has as a principal at current school (Pr) interacted with level of centralization (PREAL)
Socecon (h)	Average socioeconomic level of the children in the school (1=extremely poor, 6=high) (S)
Socecon*Center ($h*A$)	Average socioeconomic level of the children in the school (Pr) interacted with level of centralization in staffing, evaluation, and compensation (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) (2001).
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[a]

Variable	N	Mean	Std. Dev	Min	Max
Endogenous variables					
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
Exogenous variables					
Child					
Age (z)	10411	9.94	1.63	6.00	18.00
Boy (z)	10411	0.50	0.50	0.00	1.00
Parent/Household					
P Educ (z)	10411	0.93	0.22	0.00	1.00
P Books (z)	10411	2.26	0.85	1.00	4.00
P Spanish (z)	10411	0.93	0.25	0.00	1.00
Community					
Citytown (d)	10411	0.30	0.46	0.00	1.00
Rural-adj (d)	10411	0.47	0.50	0.00	1.00
Rural-iso (d)	10411	0.04	0.19	0.00	1.00
Instruments					
Pexp (h)	10411	13.65	7.54	0.00	40.00
Center (A)	10411	5.92	1.41	4.17	8.00
Pexp*Center ($h*A$)	10411	80.44	47.85	0.00	245.33
Socecon (h)	10411	2.44	0.86	1.00	5.00
Socecon*Center ($h*A$)	10411	14.56	6.82	4.17	40.00

[a] 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.