Autonomy, Participation, and Learning in Argentine Schools: Findings, and Their Implications for Decentralization

Gunnar S. Eskeland

Development Research Group, World Bank

geskeland@worldbank.org

Deon Filmer

Development Research Group, World Bank

dfilmer@worldbank.org

January 2002

We thank Lucrecia Tulic and the National Evaluation System for support and access to data; Ruben Cervini for help with preparation and understanding of the system, its context and data; Michael Kremer and Martin Ravallion, as well as participants at seminars at The World Bank for useful comments and suggestions on an earlier draft; and Christian Gonzales and Dennis Nikitin for able research assistance. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors and do not necessarily represent the views of the World Bank, its Executive Directors, or the countries they represent. Working papers describe research in progress by the authors and are published to elicit comments and to further debate.

Abstract

According to a theoretical model, student learning can be raised by *school autonomy* and *parental participation* through separate channels. Increased *school autonomy* increases the rent that can be distributed among stakeholders at the school, while institutions for *parental participation* (such as a school board) empowers parents to command a higher share of this surplus, for instance through student learning.

With a rich cross-section data set from Argentine schools (6th and 7th grade), autonomy and participation are found to raise student test scores for a given level of inputs in a multiplicative way, consistent with the model. Autonomy has a direct effect on learning (but not for very low levels of participation), and participation affects learning only through mediation the effect of autonomy. The results are robust to a variety of robustness checks, and for sub-samples of children from poor households, children of uneducated mothers, schools with low mean family wealth, and public schools, the results are the same or stronger.

It is possible that autonomy and participation are endogenously determined and that this biases the results, and the data available do not allow this to be ruled out with certainty. Plausible predictors of autonomy and participation are also plausible predictors of test scores directly, and fail tests for the over-identifying restrictions. Heuristically argued, however, the potential for correlation with unobserved variables may be limited: the data set is rich in observed variables, and autonomy and participation show very low correlation with observed variables.

Subject to the caveats mentioned, the results may have relevance for *decentralization* in two ways. First, as decentralization moves responsibility from the center toward the province/state level and/or toward local governments, the results should be directly relevant if this raises autonomy and participation in schools. Second, if the results are interpreted to represent a more general effect of moving decision-making *toward* users and the local community, the results have relevance even if little happens to autonomy and participation in schools. More importantly, perhaps, we illustrate empirically how important it is to check who is being empowered when higher-level strings are loosened.

1. Introduction

Studies revealing that schools are far from efficient in translating resources into learning (for example Hanushek 1994, 1995) have led to an increasing interest in the education literature on issues such as governance, reform, and decentralization. Our study analyses the potential relationships between learning in Argentine schools on the one hand and school autonomy and parental participation on the other hand. This introductory section places the study in the broader literature on decentralization in education systems. Section two develops a model in which school autonomy and participation play distinct but related roles in determining how the school operates. Section three introduces data and measurement issues. Section four presents analysis and results. Section five concludes.

In a thought-provoking review of the school "production function" literature, Hanushek (1986) finds no relationship between increased resources and improved results in schools. He concludes that schools do not use resources efficiently.[1] Building on this, Pritchett and Filmer (1998) argue that the non-relation between increased resources and increased outputs (or quality) strongly suggests that the sector is governed by a political economy different from a technocratic—or business—model that would efficiently translate additional resources into additional outputs (learning, say). This leads into a perspective whereby there are rents available to be shared by users, workers, unions, bureaucrats and politicians. More broadly, the question is whether there are aspects of how the education sector—or an individual school—is organized that determines how a school operates and how efficient the system is in generating learning among children.

Edited volumes such as Clune and Witte (1990), Hannaway and Carnoy (1993) and Chapman and others (1996) are evidence of the interest in whether institutional reforms such as decentralization lie at the heart of schools' problems. Witte (1990), writing on a U.S. context, concludes that arguments for and against decentralization are

[1] There are of course studies finding a positive relation between school resources and schooling output (Card and Krueger, 1992, is one among many examples). Also, the disturbing "nonrelation" between resources and performance does, of course, have competing explanations. If there are relevant economies to scale in the classroom, for instance, then high-cost, small schools in rural areas may be confounded with well-equipped low-performance schools, and these challenges are deepened by the fact that unobserved socioeconomic characteristics are correlated with this rural/urban dimension (Lazear discusses such a structure). Urquiola (2001) uses the subsample of rural schools that have only one room to circumvent this problem, finding that more resources raise school outputs.

difficult to sort out, and that there is as yet little evidence about the impact of decentralization on results. He comments that this makes recommendations difficult, but finds the logical arguments supporting decentralization compelling. Nevertheless, he cautions that decentralization and choice are not panaceas for solving the complex and very serious problems that affect the most problematic public school districts.

There is general recognition that both centralized (France, Japan, Korea) and decentralized (United States, New Zealand) education systems can deliver decent results, but there is also dispute over even quite basic issues. Though the U.S. system is seen as a very decentralized one, a number of scholars seem to agree (for example, see Hannaway and Carnoy 1993) that the history of U.S. education over the past century has been one of continuous centralization. These studies also point to the fact that centralizing forces are not just the powers of a central government to legislate the education sector: "textbook publishers and ideologies about teaching practice may produce more homogeneity across classrooms in the U.S. than central directives could ever hope to yield" (Tyack 1993 paraphrased in Hannaway and Carnoy 1993). Similarly, testing systems—plausibly justified as a means of conveying quality information—will inevitably play a homogenizing and centralizing role in shaping the industry, whether by central regulation (as the evaluation systems found in Europe, Argentina, Brazil and in some U.S. states) or in a context (such as in the United States in general) where tests are chosen to varying degrees by schools, school systems, students, and receiving institutions. Finally, higher-level government may play a role extending beyond its regulatory and/or ownership roles through its capacity to provide funding. Several authors argue that the gradual transition from district toward state and higher-level funding in the United States has made the school system less responsive to users (Witte 1990, Peltzman 1993, and Zeigler, Tucker, and Wilson 1977).

Among economists, advocates of efficiency gains associated with decentralization in the education sector typically rely on two hypothesized mechanisms: (1) *competition* for students can improve schools, so that school *choice* for users is an important institutional feature, and (2) decentralization can make the education system more nimble by exploiting *voice and participation*, either at the level of local government or directly at the school level, as autonomy is expanded at lower levels in the system and ultimately to the school level. To illustrate with a market metaphor: assume there is a bakery at each end of town. They could be "decentralized," or they could be owned and operated by the same family. The competition hypothesis says consumers are better served under decentralization because the owner of each outlet profits from drawing customers from the other. The voice and participation hypothesis says consumers are better served under decentralization because they are closer to the real decisionmaker—so "talk" rather than

"walk" is operative. There is nothing necessarily contradictory in these hypotheses: in any given context, they could both be important—and it could well be the baker is more perceptive to voice if he is exposed to competition. Finally, centralization arguments could rest on scale economy arguments.

Apart from depending on underlying features (such as population density), the potential for either mechanism to deliver results in the education sector depends on the specific characteristics of the ongoing decentralization. Public schools are fiscally decentralized if they are organized by small jurisdictions that finance them out of own revenue. Winkler (1993) highlights that potential benefits of decentralization then relate to the kind of accountability pressures this could produce, and that real-world features of fiscal decentralization leave varying expectations.

Government decentralization can also refer to whether political decisions and bureaucratic decisions are made with reference to a local or a national constituency (see OECD 1993). Schools and principals could be given increased autonomy in a national school system without necessarily shifting final responsibility from the nation's capital to provincial governors or mayors. In the Nicaraguan reform, for instance, schools sign a contract for autonomy with the national ministry of education (King and Özler 2000).

There is not much hard and quantitative evidence on whether decentralization *per se* can improve the efficiency of schools through voice and participation. Some analysts interpret a positive effect of user charges (or local finance) on school performance as being due to a greater sense of ownership, which makes parental voice more effective (Jimenez and Paqueo 1996 and James, King, and Suryadi 1996). King and Özler (2000) find better test scores among schools that have more *de facto* autonomy in Nicaragua.[2] Jimenez and Sawada (1999) find that *participation* by parents and the local community improves performance in El Salvador's EDUCO schools, despite the much poorer conditions in which they work.

The present paper builds on this literature, but emphasizes interdependence between school autonomy and participation. Our model postulates that greater autonomy increases the rent available to stakeholders at the school, and that parental participation plays a role in directing part of this to families through increased learning.

[2] They distinguish between schools formally having attained a level of autonomy by signing a contract from those de facto displaying autonomy: the former is not significantly associated with learning.

In addition to parental participation and autonomy, choice and competition can be hypothesized to determine efficiency and responsiveness in schools. In the Argentine system, with provinces as owners, these effects are not thought to be forceful, and cannot be tested with the available data. In the empirical literature on choice and competition, a good example is Hoxby (1994), who finds "strong evidence that easier choice [meaning smaller school districts] leads to greater productivity." Angrist and others (2001) finds that a voucher program succeeded in increasing enrollment of poor children in Colombia at a low cost. Methodological challenges are important: two recent analyses of the Chile education reform (Gauri 1998 and Carnoy and McEvan 1997), emphasize that the purported higher efficiency of private subsidized schools, funded by vouchers, are due in part to the fact that these schools attract and select children that are easier to teach.[3] Several analysts conclude that competition and choice can do little to improve services for children in poorly equipped families and/or rural areas (Lewis 1993, Gauri 1998, and Carnoy and McEwan 1997). The present study suggests that there may be a tradeoff between choice and participation as mechanisms to energize schools: choice serves the most engaged families, and mediocre schools then lose the families that would otherwise have engaged to lift performance (McMillan 1999).

2. A simple model of the school

Consider a school producing multiple outputs, one of which is learning as measured by test scores in the national evaluation system. Other outputs could be student-related (learning as valued by families or employers locally; child care; sports; fun), teacher-related (furthering career or other goals; professional or leisure interests) or along other lines (civic; religious; nationalist orientation). Let the *technical possibilities* at the school be described by

$$g(y_s,..,y_m,x_1,..,x_n)=0 \tag{1}$$

where y_s is student learning measured by test scores and y_m is another output such as student sports or teacher leisure. In addition, x is a vector of inputs for example, pencils, bricks, teacher training) but can also include fixed characteristics and determinants at the school level, such as the availability of roads, bad weather, mountains and culture.

[3] In a market, providers engage in cream-skimming to get a clientele with better underlying characteristics: Healthy individuals for health providers, children with high ability for schools

The essence of the relationship in (1) is that there is a link between incremental outputs given an increase in inputs or a reduction in other outputs. For instance, an increase dx_1 in input *1* can deliver an increase in output *s*, dy_s (if other variables are held constant) equal to

(2) $$dy_s = \left(\frac{\partial g}{\partial x_1} \Big/ \frac{\partial g}{\partial y_s} \right) \cdot dx_1 \equiv (g_1 / g_s) dx_1 \ .$$

Optimization Now let the school operate in a context which results in implicit weights ("prices") on the various output measures, $p_s, p_m, \ldots$. The school can choose the level of input for a subset, or perhaps all, of the inputs either because it has a budget and pays input prices $w_1, .., w_n$ or because it in other ways faces tradeoffs. Consider the possibility that the school's outputs and inputs are governed to maximize the net valuation of outputs minus the costs of inputs

(3) $$M = p_s y_s + p_m y_m - \Sigma_j w_j x_j \text{ subject to } g(y_s, .., y_m, x) = 0 \ .$$

The first order conditions for optimum would then be:

For each input, *i*, the value of its marginal product must equal its cost:

(4) $$-\frac{p_s g_i}{g_s} = w_i = -\frac{p_m g_i}{g_m}, \text{ and}$$

marginal rates of substitution equal relative prices, both for inputs (5) and for outputs

(5) $$\frac{g_i}{g_j} = \frac{w_i}{w_j}$$

(6) $$\frac{g_s}{g_m} = \frac{p_s}{p_m} \ .$$

This last relationship (6) is perhaps of greatest interest, since the school's implied priorities p_s / p_m can in principle be inferred from the productivity parameters. Pritchett and Filmer (1998) follow such a line of reasoning when they argue that the typical empirical finding of no marginal product of "inputs" indicates that the school cannot be an entity that maximizes student learning under a budget constraint.

Note that in this optimizing framework the equality sign in (1) implies an absence of any slack relative to what is technically feasible. As a matter mostly of terminology, this model describes the school as having the potential to deliver many types of outputs.

Thus, what might be described elsewhere as technical inefficiency is considered here—somewhat more neutrally—to be priority toward certain outputs (for example, a balance between leisure or quality of life for teachers on the one hand and student learning on the other). This approach has certain advantages. First, there is an explicit acknowledgement that there are several types of interests influencing school operations. This language emphasizes positive rather than normative aspects. Second, with this language as a descriptive tool, hypotheses regarding changes in implicit priorities within the school can be analyzed from the point of view of *economic inefficiency* (this is elaborated on below).

Institutions: autonomy and participation

Let school *autonomy* describe the extent to which the school itself may choose inputs (the vector x, or a strict subset of its variables). Absence of autonomy means that constraints on inputs and outputs are given by outside procedures, for example when the school is allocated six teachers and a book case, rather than a budget that can be used for teachers and other things. A subset of x would be exogenously given to any school: natural conditions, rural roads, and the parental background of the children. A way of understanding the value of autonomy is that it allows more decisions to be taken in the light of the level and combination of those other, exogenously given variables. Autonomy would enable a school to reallocate resources to address a problem, for example, repairing a roof. The value of autonomy then depends on the variability of truly exogenous factors across the system of schools, the degree to which a system with less autonomy would be able to allocate increases efficiently, and how well institutions and incentives are rigged to let autonomy work in favor of student learning.

Optimization theory implies that the attained value of M (the value of outputs minus costs) can only be higher when maximization is less constrained. Assuming that available resources are the same, constraints can only reduce the attained value of M, and a constraint can reduce M only if it is binding, so

$$\text{(7)} \qquad \begin{matrix} M(p_s,..,p_m,w_1,..,w_n) \\ \text{subject to } x_j \le \overline{x_j} + \Delta \end{matrix} \ge \begin{matrix} M(p_s,..,p_m,w_1,..,w_n) \\ \text{subject to } x_j \le \overline{x_j} \end{matrix} .$$

This constraint is more likely to bind, or binds more restrictively, the less a school has in its ability to determines the level of variable j. Similarly

$$\text{(8)} \qquad M = (p_s,..,p_m,w_1,..,w_n,\overline{x}_{j+2},..,\overline{x}_n) \ge M(p_s,..,p_m,w_1,..,w_n,\overline{x}_{j+1},\overline{x}_{j+2},..,\overline{x}_n),$$

where there is one more variable constrained in the expression on right-hand side (the assumption is that constraints that apply in both cases are the same). For example, if in

the right-hand side $\bar{x}_{j+1}$ was a specific type of text book, the left-hand side corresponds to a school with equivalent budget, which can alternatively use the money as it sees fit.

Using this framework, *autonomy* is greater flexibility at the school level; that is, the left-hand side of expressions (7) and (8). It has a role explicitly linked to optimization theory: by letting schools operate under fewer or more "lax" constraints, autonomy allows the school slack—gains that can be taken out as student learning or as other outputs.

Let *participation* describe the kind of leverage parents (students and the local community) are given in school operations—perhaps by outside laws and regulations. Participation thus may influence priorities implicit in school operations, as reflected in the implicit output prices. Thus, participation could be representing institutional features such as a school board, parental representation in the school board (for example percentage of votes), and finally its powers (for example, whether or not the school board can fire teachers).

Coverage of a given input can belong both in an autonomy variable and in a participation variable, in the following way: autonomy in the choice of textbooks and curriculum describes the extent to which the school can make decisions in those matters. Participation in the choice of textbooks and curriculum, correspondingly, describes the extent to which those decisions are taken with parental consultation (or in fora with parental representation).

Three simple hypotheses

A simple hypothesis can be illustrated as follows: Assume that the school has two "outputs," one is student learning, y_s, another is teacher leisure, y_l. Then, as more participation changes the school's implicit priorities between these two outputs, one would expect

$$\frac{\partial\left(\frac{p_s}{p_l}\right)}{\partial P} \geq 0, \tag{9}$$

where P is participation. Since output prices are not observed, but since an implication of optimization is that elasticities of outputs with respect to own price are non-negative; optimization theory and equation (9) imply *hypothesis one*:

$$\frac{\partial y_s}{\partial P} \geq 0. \tag{10}$$

Practical realities are, of course, likely to be more complex, leading to counterpropositions consistent with this framework. The most obvious is that the students and their families may care about more than one aspect of school outputs. In particular, measuring the effects of increased participation in terms learning as defined by the national education ministry's test system may be too restrictive and output as perceived by families may have increased even if it is not measured by y_s.[4]

Hypothesis two is that test scores will increase with greater autonomy only if they are valued:

(11) $$\frac{\partial y_s}{\partial A} \geq 0 \text{ if and only if } p_s \geq 0 .$$

Again, however, even within this framework, there is room for opposing findings. Most obviously, a school may be subject to other pressures (including through constraints on x that apply in the absence of autonomy) and these may work to ensure learning. For instance, if a rigorously regulated national curriculum constrains school autonomy, these constraints might protect student learning in situations where learning would lose to other outputs under greater autonomy. If such a constraint is binding, so that "learning" is locked at levels that are "too high" from the school board's point of view, then autonomy could potentially yield reductions in learning.

Again, implicit output prices are not observed, but the assumption that participation supports outputs favored by students and their families, together with (11) yields an interaction effect:

(12) $$\frac{\partial^2 y_s}{\partial A \partial P} \geq 0,$$

that is, that autonomy contributes more to learning the higher is the extent of parental participation, and participation contributes more the higher is autonomy. Again, opposing findings could have empirically and theoretically plausible explanations. Parental influence in the school need not be the only force interested in student learning: the school's owner (the province, in Argentina's primary schools), teachers or regulator (the national education ministry, in Argentina) might all be as well.[5]

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[4] Another important qualifier is, of course, that there is sufficient autonomy to give the weight of parental participation an effect on student output.

[5] The existence of the national testing system can be seen as evidence of a national ministry's interest

3. Data and empirical framework

The relationship between autonomy, participation and output will be investigated by estimating a traditional education production function

$$t=f(x_1,x_2,A,P), \text{ where}$$

- t is test scores in the national evaluation system;
- x_1 is a vector representing the socioeconomic background of students, to represent private inputs into the production process;
- x_2 is a vector representing school inputs (for example the education of teachers);
- A,P is a vector of variables representing autonomy and parental participation at the school level.

Notions of equity will be explored by examining whether patterns are different for students from the poorest households, students whose mother has less than primary schooling, the schools with the poorest parents, and among public schools alone.

National evaluation system data

The primary school system in Argentina has been owned by the provinces since 1978. Secondary schools were transferred to the provinces in the early 1990s. Our sample is a random sample of schools in a cross section from the national system of education evaluation, with tests of children in 6th and 7th grade. It consists of urban public schools, urban private schools, and rural public schools. However, only urban schools are included in our analysis, since many variables are missing for rural schools. Moreover, including rural schools would introduce new—and potentially unobserved—dimensions of heterogeneity.

The data set is the output of an ambitious system to monitor the school system. The system randomly samples schools in each province, and for those schools provides the following:

- For students in 6th and 7th grade, a sample of test scores in language and math, and a questionnaire that indicators of a child's socioeconomic background.

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in student learning as measured. Our thrust in terms of the participation variable is a belief that parents' interest in learning is at least in part consistent with what the test system picks up. If it is not, however, it should show up with a negative coefficient on the participation variable in the test-score equation, and perhaps on autonomy variable as well, if constraints are the ministry's means of defending learning.

- For teachers, a questionnaire about the teacher, the school, and practices.
- For the principal, a questionnaire about the school, practices, etc.

The questionnaires for teachers and principals provide rich data on the traditional input vector for the production function. They also provide a number of variables for the institutional description, or "expansion," of the production function. In particular, a range of questions can be directly associated to notions of a school's autonomy on the one hand, and of the participation of parents and the community on the other.

Table 1 provides summary statistics for the sample used, for all schools and restricted to schools in the capital area, and the poorest schools. Measures of autonomy and participation (to be defined more precisely below) are highly skewed: 30 percent of schools with lower than mean autonomy whereas 63 percent of schools have lower than mean participation. The levels of both autonomy and participation are higher than average in capital area schools, and lower than average among the poorest schools.

Table 1. Selected descriptive statistics of schools in the sample

	All schools		*Greater Buenos Aires*		*Poor Schools*	
	Mean	*Std. Dev.*	*Mean*	*Std. Dev.*	*Mean*	*Std. Dev.*
Math score (standardized)	0.00	1.00	0.39	1.01	–0.47	0.86
Language score (standardized)	0.00	1.00	0.39	1.01	–0.44	0.87
Household wealth index	0.00	2.05	0.84	1.89	–1.69	1.79
Proportion of families in poorest quartile	0.25	0.43	0.12	0.33	0.57	0.50
Proportion of public schools	0.85	0.36	0.71	0.45	0.96	0.19
Proportion of poor schools	0.25	0.43	0.06	0.24	1.00	0.00
Mean autonomy index (standardized)	0.00	1.99	0.28	1.82	–0.20	2.15
Proportion of schools with lower than mean autonomy	0.30	0.46	0.19	0.39	0.37	0.48
Mean participation index (standardized)	0.00	1.85	0.46	2.30	–0.17	1.73
Proportion of schools with lower than mean participation	0.63	0.48	0.54	0.50	0.64	0.45
Number of students	24,353		2,853		5,446	
Number of schools	1,118		132		279	

Conceptual issues around autonomy and participation: the principal components method

The model outlined above defines autonomy and participation as specific concepts with particular meaning in an economic model of the school. The Argentine data contains multiple variables, each of which could be interpreted as representing (say, for autonomy) a very specific and narrow concept of autonomy (does the school choose its textbooks). Table 2 gives a list of the 12 variables used to construct indexes for autonomy and participation, respectively. A possible use of this data would be to ask what type of autonomy matters for school results. An alternative interpretation is that autonomy itself is a broader concept ad that a list of questions on autonomy gives us multiple noisy signals about a one-dimensional autonomy, broadly defined, granted to this school. An intermediate interpretation is that autonomy can be granted in several areas, and that groups of individual questions give us signals about autonomy in each of those areas. One classification could be: autonomy in teacher management and organization, autonomy in curricular and pedagogical matters, autonomy in relations with parents, autonomy in other matters (Table 2).

This complex problem is addressed with a flexible approach. The results reported here use only one *autonomy* concept, and use the first principal component of the 12 autonomy variables (the method for participation is analogous). This approach assumes that the various measures are noisy signals of one underlying concept of autonomy and one concept of participation. A variety of alternative approaches were carried out as well: (a) under the alternative hypothesis that all the 24 variables are relevant in themselves; (b) under the hypothesis that there are four relevant sub-aggregates (see Table 2); (c) under the alternative hypothesis that more than the first principal component should be used; and (d) using factor analysis rather than principal components, in an identical approach.

For the main analysis, however, only one variable for autonomy (hypothesis one, equation 10), one for participation (hypothesis two, equation 11), and the interaction of the two (hypothesis three, equation 12) are reported. For both autonomy and participation the respective variable should be seen as a synthetic variable, distilled from a broader range of questions.

Table 2. Variables measuring autonomy and participation

	Mean	*Std. Dev.*	*Min.*	*Max.*
School autonomy				
Autonomy in teachers management and organization				
Decisions about organization of teacher's work	0.962	0.192	0	1
Criteria for evaluation of teachers' performance	0.848	0.359	0	1
Autonomy in curricular and pedagogical matters				
Curricular innovations	0.853	0.354	0	1
Selection of didactic material	0.934	0.249	0	1
Criteria for evaluation of students' performance	0.936	0.244	0	1
Selection of textbooks	0.807	0.395	0	1
Autonomy in relations with parents				
Decisions regarding parents meetings	0.963	0.188	0	1
Autonomy in other matters				
Decisions about organizational aspects of the school	0.986	0.119	0	1
Decisions about elaboration of institutional projects	0.957	0.203	0	1
Decisions about inclusion of material of interdisciplinary content	0.860	0.348	0	1
Decisions about elaboration of disciplinary norms	0.886	0.319	0	1
School plans extracurricular activities	0.840	0.367	0	1
Parental participation				
Parents' participation in teachers management and organization				
Decision–making regarding organization of teacher's work	0.027	0.162	0	1
Setting the criteria for evaluation of teachers' performance	0.020	0.139	0	1
Parents' participation in curricular and pedagogical matters				
Selection of didactic material	0.046	0.209	0	1
Selection of textbooks	0.048	0.214	0	1
Development of criteria for evaluation of students' performance	0.038	0.190	0	1
Decisions regarding curricular innovations	0.073	0.261	0	1
Parents' participation in parents' convocations				
Decisions regarding parents meetings	0.192	0.394	0	1
Parents' participation in other matters				
Elaboration of institutional project	0.358	0.480	0	1
Elaboration of disciplinary norms	0.283	0.450	0	1
Planning extracurricular activities	0.361	0.481	0	1
Organizational aspects of the school	0.067	0.250	0	1
Inclusion of material of interdisciplinary content	0.098	0.298	0	1
Pct. of parents who regularly participate in school activities	4.699	2.449	0	10
Index of parents assistance to meetings	3.400	2.524	0	8
Parents participate in the creation of policies	0.254	0.436	0	1
Families participate by contributing additional resources	0.477	0.328	0	1

4. Model and results

The basic model estimated includes a rich set of child, household, and school-level characteristics. Socioeconomic characteristics of students cover three areas: mother's and father's education and an index of household wealth based on characteristics of the home and items/appliances available in the home, plus "higher-order" variables derived from these (described in more detail below).[6] On the school input side, variables include characteristics of teachers and the principal, school equipment and infrastructure. In addition, fixed effects are included for each province to represent omitted variables constant at the province level. The full list of variables, with summary statistics, is reported in Annex Table 1.[7]

In addition, the specification includes variables based on aggregates of socioeconomic characteristics across families. These "higher-order" statistics are calculated for parent wealth, and for the mother and father's education. Using parental wealth as an example, they are defined as mean parental wealth for a school; variance of parental wealth at a school; and the squared difference between mean parental wealth in a school and in the province (each of these measures excludes the index school). The first reason for including these aggregates is simply that the socioeconomic background of other children in the classroom is potentially associated with a student's learning. A causal interpretation would be external effects across students in a classroom. A non-causal interpretation would be that there are variables omitted from the true causal model (socioeconomic characteristics and/or school inputs), and that these are correlated with the socioeconomic characteristics of other families. The second reason is that these aggregates themselves represent arguments in sensible models of autonomy and participation. Thus, including them as variables in the model eliminates the potential for certain biases in the estimated effects of autonomy and participation on student learning (this is discussed further below in the section on potential endogeneity). For instance, a high variance between families in a school could make their joint governance of the school less (or more) efficient. Similarly, if the school's composition—represented by the

[6] Family wealth is defined as the first principal component of the set of 18 variables describing the assets owned by the house household (e.g., ownership of a refrigerator, a car, a TV, and number of rooms per person). The variable is used as a wealth indicator, and also to create subsamples of poor students and schools, as well as to explore the effect of within school and within province wealth averages and variances. Filmer and Pritchett (2001) explore the implications of using an "asset index" of this type in analyzing school enrollment and conclude that it is a valid approach.

[7] The school's location cannot be further specified in these data.

mean across families—is much different from that of the province, then this could make hierarchical management from the province less productive and place a specific value to autonomy for this school. Correspondingly, a province with high variance between schools but low variance within schools could be one with a more productive role for school autonomy and participation.

Table 3 reports the results for selected variables of the mathematics and language (Spanish) test scores models (Annex Table 1 reports the full set of coefficients and *t*-statistics estimated for the first models). There are two basic specifications: first, a full specification that includes all school-level variables, and second a reduced specification that excludes school inputs and characteristics and includes only autonomy, participation, and school level aggregates of the socioeconomic backgrounds of students as school-level variables.

The first three variables in Table 3 are autonomy, participation and an interaction term measuring the distinct multiplicative effect of autonomy *and* participation (hypothesis three, equation 12). Autonomy is significantly positively associated with math test scores (at the 10 percent level); participation has no significant independent effect on test scores, but the interaction between participation and autonomy is significant and therefore participation has an impact through the way it modulates the effect of autonomy. The R-squares of .26 for math and .23 for language are consistent with those found elsewhere in the school production function literature.[8] Neither autonomy, participation, nor their interaction is significantly associated with language test scores. The other variables in the language model are significant, and in general the overall explanatory power in the production functions for the language test is not dramatically lower than that of the math test.

[8] The relatively low values do suggest that a large part of the variation in learning outcomes is not explained using these simple models.

Table 3. Selected results from basic models of math and language test scores (all students in urban areas)

	Model with school inputs		*Model without school inputs*	
	I *Math*	*II* *Language*	*III* *Math*	*IV* *Language*
Autonomy	0.017*	.006	0.018*	0.007
	(1.81)	(0.71)	(1.91)	(0.87)
Parental participation	–0.007	0.006	–0.003	0.005
	(–0.70)	(0.67)	(0.29)	(0.56)
Autonomy and participation interaction	0.012*	0.003	0.012*	0.003
	(2.10)	(0.59)	(1.98)	(0.72)
Parent wealth	0.029*	0.013*	0.030*	0.012*
	(8.65)	(3.21)	(8.72)	(3.19)
Mother's education	0.046*	0.046*	0.046*	0.046*
	(8.64)	(7.36)	(8.64)	(7.34)
Father's education	0.019*	0.024*	0.019*	0.024*
	(3.63)	(4.07)	(3.66)	(4.11)
Number of observations	23,961	22,872	23,961	22,872
R-squared	.26	.23	.24	.21
P-value of joint test of sig. of autonomy and interaction	.0738	.7141	.0939	.6177
P-value of joint test of sig. of participation and interaction	.1056	.6263	.1372	.6266
P-value of joint test of significance of school inputs	.0136	<.001		

Note: *t*–statistics adjusted for school clustering, * indicates significance at the 10 percent level. Models include parent wealth (school mean, school variance, school deviation from province mean), mother's education ("), father's education ("), public school dummy variable, Provincial dummy variables (22), student characteristics (age, gender), school characteristics (65 variables). See Annex Table 1 for details.

In order to illustrate the interactive effect of autonomy and participation on math test scores, Figure 1 shows the marginal effect of each as a function of the other. For example, if the model estimated is

(13) $$t = a + b_a A + b_p P + b_{ap} AP + \text{ other terms,}$$

then the top left panel of Figure 1 shows

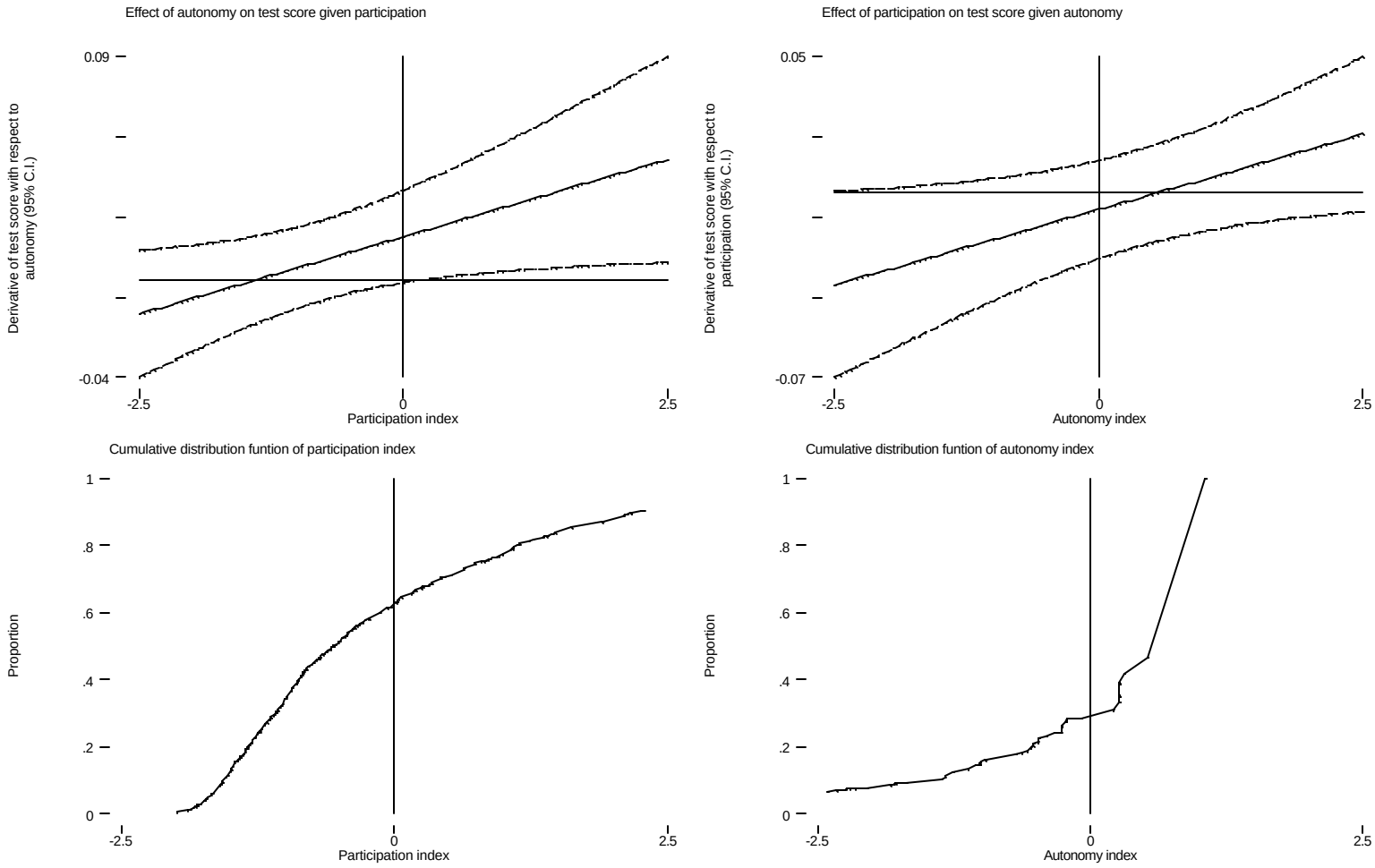
(14) $$D_A = \frac{\partial t}{\partial A} = b_a + b_{ap} P,$$

that is the effect of autonomy on test scores as a function of participation.[9] The lower left panel shows the frequency distribution of the participation variable. Autonomy has a positive effect on math test scores (the line lies above zero) and this effect is increasing in the extent of parental participation (the line slopes upward). Above a value of about zero for participation (which is larger than the value for 60 percent of the sample) the effect of autonomy effect is positive and significant. The relationship between test scores and participation is insignificant over the whole range of values of autonomy. For the values of autonomy where most of the sample lies, the point estimate of the marginal effect is particularly close to zero.

It is possible that this approach sets the hurdle too high for measuring the effect of autonomy and participation. The specification estimated, derived from the model outlined in Section 2, includes a full set of variables capturing school level educational inputs. An alternative formulation could have yielded a hypothesis whereby the impact of autonomy and participation was through changing the levels of these inputs. In order to explore this possibility Table 3 also reports (in columns III and IV) the same model but excluding these school input variables. While these variables are significantly associated with test scores in the full model (with p-values of the joint tests of significance equal to .0136 and less than .001 in the math and language models respectively), their exclusion does not change the estimated relationship between test scores and autonomy and participation: point estimates are virtually identical and the pattern of significances is the same.

[9] The panel also shows the upper and lower bounds of the 95 percent confidence interval based on the variance estimate for the derivative: $s^2_{D_a} = s^2_{b_a} + p^2 s^2_{b_{ap}} + 2Psp_a, b_{ap}$ where $s^2_{b_a}$ and $s^2_{b_{ap}}$ are variance of the estimates of b_a and b_{ap} respectively, and $s_{b_a, b_{ap}}$ is the covariance between the estimates.

Figure 1. The marginal effect of autonomy given participation, and of participation given autonomy on math test scores (and cumulative distribution of participation and autonomy)



Potential endogeneity of autonomy and participation

One potential problem with these estimates is the fact that schools that are more autonomous, or in which parents participate more, might be different in ways not captured in the data. If these differences are correlated with autonomy and participation but also have an independent effect on test scores (that is, not merely *through* autonomy and participation), then the parameter estimates could be biased. For example, if schools that appear more autonomous reflect more "activist" communities and have otherwise better characteristics that would lead to higher test scores regardless of their level of autonomy, then the coefficient would overestimate the impact of autonomy. Likewise, if more "motivated" parents are more likely to participate in school affairs and also more likely to encourage their children to do schoolwork at home (even in the absence of participation in school affairs) then the coefficients would be overstating the role of participation by attributing these omitted effects to it. These problems would occur, however, only if the variation across communities in the unobserved "activism" dimension and across families in the "motivation" dimension were not adequately captured through other exogenous variables. For this reason, the extensive data set, with a rich set of socioeconomic characteristics and school variables, leaves less room for potentially omitted variables in the test-score equation (at least by the standards of the literature on education production functions).

In order to deal with this problem, one would need either an experimental framework where some schools were randomly "allocated" more or less autonomy and/or parental participation, or one would need a statistical method robust to the problem. The typical statistical approach is to use instrumental variables. In this approach, a valid "instrumental variable" for autonomy would be one assumed to affect autonomy but not test scores directly (i.e., other than through its effect on autonomy). The Argentine data set does not include what could be rationalized *ex ante* as valid instruments. Nevertheless, two main modifications to the basic setup were carried out in order to explore potential instruments.

First, provincial dummy variables were excluded from the test-score equation to include them in a first stage of an instrumental variables procedure. The assumption underlying this approach would be that the function relating inputs to test scores is stable across provinces, but that the degree of autonomy and participation is determined in part by provincial level policies. Indeed, in a first-stage regression model explaining autonomy or participation, the provincial dummy variables are highly jointly significant. In addition, the "incremental R-squared," that is the additional variation explained by the provincial dummy variables when they are added to the first-stage autonomy or

participation regressions (including all other exogenous variables), is between .04 or .05 (from a base of about 0.16, i.e., 25 percent) which is reasonable when compared to other values found in the literature. Nevertheless, the approach fails a test of overidentification (Annex Table 2). Note that since one needs to assume that the model is at least just identified in order to estimate it consistently, one can only test the validity of the overidentifying restrictions. The test soundly rejects the validity of these restrictions, suggesting that the provincial dummy variables are not a feasible way to test and correct for potential endogeneity. An intuitive way of understanding this finding is that the province dummies have power in explaining test scores even after controlling for their impact via autonomy and participation.[10] Ignoring these problems and carrying out the estimation yields a positive and significant effect on participation, and insignificant effects on autonomy and the interaction term.

The fact that valid instruments are difficult to come by should not be too surprising: despite the richness of the data set it is very difficult to rule out variables from a test score equation *a priori*. Provincial dummies belong in the test-score equation not on theoretical a priori grounds (province names are not an input, strictly speaking), but based on the plausible empirical argument that they are correlated with omitted variables in the test score equation—a finding confirmed by ours and the most similar studies.

The second main modification to the basic setup was to exclude certain variables from the production function, "freeing" them for use as instruments. The variables excluded were the within school variance of wealth and parental education, as well as the squared deviation from provincial averages for wealth and parental education. Again, the assumption justifying this approach would be that these variables are not direct inputs into the production of test scores, but that they influence scores only because they are associated with more or less autonomy and participation. Indeed, a plausible theoretical model could specify these heterogeneity measures as determinants of autonomy and participation. Despite this, these variables perform extremely poorly as identifying instruments at the first stage regression. They are not jointly significant in a regression explaining autonomy or participation, and they add less than 0.01 to the R-square of the regression (Annex Table 1). Clearly these are very weak instruments. Moreover, they fail

[10] More formally, the test involves regressing the IV residuals on the set of exogenous variables and multiplying the resulting uncentered R-square by the sample size. Under the null hypothesis that the instruments are valid, the test statistic is distributed as chi-squared with degrees of freedom equal to the number of instruments minus the number of endogenous variables (see Deaton, 1997, p. 112, and Davidson and MacKinnon, 1993, pp. 232-37).

the test for overidentifying restrictions, indicating that (under the assumption that at least three of them are valid to identify the model) the remaining three have a direct effect on test scores. Again, this approach does not seem to be validated by the data. Carrying out the second-stage regression regardless of the problems yields insignificant effects on all three variables (unsurprisingly given their weakness as first stage explanatory variables). A minor variant of this approach was to exclude the school average levels of the socioeconomic variables under the same assumption and the results were very similar.

It is not possible to rule out that the results from Table 3 are biased because of correlation with unobserved (and perhaps unobservable) variables, but the fact that we are able to control for many family and school characteristics suggests that the problem is, at least, limited. Average wealth at the school level is significantly positively correlated with autonomy, and the average education level of mothers is significantly positively correlated with both autonomy and participation. However, while these correlations are statistically significant, they are very small (less than 0.1; Annex Table 3). The correlations with the other socioeconomic characteristics (and transformations) are smaller still, and all are insignificantly different from zero. While this certainly doesn't rule out that autonomy and participation might be correlated with other *unobserved* attributes of households, the low correlation with *observed* socioeconomic attributes suggests that the unobserved variables might not be such a problem.

Robustness to changes in specification

Given that the search for valid instruments was unsatisfactory, robustness checks were carried out reverting to specifications that include province dummy variables and the socioeconomic variables and transformations thereof in the test score equations.[11] The results for mathematics test score are reported in Table 4; language test score results are not reported since the coefficients on the autonomy and participation variables remain insignificant across the various models estimated. To the extent that the assumptions asserted in the search for valid instruments described above are true, these potential causes of bias would be mitigated by the fact that the variables are controlled for directly in the regression. That is, provincial dummies and the set of socioeconomics variables and transformations will capture a large part of the bias introduced—if any—by the fact that "community activism" and "parental motivation" are not in the regression itself.

[11] Perhaps a more satisfactory approach would be to use supplementary information at a lower administrative level than the Province. Unfortunately, as mentioned above, these are not identifiable in these data.

Note that in addition to these variables, the model includes a large set of school-level and household-level variables, which will attenuate the bias problem as well.

Column I of Table 4 repeats the earlier result for comparison. Column II reports selected results that include (linearly) higher order components derived from the principal components analysis of the autonomy variables, the participation variables, and the variables capturing household wealth. The results are virtually identical of the basic model that includes only the first principal component for each of these. First, there is no change in the estimated coefficients of autonomy and participation. Second, while some of the coefficients for subsequent principal components are significantly different from zero, they do not have a pattern of declining significance to indicate a cut-off point. Moreover, the pattern of factor loadings on the variables that make up these components do not lead to a natural interpretation of the various indexes. Specifications with "group" variables (as described in Table 2) gave similar conclusions, as did specifications with all the 24 variables (12 for autonomy, 12 for participation): one autonomy measure and one participation measure yields the most interpretable and consistent model across specifications. The same exercise using factor analysis, rather than principal component, to aggregate variables yielded no qualitative differences.

Column III reports selected results from the specification that excludes the variables that are derived from aggregating socioeconomic characteristics across children and across schools. Again, the results are remarkably similar to those that include them—although the coefficient on autonomy is now significantly different from zero at the 5 percent level. Column IV reports selected results from a model that includes all the variables that make up the wealth indicator individually, rather than including the aggregate derived from principal components analysis. Again, the coefficients and significances of the autonomy and participation variables are virtually identical to those from the basic model. This suggests that we do not loose much information through aggregating, but rather gain in our ability to interpret the overall relationship between household wealth and test scores.

Table 4. Selected results from basic models of math test scores with variations on the specification and inclusion of certain variables
(all students in urban areas)

	I	*II*	*III*	*IV*
	Basic (Table 3, Column I)	*Basic, including higher order PC*	*Basic, excluding average, variance and deviation from province*	*Basic, including all asset variables individually*
Autonomy	0.017*	0.015*	0.020*	0.018*
	(1.81)	(1.73)	(2.12)	(1.98)
Participation	–0.007	–0.006	–0.001	–0.007
	(0.70)	(0.60)	(0.12)	(0.66)
Autonomy and participation interaction	0.012*	0.010*	0.011*	0.012*
	(2.10)	(1.86)	(1.99)	(2.09)
Parent wealth	0.029*	0.033*	0.057*	
	(8.65)	(9.53)	(12.02)	
Mother's education	0.046*	0.045*	0.065*	0.039*
	(8.64)	(8.51)	(9.96)	(7.28)
Father's education	0.019*	0.019*	0.032*	0.013*
	(3.63)	(3.62)	(5.01)	(2.48)
Autonomy variables 2nd PC		0.014		
		(0.96)		
Autonomy variables 3rd PC		0.018		
		(1.16)		
Autonomy variables 4th PC		0.005		
		(0.32)		
Participation variables 2nd PC		–0.001		
		(0.05)		
Participation variables 3rd PC		–0.028		
		(1.69)		
Participation variables 4th PC		–0.016		
		(1.03)		
Wealth variables 2nd PC		0.014*		
		(2.87)		
Wealth variables 3rd PC		–0.043*		
		(6.30)		
Wealth variables 4th PC		–0.009		
		(1.39)		
Number of observations	23,961	23,961	23,963	23,961
R squared	0.26	0.27	0.24	0.27

Note: *t*–statistics adjusted for school clustering, * indicates significance at the 10 percent level. Except where noted, models include parent wealth (school mean, school variance, school deviation from province mean), mother's education ("), father's education ("), public school dummy variable, provincial dummy variables (22), student characteristics (age, gender), school characteristics (65 variables). See Annex Table 1 for details.

Exploring equity: the relationship in subsets of students and schools

Table 5 reports selected results after restricting the sample to subsets of students and schools. These variations on the basic model (reproduced in Column I for comparison) yield remarkably similar results: autonomy matters on its own, participation is insignificant alone, and the combination of autonomy and participation has a significant positive effect. Columns II and III estimate the model for "poor students" (students whose family wealth index is in the poorest quintile) and "poor schools" (schools in the poorest quintile of schools based on average family wealth in the school). For poor students the coefficients on autonomy, participation, and the interaction are almost identical to those from the basic model: there is no indication that autonomy and participation are less associated with learning for the students from poorer households. Restricting the sample to the poorest schools does show a difference: the magnitude of the effects are larger. In these schools autonomy is more strongly associated with scores, and the effect grows sharply with the level of parental participation. This is illustrated in the top left panel of Figure 2 which repeats Figure 1 restricted to students from the poorest schools. The figure shows that above a value for the participation index of –.4 (corresponding to slightly more than 40 percent of school) the relationship between autonomy and test scores is positive and significantly different from zero. Moreover, the magnitude of the marginal effect is substantially larger than that derived for the sample as a whole.

Column IV reports selected results for a similar variation: it is estimated on the roughly 20 percent of the student sample for which the mother has less than primary education, and the result is again no substantial difference in the coefficients for autonomy and participation as compared to the "all student" or "all poor student" samples. Column V reports the selected results for public schools only. These constitute about 80 percent of the sample, and 95 percent of the poorest quartile. The general pattern of results is slightly strengthened: autonomy matters, and participation matters when in combination with autonomy.[12]

[12] A similar model for private schools revealed somewhat different results: participation was significantly negatively related to test scores and autonomy was not directly related to scores. The interaction variable was significant and the combined effect ranged from significantly negative to significantly positive. It is important to note that this is a sub-sample with very different levels for most variables: Private schools on average have comparatively high levels of autonomy - while for participation the levels and variation more comparable to the larger sample.

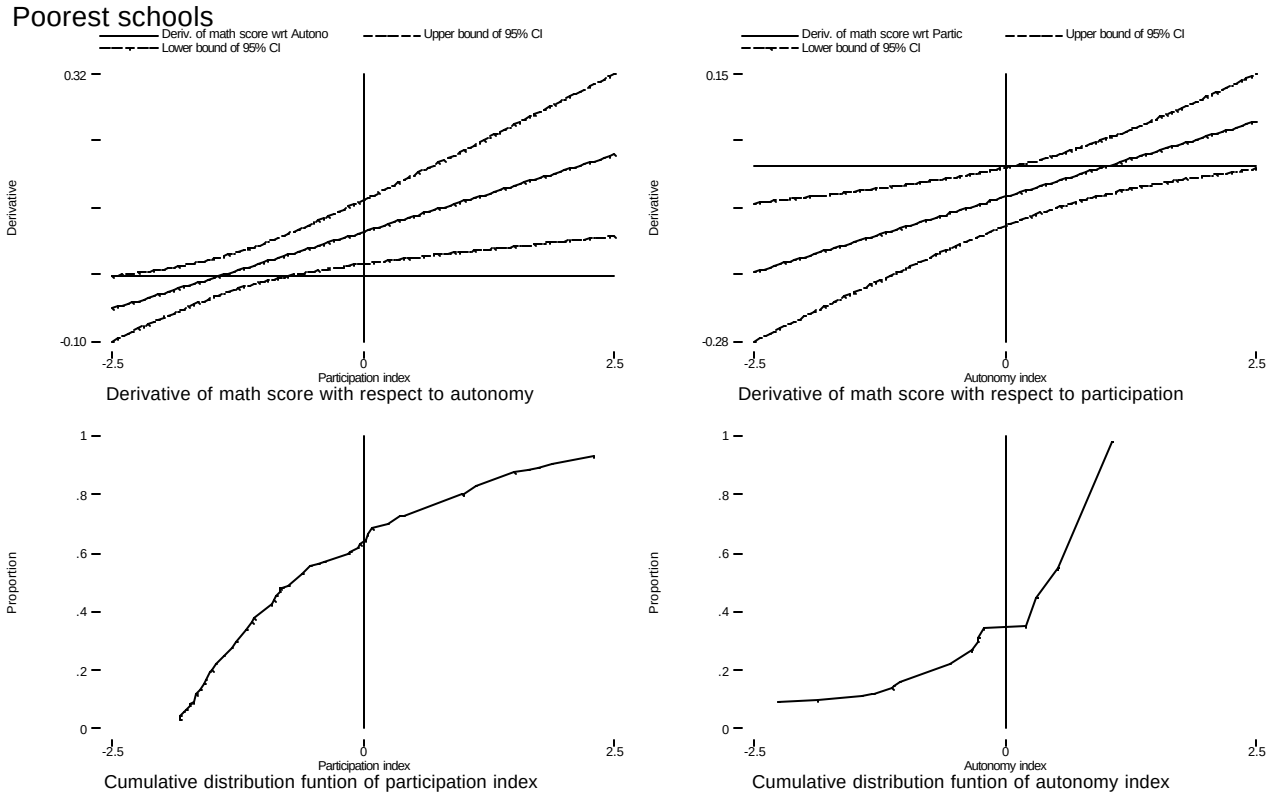
Table 5. Selected results from basic models of math test scores with variations on the subsets of schools and students included
(urban areas)

	I	*II*	*III*	*IV*	*V*
	All students (Table 3, Column I)	*"Poorer" students*	*"Poorer" schools*	*Mothers with no schooling*	*Public schools*
Autonomy	0.017*	0.020*	0.071*	0.029*	0.020*
	(1.81)	(1.82)	(2.70)	(2.26)	(2.04)
Parent participation	–0.007	–0.011	–0.048*	–0.003	–0.003
	(–0.70)	(0.92)	(2.01)	(0.18)	(0.25)
Autonomy and participation interaction	0.012*	0.011*	0.049*	0.023*	0.011*
	(2.10)	(1.87)	(2.85)	(2.86)	(1.91)
Parental wealth	0.029*	0.011	0.032*	0.030*	0.031*
	(8.65)	(1.14)	(5.76)	(4.06)	(8.50)
Mother's education	0.046*	0.027*	0.022*		0.040*
	(8.64)	(2.56)	(2.31)		(7.11)
Father's education	0.019*	0.010	0.005	0.009	0.016*
	(3.63)	(1.03)	(0.51)	(0.80)	(3.00)
Number of observations	23,961	5,968	5,340	4,722	20,105
R-squared	.26	0.17	0.23	0.20	0.23

Note: *t*–statistics adjusted for school clustering, * indicates significance at the 10 percent level. Models include parent wealth (school mean, school variance, school deviation from province mean), mother's education ("), father's education ("), public school dummy variable, provincial dummy variables (22), student characteristics (age, gender), school characteristics (65 variables). See Annex Table 1 for details.

Figure 2. The marginal effect of autonomy given participation, and of participation given autonomy on math test scores, poorest schools only

(and cumulative distribution of participation and autonomy)



5. Conclusions

This paper set out to use a rich dataset—at least compared with the literature on educational production functions—to analyze whether school autonomy and participation by parents are associated with learning over and above what would be expected given socioeconomic background and other school inputs. The conclusion—the interaction of autonomy and participation matters for learning (in mathematics)—is consistent with our theoretical model and robust to varying the specification estimated. Furthermore, the effect is stronger among the poorest schools, and as strong for children of poorer households. The possibility that the results biased due to endogeneity (i.e., correlation between unobserved variables and autonomy and participation), cannot be ruled out by statistical methods, but the inclusion of many observed inputs hopefully mitigates the problem. Furthermore, the low correlation between autonomy and participation on the one hand and observed variables on the other suggest that the bias problem is likely not severe.

A positive effect on learning attributed to participation and autonomy at the school level is relevant to the question of decentralization in two ways: (1) if decentralization leads to more autonomy and participation al the school level, then the results appear to be relevant without further assumptions, and (2) decentralization typically would mean more autonomy and electoral participation at lower levels of government, and the results are relevant if one assumes they reflect more general effects of bringing decisions closer users or the community geographically and jurisdictionally. Nevertheless, both interpretations require restrictive assumptions: it is not necessarily the case that general decentralization in the sector (say, transferring schools from provinces to local government) leads to more autonomy and participation at the school level, nor is it necessarily the case that bringing decisionmaking *closer* to the school (say to, local government) has effects similar to decisionmaking at the school. Thus, the relevance of this analysis for any specific dimension of decentralization reform must rest much on the particular case.

Annex Table 1. Variables, summary statistics, and estimates for one model (N=23,961)

Variable	*Mean*	*Std. Dev.*	*Basic Model: Math test score (Full model of Table 3 Column I)*	
			Coefficient	*t–stat*
Math score (standardized)	0.01	1.00		
Language score (standardized)	0.01	1.00		
Autonomy index – first PC	0.03	2.00	0.017	1.81
Participation index – first PC	0.04	1.89	–0.007	–0.70
Interaction bw Autonomy and Participation indexes	0.59	3.18	0.012	2.10
Household wealth index	0.01	2.05	0.029	8.65
Mean hh wealth within school	0.00	1.29	0.147	4.66
Variance of wealth within school	2.67	1.21	–0.004	–0.34
Sq dev of wealth in school rel to province	1.35	1.86	0.000	0.01
Mothers education	1.78	1.18	0.046	8.64
Mean mothers ed in school	1.78	0.60	0.020	0.28
Variance of mothers ed within school	1.07	0.38	–0.196	–2.85
Sq dev mothers ed in school rel province	0.34	0.39	–0.147	–1.89
Fathers education	1.74	1.17	0.019	3.63
Mean fathers ed in school	1.74	0.60	0.044	0.66
Variance of fathers ed within school	1.07	0.39	–0.053	–0.77
Sq dev fathers ed in school rel province	0.34	0.40	0.084	1.05
Student s Age	3.72	0.83	–0.110	–12.72
Male	0.49	0.50	0.022	1.57
More than X students in school	0.17	0.37	–0.057	–0.89
Number of students	6.06	2.73	0.002	0.26
Facility building good and adequate	0.60	0.49	0.022	0.48
Furniture good and adequate	0.49	0.50	–0.028	–0.62
Classroom good and adequate	0.55	0.50	0.010	0.21
Library good and adequate	0.46	0.50	0.020	0.52
School yard good and adequate	0.50	0.50	–0.033	–0.81
Bathrooms good and adequate	0.41	0.49	–0.035	–0.83
Student desks are in good state	0.63	0.48	0.063	1.50
Boards are in good state	0.68	0.47	0.003	0.07
Lights are in good state	0.71	0.45	–0.021	–0.43
Heat is in good state	0.39	0.49	0.048	1.17
Vents are in good state	0.73	0.44	–0.098	–1.93
Surface/student is in good	0.67	0.47	–0.005	–0.12
Director has a computer for school duties	0.35	0.48	–0.005	–0.14
Director s age	3.75	0.65	0.016	0.61
Years of experience as director	1.96	1.12	–0.006	–0.36
Books are available for teacher and are good	0.82	0.38	0.017	0.36
Magazines are avaliable and are good	0.52	0.50	0.014	0.40
Manuals and books are avaliable for student and are good	0.66	0.47	0.042	1.09
Other textbooks are avaliable for student and are good	0.64	0.48	0.063	1.63
Working Guides are avaliable for students and are good	0.31	0.46	–0.087	–2.15
Maps and Charts are avaliable and are good	0.59	0.49	0.034	0.93
Geometry tools are avaliable for blackboard and are good	0.65	0.48	–0.002	–0.06
Videos are avaliable and are good	0.63	0.48	–0.001	–0.01
Other Software are avaliable and are good	0.00	0.03	0.394	2.32
Projectors are avaliable and are good	0.29	0.46	0.040	0.94
Retroprojectors are avaliable and are good	0.18	0.38	0.096	1.89
Tape players are avaliable and are good	0.65	0.48	0.049	1.36
VCRs are avaliable and are good	0.79	0.41	–0.003	–0.06
Copy machines are avaliable and are good	0.27	0.44	0.093	2.28
Computers are avaliable for students and are good	0.33	0.47	–0.036	–0.89
TVs are avaliable and are good	0.83	0.38	–0.025	–0.46
Labs are avaliable and are good	0.13	0.33	0.036	0.58
Lab materials are avaliable and are good	0.29	0.45	–0.018	–0.42

Continued …

Annex Table A (continued)

Variable	Mean	Std. Dev.	Basic Model: Math test score (Full model of Table 3 Column I) Coefficient	t–stat
Textbooks for students–received through Social Plan	0.69	0.46	–0.007	–0.09
Textbooks for library–received through Social Plan	0.56	0.50	–0.046	–0.74
Textbooks for teachers–received through Social Plan	0.55	0.50	0.052	0.83
Money to improve building–received through Social Plan	0.26	0.44	0.039	0.95
Materials for students–received through Social Plan	0.70	0.46	–0.078	–1.01
Materials for teachers–received through Social Plan	0.44	0.50	0.027	0.61
Didactic materials–received through Social Plan	0.53	0.50	–0.108	–1.99
Money for institutional initiatives–received through Social Plan	0.22	0.42	–0.056	–1.31
Percentage of students receiving free meals	1.50	1.52	–0.003	–0.19
Percentage of students receiving a free glass of milk	2.65	1.97	–0.001	–0.12
Percentage of students receiving free academic support	1.32	1.34	0.015	1.23
Percentage of students with alleviated work load	3.44	1.87	–0.012	–1.01
Average teacher s age	2.64	0.57	0.083	1.70
Average years of teaching experience of teachers	3.55	0.97	0.009	0.31
Problem to innovate curricula	0.34	0.47	0.006	0.12
Problem to innovate teaching methods	0.34	0.47	–0.028	–0.51
Only school in the neighborhood	0.24	0.43	0.091	2.09
Distance to nearest school	2.00	1.08	–0.006	–0.84
Evaluation of school regard community	3.44	1.14	0.023	1.40
Director receives information regarding training course offerings	1.34	0.62	0.017	0.57
Quantity of information received by director about curricular dev.	1.51	0.65	–0.026	–0.79
Quantity of information received by director about school management	1.40	0.67	0.008	0.25
Share of teachers with title: school teacher	0.22	0.26	–0.026	–0.16
Share of teachers with title: primary school professor with higher non–univ.	0.70	0.29	–0.093	–0.57
Share of teachers with title: primary school professo r with higher univ.	0.05	0.14	0.040	0.17
Share of teachers with title: professor with higher non–univ. education	0.04	0.12	–0.250	–1.37
Share of teachers with title: professor with higher university education	0.01	0.05	0.167	0.47
Share of teachers with title: “profesional universitario”	0.01	0.07	0.158	0.51
Share of teachers with other title	0.06	0.13	–0.183	–1.45
Share of teachers with no title	0.00	0.02	–0.249	–0.55
Share of teachers with more than one position in this school	0.06	0.16	0.210	1.68
Share of teachers who work in another school	0.22	0.25	–0.044	–0.65
Public school	0.84	0.37	0.086	1.40
MCBA	0.05	0.22	0.150	1.19
CABA	0.04	0.19	–0.019	–0.13
Catamarca	0.05	0.22	–0.189	–1.25
Chubut	0.06	0.23	–0.270	–2.19
Cordoba	0.01	0.07	–0.787	–4.55
Corrientes	0.05	0.22	0.150	1.16
Chaco	0.06	0.24	0.112	0.81
Entre Rios	0.06	0.23	0.142	1.08
Formosa	0.05	0.21	–0.085	–0.60
Jujuy	0.06	0.24	0.253	1.80
La Pampa	0.04	0.20	–0.020	–0.16
La Rioja	0.04	0.19	–0.301	–2.14
Mendoza	0.04	0.20	0.274	1.98
Misiones	0.05	0.22	–0.136	–0.99
Neuquen	0.03	0.18	0.192	1.47
Rio Negro	0.03	0.18	0.133	0.94
Salta	0.06	0.23	0.365	2.75
San Juan	0.06	0.23	0.254	1.93
San Luis	0.04	0.19	–0.211	–1.65
Santa Cruz	0.02	0.13	–0.339	–2.17
Santa Fe	0.05	0.21	0.251	2.00
Santiago del Estero	0.04	0.21	–0.237	–1.45
Constant			0.117	0.37

Annex Table 2. Tests for incremental explanatory power, and of overidentification, of potential instrumental variables

	IV 1	*IV 2*	*IV 3*
Instruments	*Province dummies*	*Within school variance of socioeconomic variables, squared "distance" from provincial average socioeconomic variables*	*Same as IV 2, plus school level averages of socioeconomic variables*
Number of instruments	22	6	9
Incremental R2, autonomy	.0376	0.003	0.008
F-test	1.73	0.90	1.48
(p-value)	(0.0199)	(0.495)	(0.149)
Incremental R2, participation	.0512	0.003	0.008
F-test	3.42	0.89	1.39
(p-value)	(<0.0001)	(0.501)	(0.189)
Incremental R2, autonomy and participation interaction	0.262	0.009	0.010
F-test	1.02	1.95	1.69
(p-value)	(0.4327)	(.070)	(0.086)
P-value of test for overidentification	<0.0001 , reject	0.0387, reject	<0.0001 , reject

Annex Table 3. Pairwise correlations between school level autonomy and participation indices and socioeconomic characteristics (N=1,118)

	Autonomy index	*Participation index*
Parental wealth, school mean	0.0804	0.0426
	(0.0072)	(0.1545)
Parental wealth, school variance	–0.0217	–0.0006
	(0.4690)	(0.9840)
Parental wealth, school deviation from province mean	0.0168	–0.0186
	(0.5751)	(0.5343)
Mother's education, school mean	0.0518	0.0722
	(0.0832)	(0.0158)
Mother's education, school variance	–0.0004	–0.0255
	(0.9904)	(0.3955)
Mother's education, school deviation from province mean	0.0245	–0.0160
	(0.4128)	(0.5930)
Father's education, school mean	0.0576	0.0621
	(0.0542)	(0.0380)
Father's education, school variance	–0.0361	0.0130
	(0.2287)	(0.6649)
Father's education, school deviation from province mean	0.0159	–0.0382
	(0.5950)	(0.2013)

Note: P–values in parenthesis.

References

The word "processed" describes informally reproduced works that may not be commonly available through library systems.

Angrist, Joshua, Eric Bettinger, Erik Bloom, Elizabeth King, and Michael Kremer. 2001. "Vouchers for Private Schooling in Colombia: Evidence from a Randomized Natural Experiment." NBER Working Paper No. 8343. Cambridge, Mass.

Card, D., and A. Krueger. 1992. "Does School Quality Matter? Returns to Education and the Characteristics of Public Schools in the United States." *Journal of Political Economy* 100(1): 1–40.

Carnoy, Martin, and Patrick McEwan. 1997. "Public Investments or Private Schools? A Reconstruction of Educational Improvements in Chile." Stanford University. Processed. (carnoy@leland.stanford.edu).

Chapman, Judith D., W. Boyd, R. Lander, and D. Reynolds, eds. 1996. *The Reconstruction of Education: Quality, Equality and Control*. London: Cassell.

Clune, William H., and John F. Witte, eds. 1990. *Choice and Control in American Education: Vol. 1. The Theory of Choice and Control in American Education.* London and New York: Falmer Press.

Davidson, Russell, and James G. MacKinnon. 1993. *Estimation and inference in econometric*s. New York: Oxford University Press.

Deaton, Angus. 1997. *The Analysis of Household Survey*s. Washington, D.C.: Johns Hopkins University Press for The World Bank.

Filmer, Deon, and Lant Pritchett. 2001. "Estimating Wealth Effects without Expenditure Data or Tears: With an Application to Educational Enrollments in States of India." *Demography* 38(1): 115–32.

Gauri, Varun. 1998. "School Choice in Chile: Two Decades of Educational Reform." Pittsburgh, PA: University of Pittsburgh Press.

Hannaway, Jane, and Martin Carnoy, eds. 1993. *Decentralization and School Improvement: Can We Fulfill the Promis*e? San Francisco: Jossey-Bass.

Hanushek, Eric. 1986. "Economics of schooling: production and efficiency in public schools." *Journal f Economic Literature* 24 (September): 1141-77.

_____. 1994. *Making Schools Work: Improving Performance and Controlling Costs.* Washington, D.C.: Brookings Institution.

_____. 1995. "Interpreting Recent Research on Schooling in Developing Countries." *The World Bank Research Observer* 10(2): 227–46.

Hoxby, Caroline M. 1994. "Does Competition Among Public Schools Benefit Students and Taxpayers?" Department of Economics, Harvard University, Cambridge, Mass. Processed.

James, Estelle, Elizabeth M. King, and Ace Suryadi. 1996. "Finance, Management, and costs of Public and Private Schools in Indonesia." *Economics of Education Review* 15(4): 387–98.

Jimenez, Emmanuel, and Vincente Paqueo. 1996. "Do Local Contributions Affect the Efficiency of Public Primary Schools?" *Economics of Education Review* 15(4): 377–86.

Jimenez, Emmanuel, and Yasu Sawada. 1999. "Do Community-Managed Schools Work? An Evaluation of El Salvador's EDUCO Program." *World Bank Economic Review* 13(3): 415–41.

King, Elizabeth M. and Berk Özler. 2000. "What's Decentralization Got To Do With Learning? Endogenous School Quality and Student Performance in Nicaragua." Development Research Group, World Bank, Washington, D.C. Processed.

Kremer, Michael R. 1995. "Research on Schooling: What We Know and What We Don't A Comment on Hanushek" *World Bank Research Observer* 10(2): 247–54.

Lazear, Edward P. 1999. "Educational production" NBER working paper No. W7349. Cambridge, Mass.

Lewis, Dan A. 1993. "Deinstitutionalization and School Decentralization: Making the Same Mistake Twice." In Jane Hannaway and Martin Carnoy, eds. *Decentralization and School Improvement: can we fulfill the promis*e? San Francisco: Jossey-Bass.

McMillan, Robert. 1999. "Parental Pressure and Competition: An Empirical Analysis of the Determinants of Public School Quality." Department of Economics, Stanford University, Stanford, CA. Processed.

Organisation for Economic Co-operation and Development. 1993. *Education at a Glance: OECD Indicator*s. Paris, France.

Peltzman, Sam. 1993. "The Political Economy of the Decline of American Public Education." *Journal of Law & Economics* XXXVI: 331–70.

Pritchett, Lant, and Deon Filmer. 1998. "What Education Production Functions Really Show: A Positive Theory of Education Expenditures." *Economics of Education Review* 18: 223–39.

Tyack, David. 1993. "School Governance in the US Historical Puzzles and Anomalies." In Jane Hannaway and Martin Carnoy, eds. *Decentralization and School Improvement: can we fulfill the promis*e? San Francisco: Jossey-Bass.

Urquiola, Miguel. 2001. "Identifying Class Size Effects in Developing Countries: Evidence from Rural Schools in Bolivia." Policy Research Working Paper 2711. Paper. World Bank, Development Research Group, Washington, D.C.

Winkler, Donald R. 1993. "Fiscal Decentralization and Accountability in Education: Experience in Four Countries." In Jane Hannaway and Martin Carnoy, eds., *Decentralization and School Improvement: can we fulfill the promis*e? San Francisco: Jossey-Bass.

Witte, John F. 1990. "Choice and Control: An Analytical Overview." In W. Clune and J. Witte, eds., *Choices and Control in American Education,* Vol. 1. New York: Falmer Press.

Zeigler, L.H., H. Tucker and L. Wilson. 1977. "How School Control Was Wrested from the People." *Phi Delta Kappa* 58(7): 291–96.