Community Participation, Teacher Effort, and Educational Outcome: The Case of El Salvador's EDUCO Program

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Abstract

Based on a principal-agent model, this paper investigates the organizational structure that made the El Salvador's primary school decentralization program (EDUCO program) successful. First, we employ the "augmented" reduced form educational production function by incorporating parents and community involvement as a major organizational input. We observe consistently positive and statistically significant EDUCO participation effects on standardized test scores. Then we estimated teacher compensation function, teacher effort functions, and input demand functions by utilizing the theoretical implications of a principal (parental association)-agent (teacher) framework. While the EDUCO school teachers receive piece rate, depending on their performance, wage payment is relatively fixed in the traditional schools. Empirical results indicate that the slope of wage equation is positively affected by the degree of community participation. This finding can be interpreted as the optimal intensity of incentive. Hence, teacher's effort level in the traditional schools is consistently lower than that in the EDUCO schools, indicating a moral hazard problem. Community participation through parental group's classroom visits seems to enhance the teacher effort level and thus increases students' academic performance indirectly. Parental associations can affect not only teacher effort and their performance by imposing an appropriate incentive scheme but also school-level inputs by decentralized school management. Our empirical results support the view that decentralization of education system should involve delegation of school administration and teacher management to the community group.

Keywords: Economic analysis of social sector reform; the optimal intensity of incentive condition; moral hazard; education production function; fixed effects instrumental variable estimation.
JEL classification: D82; I2; O12; O54

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1 Introduction

Recently, social sector amelioration has become the focal point of micro-level policy reforms in developing countries. Since social services such as education, nutrition and health are directly related to improvement of households' welfare, it is important to investigate the conditions that are necessary to enhance local public action to improve the well-being of the poor. Examples of intra-community cooperation include issues of forming irrigation and water user associations, providing communal health facilities, and enhancing community involvement in schools. The central question of social sector reform, therefore, is how rural communities in developing countries form associations to overcome weak formal institutions such as the lack of enforcement mechanism for formal contracts and various information problems.

Individuals in a community, however, are diversified with respect to their ability to cooperate in formation of community groups, local social service provision, and monitoring public agencies and officials. As a result, traditionally, the resource allocation process in developing countries' social sectors has been characterized by a highly centralized structure. In an education system, which is our focus, school administrators, teachers, students and parents traditionally play only a limited role in determining school resource allocation. Since monitoring, inspecting and enforcing detailed guidelines for individual schools are likely to be very costly, an education ministry sets rules, such as for the distributions of budgetary allocations between teachers' salaries and other inputs. Teachers are usually government employees and subject to highly regulated and hierarchical management systems. Teacher salaries are often fixed or negotiated centrally. If the rules set by the government do not match the school's needs or the community's preferences, the use of resources becomes inefficient. Moreover, school administrators might become accountable not to parents and students but to central authorities, and thus a centralized system will lead to low school productivity. The widespread observations of failures of centrally planned education systems, especially in developing countries, indicate that community specific factors and conditions should be considered properly for effective provision of social sector resources [World Bank (1996a)].

With this regard, "community participation" has recently become a key concept in local-level decision making process in the arguments on the social sector reforms. The stress on the process and mechanism design of participation is a natural outgrowth of agency problems. In the context of developing countries, the policy makers and researchers began to recognize the significance of potential discrepancies between the actions taken by an agent and the interests of those that the agent is supposed to serve [Stiglitz (1999)]. Recent research provides evidence that participation is necessary for an

effective development of a community. Isham, Narayan, and Printchett (1995), for example, have shown that increasing beneficiary participation directly causes better project outcomes, by using data from 121 diverse rural water projects. Participation not only brings to the project relevant information that outside development agencies are not likely to have, but also brings with it commitment. In turn, commitment brings with it greater effort of agents that is a necessary condition of a successful project [Stiglitz (1995)]. Local participation in project implementation ensures that projects and policies match with the local context. Educational quality, for example, can be improved when schools are able to implement resource allocation according to local conditions and are accountable to parents and communities through community participation [World Bank (1995)]. In the context of developing countries, two examples of empirical investigations are James, King and Suryadi (1996) for Indonesia, Jimenez and Paqueo (1996) for the Philippines, and Glewwe (1997) for the Philippines. These studies conclude that there are efficiency gains from community-based involvement. However, in spite of the powerful reasoning, there is relatively little empirical evidence except the above mentioned studies to document the merits of community-management in education, especially in the context of developing countries. The main reason of the lack in empirical studies is that these administrative arrangements have only recently begun to be implemented in developing countries [World Bank (1996a)].

As another important background of our research, the recent charter school and school-based management movements in the US also document the importance of community participation and school autonomy in education [Hanushek (1994)].[1] Charter schools are independent public schools designed and operated by educators, parents, community leaders, and others. By construction, the charter schools are more responsive to communities and free from the demands of the bureaucratic process. The autonomy of charter schools overcomes the traditional bureaucracy and regulations that prevent an efficient allocation of school resources. Yet, we should note that well-defined goals and performance incentives are the key of a successful school-based management system [Hanushek (1994)]..

This paper investigates the role of community participation in the area of primary education reform through a new case study from El Salvador. We examine a recent successful example of El Salvador's Community-Managed Schools Program (more popularly known by the acronym, EDUCO, or *Educacion con Participacion de la Comunidad*). The EDUCO program is an innovative program for both pre-primary and primary education to decentralize education by strengthening direct involvement and participation of parents and community groups [See, for example, Jimenez and Sawada (1999)]. In terms of both theoretical and empirical analyses, we will investigate the incentive and organizational structures that make the EDUCO program overcome the inefficiency that is widely observed in the centralized

[1] As of February 1999, 34 states and the District of Columbia had passed charter school laws and 27 states and the

education systems.

There are two important empirical findings emerge. First, we observe consistently positive and statistically significant community participation effects on standardized test scores. Second, empirical results of teacher compensation scheme estimation indicate that the slope of wage equation is positively affected by the degree of community participation. As a result, teachers' effort levels in the traditional centrally-managed schools are consistently lower than that in the community-managed EDUCO schools, indicating a moral hazard problem. Peer pressure through community participation seems to enhance the teacher effort level and thus increases students' academic performance indirectly. Our empirical results support the view that decentralization of education system should involve delegation of school administration and teacher management to the community group.

The EDUCO Program in El Salvador

In El Salvador, community education has endogenously emerged in the 1980s during the civil war. At that time, public schools could not be extended because of warfare around the country. Some communities, therefore, took the initiative to organize their own schools, administered and financially supported by an association of households. In 1991, El Salvador's Ministry of Education (MINED) institutionalized these community schools as the EDUCO schools and also decided to use the prototype as the principal method of expanding education in rural areas. In EDUCO schools, the Community Education Association (*Asociacion Comunal para la Educacion* or ACE) elected from the parents of the students has a central role of school administration and management: ACE is responsible for allocation of school budgets and for hiring and dismissing teachers by monitoring teacher's performance. The partnership between MINED and ACEs is expected to improve school administration and management by reflecting local demand needs more appropriately. On the other hand, the parents' associations (*Sociedad de Padres de Familia* or SdPF) in traditional schools have limited roles: SdPF has no administrative capability over school personnel nor budget.

Initially, MINED imposed three purposes of the EDUCO program; first, augmentation of educational supply in the poorest rural communities; second, promotion of the participation of local community members in education; third, improvement of the quality of pre-primary and primary schooling. The initial evidence indicates that the EDUCO program has accomplished these objectives successfully [El Salvador, MINED (1995)]. MINED also expects that moving away from traditional programs that provide education centrally could improve outcomes through increased community and

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District of Columbia are operating 1,200 charter schools, serving over 300,000 students.

parent involvement.

Outline of the Paper

This paper investigates the organizational structure and incentive scheme which made the EDUCO program successful. Figure 1 and 2 represent the basic school governance structure inside the augmented production function for traditional and EDUCO schools, respectively. First, we will construct a formal theoretical model of the EDUCO school. Utilizing a principal-agent framework, we will show that parents or parental associations (principal) can affect not only teacher (agent) effort and their performance by imposing an appropriate incentive scheme but also school-level inputs by delegated school management. Outputs of educational production, usually measured by child educational performance, are created by school level inputs as a result of school-community interactions and by household level inputs such as home teaching (Figure 1 and 2).

Secondly, this paper examines empirically the prediction of the formal model. It estimates "augmented" reduced form production functions using two measures of educational outcomes, i.e., standardized test scores in mathematics and language, among third-grade students.[2] We incorporate parents and community involvement as major organizational inputs. Then, the transmission mechanism from community participation to educational output is investigated. To this end, we estimate teacher compensation function, teacher effort function, and input demand functions, based on the theoretical implications of the principal-agent framework. Empirical results indicate that the slope of wage equation is positively affected by the degree of community participation and teachers' effort levels in the traditional centrally-managed schools are consistently lower than that in the community-managed EDUCO schools, indicating a moral hazard problem.

The rest of this paper is organized as follows. Section 2 discusses the importance of an appropriate teacher payment scheme is reviewed. In Section 3, the formal theoretical framework is derived. We first derive the optimal incentive scheme by solving an optimization problem of parental association. Then the optimal level of teacher effort is determined endogenously. The final sub-section represents the "augmented" reduced form educational production function by taking into account endogenous teacher effort as a function of community participation. In Section 4, we discusse the data set and the estimation results of the student achievement equation. Section 4 also present the formal econometric framework. First, it includes of the production function is constructed and estimated.

[2] Jimenez and Sawada (1999) estimates the reduced form production function extensively. The section of the estimation of production function in this paper basically replicates the results of Jimenez and Sawada (1999) with an alternative set of variables.

Second, the paper empirically investigates the theoretical prediction of the transmission mechanisms from community participation to educational outcome. We estimate teacher compensation function, teacher effort functions, and input demand functions. Section 5 concludes with discussions of policy implications.

2 The Importance of Teacher Payment Scheme and Community Participation

In a conventional centralized education system, teacher payment rates are usually set by the central government. While in most developed countries, teachers' organizations negotiate levels of payments, their influence varies depending on the collective bargaining process and the form of negotiation. In developing countries, government regulations usually construct the teacher payment scheme. For example, in Paraguay, a completely fixed-wage compensation scheme is employed for teacher payments [World Bank (1996b)]. There are no wage premiums for seniority and no rewards for superior performance. Such a centralized education system with rigid teacher payment schemes is highly likely to create deterioration of teacher effort and educational quality. The prototypical argument is that payments that are not connected to performance discourage high productivity [Cohn (1996)]. Teacher compensation, therefore, must be linked to job performance in order to retain well-qualified teachers [Gaynor (1998)]. It is reasonable to expect that linking compensation to job performance would motivate teacher and thus improve quality of education. In recent years, merit teacher payment schemes have been introduced in many states and districts in the US [Cohn (1996)].[3] A study of US schools by Jacobson (1988), for example, concluded that the implementation of an incentive plan that monetarily rewarded high rates of teacher attendance was accompanied by a significant, short-term reduction in teacher absences. During the first year of this attendance incentive plan, teacher absences declined significantly and the total number of teachers with perfect attendance increased four-fold. Cohn (1996, p.227) also shows that the South Carolina Teacher Incentive Plan Award had a significant impact on scores of student achievements. Mickler (1987) concludes that three merit pay plans conducted in Ladue School District, MO, Dalton County, GA, and Lake Forest, IL have been successful as well. Mickler (1987) argues that an important ingredient in a successful implementation of merit payment scheme is the active participation and involvement of teachers in the teaching performance evaluation process.

The empirical evidence, however, is not abundant enough to endorse the importance of merit payment in developing countries. But the following examples from South America and South Asia are the exceptions. In the first example, a locally monitored incentive scheme has been implemented in Nicaragua [Gaynor (1998)]. The Nicaraguan Ministry of Education is developing guidelines that include

[3] The merit-based payment is defined as the payment by results [Cohn (1996, p.210)].

teacher performance incentives, personnel management, and criteria for applying salary supplements to teachers funded by local contributions. Approximately, 25% of the basic teachers' salary are paid monthly as teacher incentives and they are adjusted each term according to teacher performance. This payment is based on regular teacher attendance and low student dropout rates. The school council elects a member who monitors teachers' attendance and administers the local contributions that are received directly by the school. Teacher attendance reports are signed weekly by the chair of the school council and then sent to the municipal education council. Penalties apply when a teacher missed days of school or is late for school by 30 minutes or more on three occasions. The second example is the teacher payment reform in the Dominican Republic. With help from the World Bank, the Dominican government has fabricated a new teacher compensation system with the aim of developing a clearer carrier structure for teachers [Gaynor (1998)]. Under the new system, teacher salaries increase according to improvements in their classroom performance. Performance evaluation of teacher accounts for 20-25% of total salaries. The final example is a merit payment scheme, which has been successfully implemented even in one-teacher schools in Nepal. At schools in the Seti Zone Project in Nepal, teachers in one-teacher schools work under the performance-based payment scheme. Teachers in these schools receive payments directly from supervisors but only if they attained observable performance goals [Bennett (1991)].

2.1 Potential Pitfalls of the Merit-based Payment Scheme

Under the above mentioned merit payment systems, a significant portion of each teacher's salary is based on her/his performance evaluated by supervisors. The opponents of the merit-based system conclude that research on teacher compensation and reward preferences in US history provides only limited support for the proposition that the merit-based payment system can effectively motivate teachers to improve their performance [Cohn (1996)]. Indeed, there is a wide range of technical, organizational, and financial obstacles for merit-based payment schemes. First, performance-based payments might encourage “opportunistic” behavior, i.e., behavior that benefits the individual teacher at the expense of others [Cohn (1996)]. Among teachers, cooperation becomes rare, while competition is common. Opportunistic behavior by teachers, jealousy by those not receiving the merit bonus, and effect of merit pay on administrators may have strong negative effects on the school quality.

Second, it is difficult to establish objective and fair criteria of teacher performance. Before standardized tests were common, school administrators usually employed their own “merit ratings” to determine teacher payments, opening the door to nepotism, arbitrariness, and discrimination, causing serious morale problems. Even if test scores become available, the use of student achievement data may

be problematic. Teachers who are compensated based on test scores of students would be tempted to neglect other aspects of education such as social skills and creative thinking. Teachers might also be led to teaching the most receptive students, whose test scores are easiest to improve, while neglecting students who have more trouble learning [Milgrom and Roberts (1992, p.230)].

Objective indicators of teaching performance, therefore, are difficult to generate, but they are necessary for an impartial and effective merit-pay system. As a result, the predominant payment mechanism for teachers in the United States is the single salary schedule [Cohn (1996)]. A study concluded that the popularity of the US's merit teacher payment scheme in the 1920's and 1950's resulted in widespread failure in the education program [Johnson (1984)]. Failure of the plans to meet their objectives, funding shortages and overall expense of the programs, and recognition that the merit pay bonuses did not provide sufficient incentives to teachers became problematic [Johnson (1984)].

In fact, similar problems with the merit-based teacher remuneration scheme apply to developing countries [Lockheed, Verspoor and associates (1991)]. First, monitoring by supervisors incurs various monetary and non-monetary costs. Usually teacher supervisors face difficulty when monitoring a consistent set of activities, since establishing and implementing an objective teacher evaluation system that justifies the supervisor's decision is costly. Especially in small rural schools with only one or two teachers, teacher evaluation by external supervisors becomes expensive and thus proper evaluation may be inherently difficult. Nonetheless, fair and appropriate evaluation is the fundamental requirement for an effective merit-based payment scheme. Second, potential inconsistency between true and observable teacher efforts can create serious inefficiency in the system. Under the merit payment scheme with external supervisors, teachers become accountable not to parents and students but to the supervisors. The scheme might promote uncooperative teacher attitudes toward parents and students. As a result, system outcomes will become inconsistent with welfare objective of the community.

2.2 Community Participation as a Necessary Condition

However, teacher monitoring by communities, not by external supervisors, can overcome these inherent problems of a merit-based teacher payment scheme. Close monitoring by community groups can be less costly than teacher evaluations by external supervisors. Even in a small rural school with only one teacher, frequent and close teacher monitoring becomes possible if the supervisor is drawn from the same community. When members of the community association are elected from the parents of the students, inconsistency between the behavior of teachers and the welfare objectives of community disappear. Teachers will become accountable to the community association which monitors, supervises, and

evaluates their performance. As a result, teacher will become responsible to parents and students. Community participation not only utilizes relevant information that outside government agencies are not likely to have, but also imposes commitment on teachers, which leads them to exert greater effort.[4]

These advantages of community management and administration of schools seem to apply to the El Salvador's EDUCO program. Teachers in EDUCO schools are selected, hired, supervised and dismissed by the parent associations drawn from the parents of the students (ACEs). The quality of EDUCO teachers is judged according to their teaching performance and behavior. While an EDUCO teacher's salary is higher in many cases, they have less job stability than teachers in traditional schools, especially when teachers do not put much effort towards improving their teaching quality [World Bank (1995)]. As we will discuss in the later sections, the observed better attendance, performance and commitment of EDUCO teachers may confirm the importance of improving the incentive structure based on teacher performance evaluation under the community monitoring system.

3 The Theoretical Framework

The success of community participation depends on how it can overcome agency problems which arise from discrepancies between the agent's action and the principal's objective. In our framework, the "principal" is either MINED in traditional schools or parental association in EDUCO schools, and the "agent" is a teacher. To investigate these teacher incentive issues formally, we will construct a principal-agent model of endogenous teacher effort.

This paper makes two contributions to the principal-agent literature.[5] First, there have been

[4] This advantage of community participation is pointed by Stiglitz (1999).

[5] The literature on theoretical treatments of principal-agent problem is substantial. For example, the model of sharecropping, which was developed during the 1970's in order to explain the particular agrarian institution in developing countries, became one of the first fully worked out principal-agent models in economics [Otsuka, Chuma, and Hayami (1992)]. On the other hand, empirical studies of agency relationships are not widely available. For example, despite the theoretical importance of moral hazard and the distinction between worker time and worker effort, there is little direct empirical evidence on worker shirking. The lack of wide empirical studies can be attributed to the difficulty for an econometrician to observe agent's performances, e.g., employer's estimate of worker effort [Salanie (1998)]. While there have been wide studies of the disincentive effects of input use such as fertilizer, seeds and worker time [Shaban (1985)], in the context of developing countries, there is almost no evidence on the withholding of worker effort except Foster and Rosenzweig (1994) and Laffont and Matoussi (1995). Laffont and Matoussi (1995) estimated production functions using the tenant's production as a natural measure of a worker's effort and performance. The data from Tunisia indicates that the tenant's share of output and the degree of efficiency have a positive relationship. Foster and Rosenzweig (1994) astutely used panel data on workers' health and calorie intake to measure the effort effects, rather than output effects, of different labor payment schemes. They showed the effort level under piece rates is higher than the level under fixed salaries. These empirical studies of the basic agency model show significant effects of compensation on performance. While it is important to point out that incentives matter, these studies do not truly test predictions of the agency theory. A more precise test of agency theory is to address whether contracts are structured to reflect agency concerns [Prendergast (1999)]. Therefore, a second line of

almost no previous applications of the agency framework to social sector management issues in the context of developing countries. In the context of the United States, McMillan (1998) formulated an insightful general equilibrium model of the interaction of parental and school preferences in determining educational outcomes. He also implemented rigorous empirical investigations. On the other hand, this paper formulates a formal theory and empirical framework of decentralization of education program in a developing country. Moreover, this paper empirically investigates not only the relationship between compensation scheme and agent's performance but also the consistency between the contracts and the theoretical prediction. Therefore, this paper provides an accurate test of the agency theory by investigating whether contracts are structured to reflect agency problems.

3.1 The Model of Endogenous Teacher Effort in El Salvador[6]

For the initial step of modeling our idea, a teacher's optimization problem can be represented as an expected utility maximization. A teacher determines his/her optimal effort level, *e*, so as to maximize the expected utility:

$$e^* = \arg\max_{\{e\}} \int_{-\infty}^{\infty} u(W)g(W)dW - CS(e), \tag{1}$$

where u(•) represents a teacher's concave utility function. W is a wage rate and g(•) is a probability distribution function of W. In other words, g(•) denotes the wage offer function. According to empirical dicta, the cost created by effort, CS, will be a concave function of effort level, e [Lazear (1996)].

In El Salvador, specific government regulations (*Escalafon Magisterial*) insure a teacher's job stability and relatively fixed amount of real wage rate in traditional public schools [World Bank (1995)]. Hence, teacher salaries are not linked directly to the teaching performance in traditional school and can be described by a fixed wage system. On the other hand, teachers in EDUCO schools receive contingent payments depending on their teaching performance. The ACEs supervise and evaluate EDUCO teachers'

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the empirical literature has focused on identifying the relationship between compensation schemes and proxies of measures of agent's performance. The most celebrated example of empirically estimating compensation schemes has been a series of papers that estimate pay-for-performance for executives and, particularly, chief executive officers [for example, Jensen and Murphy (1990)]. However, there is only limited evidence that show that the optimal slope of the compensation scheme is determined by risk aversion and the returns to effort and contracts are designed to optimally trade off risk against incentives [Prendergast (1999)]. Yet, it is notable that Kawasaki and McMillan (1987) found supportive evidence of the incentive intensity principle in the Japanese automobile industry.

[6] The model constructed in this paper follows a standard principal-agent model with a linear compensation scheme. For example, see Ross (1973), Hart and Holmstrom (1987), Milgrom and Roberts (1992), and Lazear (1996).

quality and performance. Moreover, EDUCO teachers' job stability itself links to their performance [World Bank (1995)]. However, the true level of teacher effort is not observable to MINED or parental associations. Hence, we can plausibly represent that a teacher, particularly an EDUCO school teacher, is paid on the basis of the "observed" level of teaching effort OE, where OE represents the principal's "estimate" of the "true" level of teacher effort. The wage payment scheme is assumed to be a linear compensation scheme. Then we can represent the teacher payment scheme by a linear function of the observed level of effort as follows:

$$W = a_1 + a_2\, OE. \tag{2}$$

Note that a case of $a_1 > 0$ and $a_2 = 0$ represents a fixed wage contract, while $a_2 > 0$ denotes a piece rate contract.

While we can simply interpret the linearity with respect to effort level as an approximation of a general non-linear wage payment formula, theoretically, the linear compensation scheme is shown to be quite robust to the specification of the environment [Holmstrom and Milgrom (1987); Laffont and Tirole (1987); McAfee and McMillan (1987); Hart and Holmstrom (1987)]. The linear payment system is preferable in the sense that this system applies a uniform incentive pressure that makes the teacher want to make additional effort no matter what his/her performance has been. Because incremental improvements in child ability are typically equally desirable for parents after either a slow or a fast start, this uniform incentive pressure is adequate and optimal. Moreover, linear systems have the advantage of being simple to understand and administer. A complex non-linear scheme might not be able to provide the desired level of a teacher's motivation since teachers may not understand the complex scheme easily and/or a principal cannot administer it as intended.

3.2 The Optimal Teacher Effort

As we have mentioned, the principal will have difficulty observing the level of the true teacher effort directly. Instead, the principal can observe an imperfect indicator of the true teacher effort, OE, that is, an indicator that provides some information about the teacher effort but is contaminated by random events beyond the control of the teacher. In other words, this observed level of effort is an estimate of the true level of teacher effort e. Such an indicator may include days of teacher attendance or intensity of a teacher's meeting with parents. Formally, we can write

(3) $$OE = e + z,$$

where z indicates a measurement error with E(z) = 0. Note that e and z are not separately observed by the principal. Yet, a more involved community association can observe teacher effort with fewer mistakes through close and frequent monitoring of a teacher's behavior. Therefore, the degree of community participation is naturally regarded as the determinant of precision of teacher effort estimation. Mathematically, this consideration can be represented as: Var(z) = V(CP), where CP is the degree of community participation with $\partial V/\partial CP < 0$. Note that the precision of effort estimation is defined as the inverse of the variance of measurement error. This function V(CP) denotes the technical relationship between teacher monitoring by community participation and precision of observing teacher's true effort.

From (2) and (3), we have the reduced form payment scheme equation:

(2') $$W = a_1 + a_2 e + a_2 z,$$

and therefore the teacher optimization problem becomes

(4) $$e^* = argmax_{\{e\}} \; E\,[u(a_1 + a_2 e + a_2 z)] - CS(e).$$

Assume that a teacher is risk averse with the coefficient of absolute risk aversion, γ. Then a teacher's certainty equivalent utility is represented approximately by $E(W) - CS(e) - (1/2)\gamma Var(W) = E(a_1+a_2e+a_2z) - CS(e) - (1/2)\gamma(a_2)^2V(CP)$. We have the first order condition of a teacher's utility maximization problem as follows:

(5) $$a_2 = CS'(e^*).$$

This condition is the so-called incentive compatibility constraint. This condition must be satisfied by any feasible employment constraint. Interpretation of equation (5) is straightforward: a teacher will select their effort levels so that their marginal reward in the left hand side equals their marginal costs from additional effort in the right hand side. Hence, we have the optimal level of effort as a function of the payment scheme parameter:

(5') $$e^* = e\,(a_2),$$

where it is easily verified that $\partial e^*/\partial a_2 > 0$. Using equation (5'), we can discuss the teaching performance in traditional schools. The lack of compensation mechanisms for improved teaching quality and of adequate supervision restricts the effective control of teacher effort in traditional schools. This inappropriate incentive structure for teacher payments seems to be responsible for poor teacher performance and for prevalent teacher absenteeism in traditional schools.

3.3 Optimal Teacher Payment Scheme given by a Parental Association

In the EDUCO schools, the ACE is responsible for hiring and replacing teachers and allocation of school budgets. In other words, the ACE has a central role in personnel and budget management and thus can change the reward structure easily. On the other hand, the SdPF in traditional schools has only a limited role in school management. The payment scheme parameters, a_1 and a_2, in El Salvadorian schools, are likely to be related systematically with school type and/or the degree of community participation. The higher intensity of community participation, CP, will be reflected in the teacher reward and punishment structure. As a result, the optimal level of teacher effort will be higher in EDUCO schools than in traditional schools. The model in this sub-section will formalize this argument.

If a parental association has full administrative and management ability, the coefficient a_2 is determined endogenously by the parental association in order to "discipline" teachers.[7] The parental association will concern the social benefit of education, which is measured by a weighted average of student i's educational achievement, Y_i, and a teacher's benefit. Let λ_i be the weight for child i, which represents the teacher and/or parental association's preference over students. Then, assuming a risk neutral principal, we can derive the principal's certain equivalent as $E(\Sigma_i\lambda_i Y_i) - E(W)$. Recall that a risk avert teacher's certain equivalent is represented by $E(W) - CS(e) - (1/2)\gamma(a_2)^2V(CP)$. Combining these two formulas, the sum of the certain equivalent incomes of the teacher and the parental association becomes $E(\Sigma_i\lambda_i Y_i) - CS(e) - (1/2)\gamma(a_2)^2V(CP)$. The optimization problem of parental association, therefore, becomes

$$(6) \qquad \underset{\{a_1,a_2\}}{Max} \sum_{i=1}^{N} \lambda_i Y_i - CS(e) - \frac{1}{2}\gamma(a_2)^2 V(CP)$$

$$s.t. \;\; a_2 = CS'(e)$$

[7] In fact, our data set (the association member questionnaire) indicates that 80% of ACEs in EDUCO schools discussed about teacher discipline at their meetings.

where the constraint is the incentive compatibility constraint.[8] The first-order condition for this problem is $[\Sigma_i\lambda_i(\partial Y/\partial e) - CS'(e) - \gamma a_2 CS''(e)V(CP)](\partial e/\partial a_2) = 0$. Hence, the optimal slope of the wage compensation scheme becomes:

$$(7) \qquad a_2^* = \sum_{i=1}^{N} \lambda_i \frac{\partial Y_i}{\partial e} \bullet \frac{1}{1+\gamma V(CP)CS''(e)}$$

This condition, a.k.a., the optimal intensity of incentives condition, indicates that the parental association will choose a_2 optimally to induce the teacher to set the marginal cost of effort equal to its marginal social value of effort, i.e., weighted average of students educational attainments. We can plausibly treat the effect of teacher effort on educational output, $\partial Y/\partial e$, as an exogenously fixed technological relationship. Moreover, to simplify the argument, the curvature of the cost function is approximated so that C''(e) is constant. Then, this optimal intensity of incentives simply becomes a function of the degree of community participation and school type parameter:

$$(7') \qquad a_2^* = g(CP),$$

where $g(CP) \equiv \Sigma\lambda(\partial Y/\partial e) / [1 + \gamma V(CP)C''(e)]$ and it is easily verified that $\partial a_2^*/\partial CP > 0$. Therefore, we have a_2 as a function of the degree of community participation.

This indicates the important role of community monitoring. The appropriate intensity of an incentive is affected by the precision with which teacher performance or effort is measured by the principal. Under the centralized system, community participation is minimal and thus precision of effort estimation is quite low. It is unfruitful to use a wage incentive scheme when effort measure is highly imprecise. As a result, the fixed teacher compensation scheme in traditional schools can be rationalized. On the other hand, in EDUCO schools, intensive community participation improves measurement of teacher effort. Strong incentives, therefore, are likely to be optimal when a teacher's performance is easy to identify. It is worth noting that the base payment a_1 does not enter as a component of the efficiency consideration of the contract. The fixed base payments, a_1, will be determined by an agreement with which both parties will obtain the sufficiently high level of welfare.

As mentioned above, specific regulations in traditional schools (*Escalafon Magisterial*) break a link of teacher salaries to the teaching performance by imposing fixed wage scheme. The typical

[8] Note that this problem is equivalent to the problem of a principal's total net output maximization subject to an agent's individual rationality constraint and incentive conpatibility constraint.

compensation scheme in traditional schools may be described by the case of $a_1 > 0$ and $a_2 = 0$. On the other hand, teachers in EDUCO schools are selected, hired, supervised and dismissed by the parent associations (ACEs), who judge the quality of EDUCO teachers by their teaching performance. The typical compensation scheme in EDUCO schools, therefore, becomes $a_1 \geq 0$ and $a_2 > 0$.

Finally, combining equation (5') with equation (7'), we have the optimal level of effort as a function of the level of community participation and school type:

(8) $$e^* = e\,[g\,(CP)],$$

where $\partial e^*/\partial CP > 0$.

3.4 Moral Hazard

The formal model in this section indicates that the intensity of the incentives provided to teachers differs according to the degree of community involvement in teacher monitoring. In a typical case, $CP^{ED} > CP^{TR}$, where CP^{ED} and CP^{TR} represent the level of community participation for an EDUCO school and a traditional school, respectively. As a result, we have $a_2(CP^{ED}) > a_2(CP^{TR})$ and thus $e\,(CP^{ED}) > e\,(CP^{TR})$, utilizing equations (5) and (5'). These results indicate that the level of teacher effort is systematically higher in EDUCO schools than in traditional schools due to difference in the intensity of community participation. The positive gap between the teacher effort level in EDUCO schools and that in traditional schools, i.e., $e\,(CP^{ED}) - e\,(CP^{TR}) > 0$, indicates the existence of moral hazard of teacher effort in traditional schools. Since teacher effort itself contributes students' achievements positively, the possible relative deficiency of student performance in traditional schools arises from the moral hazard problem of unobserved teacher effort.

3.5 The Production Function Approach

As we have seen above, the production of educational outcomes is a complex interaction of the behaviors of various agents who participate in the schooling process such as students, groups of parents, teachers, and administrators at various levels, from the school up to the education ministry. Moreover, agents not directly connected to the educational system may affect these outcomes if they influence the environment in which students learn. For example, the performance of students at schools in a particular community has been attributed to community and peer group effects of social capital, i.e., stock of mutual

trust [Coleman (1990)][9]. To investigate empirically these various aspects of the schooling process in this section, we employ a conventional reduced form model of educational production [Hanushek (1995)]. Most studies measure output by students' achievement scores, school attendance rates, repetition rates, school continuation or dropout rates. These variables are thought to capture prospects of future earnings in the labor market. In this paper, we focus on student scores on standardized achievement tests.

Suppose that a child i's educational achievement, Y_i, who is studying at a school j in munitipality m can be represented by the production function:[10]

$$Y_i = f(X_i, C_m, D_j, Z_j, e_j^*), \tag{9}$$

where X represents a vector of student and household characteristics, C is a vector of municipality m's specific variables, D is an indicator variable of school type attended by a student, where D = 1 for an EDUCO school and D = 0 for a traditional school, and Z denotes a vector of observed school-level characteristics which varies by school rather than by student. Equation (9) really expresses achievement for the ith student in a particular school. To simplify notation, we drop the school subscript. By combining equation (8) and (9), we can derive a reduced form model as follows:

$$Y_i = f[X_i, C_m, D_j, Z_j, e(CP_j)]. \tag{10}$$

This formulation represents that the effect of community participation on outcomes may be mediated through teacher's effort level.[11]

The optimization behavior of a school administration entity, either MINED in traditional schools or ACEs in EDUCO schools, leads to the resulting input demand functions:

$$Z = Z(C_m, D_j), \tag{11}$$

where a vector of relative prices of various school inputs is represented by municipality-specific variables C. The school type indicator variable is incorporated as the argument of this demand function since this variable potentially affects productivity of school output. Substituting equation (11) into (10), we have a

[9] Recent development literature suggests that importance of trust and relationship among people in developing countries. Fafchamps and Minten (1999), for example, documents the important role that personal relationships play in economic exchange among agricultural traders in Madagascar.
[10] Gaynor and Pauly (1990) called this function the “efficient” or “maximum (observed) effort” production function.
[11] This function corresponds to the “behavioral production function” defined by Gayor and Pauly (1990) in a different context.

highly reduced form production function:

$$Y_i = f\,[X_i, C_m, D_j, Z(C_m, D_j), e(CP_j)]. \quad (12)$$

This reduced form model assumes that the effects on achievement of a school's observed characteristics, such as class size, teacher characteristics, etc., are fully determined by its management structure, i.e., whether it is EDUCO or not, the characteristics of the students and their parents, and the intensity of community participation in school administration and management.

4 Data and Empirical Analysis

Our empirical analysis is composed of four parts. First, based on equations (10) and (11), we employ the "augmented" reduced form educational production function by incorporating parents and community involvement as a major organizational input. Second, we estimate teacher wage compensation function, utilizing the linear compensation scheme function (2'). Then, the resulting teacher effort functions, (5') is investigated empirically. In other words, we examine moral hazard of a teacher's behavior statistically, by utilizing the theoretical implications of a principal-agent framework. Finally, we estimate the school-level input demand functions (11). Before presenting econometric framework and empirical results in detail, the next sub-section explains the data set used in this paper.

4.1 Data

The data of 311 primary schools, which are randomly sampled from the 3634 primary schools, was collected in October 1996 by MINED of El Salvador with the assistance of the World Bank and USAID. The survey covered 162 municipalities out of 262 that share responsibility with the central government for the delivery of social services. The original data set contains information from four different school types, pure EDUCO, mixed, traditional public and private schools. Since EDUCO was introduced only in 1991, it was not possible to give achievement tests in 1996 to those students who were about to finish primary education in EDUCO schools and to compare their scores with those in traditional schools. Instead, third-grade sections were selected for each school and then five students were randomly selected in that same section.

The sampling scheme is designed so that the survey is nationally representative. Moreover, the original sample was selected in such a way as to allow for four types of schools -- pure EDUCO, pure

traditional, mixed, and private schools -- to be considered. In this study, we dropped students from private schools and traditional public urban schools from the sample since their students are not comparable with the EDUCO students. Moreover, since mixed schools have their own specific school administration and management structure, we only compare students in the pure EDUCO and pure traditional schools in this paper. This left us with 594 students in 30 pure EDUCO schools and 99 pure traditional rural schools in 88 municipalities. The actual data collection process was composed of interviews with five different types of participants in the education community: a director of a sampled school, a teacher of a sampled 3rd grade class, five randomly-sampled students in the 3rd grade, parents of the student, and parents in the parent group of the sampled school. With respect to our notation, the subscript $j = 1,\cdots,129$ stands for teacher, school, or community (parent) group, and $i = 1,\cdots,594$ represents students, and $m = 1,\cdots,88$ is for administrative division, either municipalities or department.

Variables and Descriptive Statistics

For dependent variables, the achievement tests for various subjects were applied by MINED on October 1996 with the assistance of the Intercultural Center for Research in Education (MINED 1997). These were applied nationally in the 3rd, 4th and 6th grades, but because EDUCO students had reached only the 3rd grade at the time of the data collection, we use only the third-grade results in the analysis. Moreover, we focus only on the results for the mathematics and language tests which are employed conventionally as measures of educational outcome.

The mathematics test is composed of 30 questions on ten key subjects, that is, three items for each subject. A student has achieved an objective if she/he got two questions right out of three questions. For the language test, there are 36 questions on nine objectives, that is, four items each. A student has achieved an objective if she/he got three questions right out of four questions. According to Table 1, for this sample, the average student was able to master 3.66 out of 10 subjects in math, but only 1.69 out of 9 in languages. These results are not out of line when compared to national averages (MINED 1997). Of greater interest, though, are the comparative average values for EDUCO and traditional schools. Students in EDUCO schools score marginally lower than their traditional school counterparts in both subjects, although the differences are not statistically significant (Table 1).

Table 1 also lists descriptive statistics of the other variables used in the analysis. In terms of child specific characteristics, students are divided equally by gender. A significant portion of them live without parents, with a slightly higher proportion among EDUCO students. EDUCO students also have a slightly higher number of siblings and are slightly older, although the differences are not significant.

Using the descriptive statistics in Table 1, we can informally evaluate the three main objectives of the EDUCO program. First, EDUCO households are poorer than traditional households and parent's socioeconomic characteristics are much better for traditional school students than for EDUCO students. Parents of traditional school students have more education than those of EDUCO students. 53% of mothers or female guardians of traditional students have basic education, compared to 50% for EDUCO students. The same is true of fathers. The education differences are reflected also in the asset indicators. Fewer EDUCO parents have access to home-ownership, electricity, sanitary services and running water. These all suggest that EDUCO students come from poorer background than traditional school students. For the coverage issue, therefore, EDUCO program has been successful in targeting poorer segments of the population.

The socioeconomic characteristics of students and households are consistent with the pattern for school characteristics. While school level teacher-pupil ratios and the availability of sanitary facilities are similar in both types, fewer EDUCO schools have access to electricity or piped water. On the other hand, more EDUCO teachers have finished university education but are less experienced. The EDUCO teaching corps consists of relatively young recent graduates who receive a “bonus” for teaching in the program. There are no differences in access to textbooks in the two types of schools.

Second, with respect to parent participation issues, parents of EDUCO students participate more in school affairs. Parent associations in EDUCO schools visit classrooms almost 4-5 times more often than their traditional counterparts. ACEs in EDUCO schools are more involved than are parents’ associations in traditional schools. At the parental association meetings, 80% and 79% of ACEs discussed teacher discipline and attendance of school personnel, respectively, while corresponding figures of PdSF are 62% and 38%, respectively. Less teacher absenteeism in EDUCO schools might reflect the effectiveness of potential teacher monitoring by parental associations in these schools. In fact, teachers are absent from EDUCO schools for 1.09 days per month on average, while 1.35 school days per month are missed by teachers in traditional schools.

Finally, with respect to the output quality, there are no significant test score differences in spite of the poorer background of EDUCO students. With a simple t-test on the equality of two means, we cannot reject the null hypothesis that both schools have the same mean test score. This implies an advantage for community participation in education. In the following sections, we will empirically evaluate whether there is an EDUCO effect, after controlling for household background and school and classroom inputs, using a formal econometric framework. By doing this, these conjectures regarding the consequence of parents’ participation and possible EDUCO effects could be investigated properly.

4.2 Production Function Estimation

First of all, we estimate a linear approximated version of the reduced form educational production function of equation (12):

(13) $$Y_i = X_i\beta + C_m\gamma + D_j\alpha + CP_j\delta + v_i,$$

where u represents a well-behaved measurement error term with assumptions of $E(v_i)=0$ and $Var(v_i)=\sigma_v^2$. To control for observed school inputs, we add school characteristics to correspond to the empirical versions of equation (10).

(14) $$Y_i = X_i\beta + C_m\gamma + D_j\alpha + Z_j\mu + CP_j\delta + v_i.$$

Endogenous community participation

So far, we have assumed that the degree of community participation CP and thus the measurement of teacher performance, which is represented by the variance V, are determined outside the scope of the model. However, CP will be endogenously determined as well, since any monitoring effort by a community association is costly because of participants' opportunity costs. As a result, the observable teacher effort variable, OE, is likely to be endogenous, too. Therefore a simple OLS estimation of production function (13) and (14) may not provide consistent estimation of coefficients. To eliminate the potential bias due to this endogeneity, we include the monetary transfer from government as one of the identifying instrumental variables. The reason of this choice of instrument is explained as follows.

To derive the optimal level of teacher monitoring, suppose M(V) denotes the minimum amount that must be spent on monitoring needed to achieve an error variance of teacher effort observation as low as V. To improve precision of teacher effort prediction should require some resources. When M is exogenously given by the government, the reduced form optimal participation level becomes a function of government transfer.

(15) $$CP^* = CP\,(M).$$

When monetary transfer, M, is exogenously given, the optimal level of V is determined optimally, which

implicitly solves the optimal level of community participation, CP.[12]

In our particular setting in El Salvador, the amount of participation cost M is exogenously determined and provided by government: in the case of EDUCO schools, MINED makes a direct transfer of funds to ACEs. In this case, we can write a reduced form optimal participation level as a function of government transfer, i.e., $CP^* = CP(M)$. Recalling equation (8), we have

$$e^* = e[CP(M)], \tag{16}$$

i.e., optimal level of effort is a positive function of the government's monetary transfer to a community association. This means that monetary transfer to the community is used a device to extract teacher effort whereas the direct payment to teachers by MINED does not enhance the level of teacher effort.

According to the argument above, it will be quite natural to treat the amount of monetary transfer from government to parental association, M, as an identifying instrumental variable for the level of community participation, CP, and the observable teacher effort variable, OE. This selection of an instrumental variable based on the theory is one of the methodological innovations in this paper.

However, the exogeneity assumption of the geographical allocation of government transfers may be restrictive, since the government transfers might be a function of a community's characteristics. Hence, in addition to this transfer variable, we constructed another identifying instrumental variable, ACP_{jm}, for a school j in a municipality m, which is defined as follows:

$$ACP_{jm} = \frac{\sum_{j \in m} CP_j \times (\text{Number of students})_m - CP_j}{(\text{Number of students})_m - 1}. \tag{17}$$

This variable captures the municipality level "net" average propensity of community participation. We can easily verify that ACP is uncorrelated with the error term by construction but is likely to be correlated with the participation variable, CP.

Tables 2 and 3 represent resulting municipality fixed effects estimators of production function (13) and (14) for mathematics and language tests, respectively. Regardless of the specification, i.e., with or without controlling for household characteristics, household assets, school and classroom inputs, and teacher quality, consistently positive EDUCO participation effects are observed. Moreover, these

[12] Our regression analysis of a community participation variable, CP, on the government's monetary transfer, M, indicates that there is a positive, statistically significant, and robust effect of the government transfer on the degree of community participation. The results, which are not reported in this paper, are available from the author.

coefficients are statistically significant for all language test specifications and most mathematics specifications. However, the loss of statistical significance when we include classroom quality variables for mathematics tests (specifications 4 and 8) indicate that positive EDUCO participation effects may be partly transmitted through better classroom environment in EDUCO schools such as the availability of classroom library (Table 2).

With this highly reduced form of a production function approach, however, the transmission mechanism from community participation to output improvement is not necessarily clear. To investigate community participation effects, we estimated wage compensation equations, teacher effort functions and input demand functions in the following section.

4.3 Estimating the compensation scheme

We represent the teacher payment scheme by a linear function of the observed level of effort multiplied by exponential wage adjustment term. Combining the reduced form teacher payment scheme of equation (2) with optimal wage payment scheme function (7'), we have:

(18) $$W_j = a_1 + g(CP_j)\, OE_j.$$

Note that the sensitivity of observed effort, OE, is represented by $g(CP) \equiv \Sigma\lambda(\partial Y/\partial e)/[1 + \gamma V(CP)C''(e)]$. For estimation purpose, we approximate this equation (18) as follows:

(18') $$W_j = a_{1k} + (a_{20} + a_{21}\, CP_j)\, OE + \varepsilon_m + u_j,$$

where u represents a measurement error for econometrician and we assume E(u)=0. This is an estimable optimal payment scheme function. The first term a_{1k} is a dummy variable which is specific to a teacher's grade, k, certified by MINED. This reflects the fact that the amount of the teacher's fixed payment is based on the teacher's formal ranking. In order to control for region-specific unobserved heterogeneity, department dummy variables, ε_m, are added.[13]

We can test whether the intensity of community participation is related to the optimal payment scheme parameter a_2 by testing a null hypothesis of H_0: $a_{21} = 0$. If we reject the null hypotheses and we

[13] Departments are the next lower administrative division in El Salvador after the national level and are higher division than municipalities. We could employ municipality fixed effects estimation. However, the data unit here is classroom-level, not student-level, and basic school sampling is based on municipality. In order to guarantee sufficient degree of freedom, we used department level fixed effects.

find a statistically significant coefficient on the slope of the payment scheme parameter, i.e., $a_{21} > 0$, then we may conclude that the finding is consistent with the optimally imposed payment scheme by the principal through the community participation.

The remaining empirical issue is how to quantify the observed measure of teacher effort, which is not observed by the econometrician. Descriptive analysis of our data set shows that almost all EDUCO school directors, 96.9% of EDUCO school directors, regard that ACEs organize school management through controlling performance and absenteeism of teachers. Moreover, according to the results of the parental member questionnaire, 80% and 79% of ACEs at EDUCO schools discussed at the group meeting teacher discipline and attendance of school personnel, respectively. On the other hand, only 62% and 38% of PdSF in traditional schools discussed these issues. These figures imply that teacher attendance rate might be reflected in ACEs' determining the teacher compensation in EDUCO schools. Moreover, according to the teacher questionnaire, when a student was absent, 75% of the EDUCO teachers visited the family, while only 41% of the traditional school teachers visited the family. Hence, observed effort level, OE, is assumed to be captured by days of teacher's attendance and hours of teacher-parents meetings. These effort measures are directly observable to both teacher and parents, and thus teachers might be interested in improving this measure.[14] We will judge the relative importance of these variables as a teacher effort measure by using various statistical criteria. We will employ two criteria of selection of regressors, i.e., the Amemiya's prediction criterion and the Akaike's information criterion [Amemiya (1980)].

Estimation results of equation (18) are represented in Table 4. The dependent variable is hourly base salary of teachers. The first observable effort variable is teacher's days of school attendance per month. The second effort variable is teacher's hours per month meeting with parents. The estimated coefficients on the interaction variables, a2OE and a2OE2, are all positive. Moreover, these coefficients are statistically significant except the instrumental variable estimation using teacher's hours of meeting with parents variable as the effort variable. Yet, the goodness of fit for these two instrumental variables results for the hours of meeting variable is relatively poor, according to the Amemiya's prediction criterion and the Akaike's information criterion. Hence, we may conclude that overall results in Table 4 indicate that the slope of wage compensation scheme is positively related with the degree of community participation, i.e., $a_{21} > 0$. This finding is consistent with the theoretical prediction of the optimal intensity of incentives condition, $a_2^* = g(CP)$ with $\partial a_2^*/\partial CP > 0$. Therefore, EDUCO schools with a relatively high degree of community participation follow a piece rate payment, which is a compensation scheme based on the level of observable effort. On the other hand, traditional schools with low level of CP might have a flatter or even a fixed wage payment scheme.

[14] Other candidates of measurable teacher effort include number of dropouts after the initial enrollment (pr_e11),

Since the Mincer wage equation is a standard empirical formula of wage determination, we also assume that the estimation model of a wage payment scheme is a combination of linear compensation scheme and standard Mincer wage equation variables. Modification of equation (18) gives:

(19) $$W_j = a_{1k} + g(CP_j)\, OE_j + QL_j\beta,$$

where the wage adjustment term *a la* Mincer, QL, represents a vector of teacher quality variables such as education level and length of teaching experience. The linear econometric model of equation (19) is:

(19') $$W_j = a_{1k} + (a_{20} + a_{21}\, CP_j)\, OE_j + QL_j\beta + \varepsilon_m + u_j.$$

Estimated coefficients on the teacher quality variables QL are all statistically insignificant (Table 5, specification II). Moreover, the null hypothesis of all zero β coefficients cannot be rejected for both effort measures, according to the F-test results reported in Table 5. This indicates that Mincer wage equation does not fit well for the teacher compensation scheme in El Salvador.

4.4 Estimation Results of Teacher Effort Function

The above estimation results indicate that EDUCO schools teachers receive a piece rate, depending on their performance observed by parental groups. In contrast, traditional schools employ a fixed teacher wage scheme. According to equation (5'), the piece rate payment scheme in EDUCO schools is thought to enhance teacher effort. On the other hand, lack of compensation scheme for improved teaching quality seems to restrict improved teacher performance in traditional schools. Moreover, choice of payment scheme should be related with the intensity of community participation according to the optimal intensity of incentives condition [equation (7)]. Hence, the observed level of teacher effort must be a function of community participation level [equation (8)].

In order to investigate this mechanism empirically, a linearized version of the teacher effort function is estimated with both teacher based and household based data sets. From equations (3) and (8), we have OE = e*(CP) + z. By linearizing this, we get an estimation model of the observed effort level:

(20) $$OE_j = \alpha_0 + \alpha_1 D_j + \alpha_2 CP_j + z_j.$$

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number of subjects taught (pr_f11), and duration of daily teaching (pr_f12).

However, we should note that CP and z are likely to be correlated each other by construction. We therefore employ the instrumental variable method to ensure consistency of estimators too.

There are two different proxy variables of the true effort level used: teacher's days of school attendance and teacher's hours meeting with parents. The estimated coefficients of the effort function with department dummy variables are presented in Table 5.[15] The estimated coefficient, α_2, is consistently positive with a sufficient level of statistical significance. This finding indicates that EDUCO school teachers have consistently higher effort level, since parent associations are more able to extract teacher effort through participation. This implies that the incentive structure and thus the optimal effort level will be significantly different between EDUCO and traditional schools. We conclude that, with the higher degree of community participation, the teacher effort measure in EDUCO schools is consistently better than that in traditional schools. Community participation seems to affect positively the teacher effort level and thereby creates better performance. This is not a surprising result, given the different wage payment scheme employed among two types of schools.

4.5 Estimation of school level input demand functions

As we conjectured with production function estimation results, positive EDUCO participation effects may be partly transmitted through a better classroom environment in EDUCO schools. To investigate the difference in classroom quality, we estimate the classroom-level school input demand function. For tractability, a linear function is utilized here:

$$Z_j = \pi_0 + \pi_1 D_j + \pi_2 C_m + \eta_j, \tag{21}$$

where we assume that prices are captured by a department dummy variable C.[16] We estimated the input demand functions for classroom variables, since these seem to capture EDUCO effects from the results of educational production functions. School type indicator variables are incorporated as the argument of this demand function since this potentially affects productivity of school output. As a second specification, the community participation variable, CP, is also added.

The estimation results are summarized in Table 6. First, we should notice that the number of students in classroom is consistently and significantly lower in EDUCO schools than in traditional schools. The difference between the average number of students in a traditional school and an EDUCO school

[15] See footnote 13.
[16] See footnote 13. Particularly, this is a useful assumption for maximizing the conditional likelihood function for

classroom is about seven students. Moreover, the result with the community participation variable indicates that the degree of community participation decreases teacher-student ratio significantly. According to the results reported in Table 2 and 3, a smaller classroom size might improve student achievement, implying that classroom size reduction is an important transmission mechanism of community participation. The coefficients of classroom size, however, are not statistically significant in Table 2 and 3.

Second, the number of books in classroom library is consistently larger in EDUCO schools than that in traditional schools. Although the coefficients themselves are not statistically significant, on average, EDUCO schools have fifty to sixty additional books in the classroom library (Table 6). Together with the significantly positive coefficients of number of books in the classroom library in the student test score regressions (Table 2 and 3), positive EDUCO effect might be well captured by a promotion of the classroom library of EDUCO schools. This observation of the classroom library effects is consistent with the World Bank's past evaluation result of the EDUCO program (World Bank 1995, pp.19-20). There may be a positive impact of classroom libraries in completing teacher strategies and in stimulating student interests and reading habits which affect achievement scores significantly.

Thirdly, textbook availability seems to be better in EDUCO schools, but the coefficients are not statistically significant. The textbook availability – student achievement nexus also is not clear since the coefficients of text availability in Table 4 and 5 are not statistically significant. Finally, Table 6 indicates that the multigrade classroom is one of distinct characteristics in EDUCO schools. The effect of community participation on educational output through introduction of multigrade education system is positive, but not strong since, in Table 2 and 3, the coefficients of the multigrade classroom are not statistically significant.

5 Conclusions

The results of reduced form production functions indicate that, controlling for household characteristics, household assets, school and teacher quality, we observe consistently positive and statistically significant EDUCO participation effects. These positive EDUCO effects, however, might be partly captured by better classroom environment in EDUCO schools such as classroom size and the availability of a classroom library.

With this reduced form production function approach, however, the transmissions structure from community participation to output improvement is not necessarily clear. To investigate the structural relationship between community participation and educational outputs, we estimated teacher compensation functions, teacher effort functions and input demand functions. First, teacher wage payment is relatively

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logit model with fixed effects.

fixed in traditional schools, while EDUCO school teachers receive piece rate, depending on their performance. We should also note that the slope of wage equation is positively affected by the degree of community participation. This finding can be interpreted as the optimal intensity of community participation. Second, teacher effort measure in EDUCO schools with the high intensity of community participation is consistently better than that in traditional schools. Community participation seems to enhance the teacher effort level through creating an appropriate design for the teacher's wage compensation scheme. ACE visits increase academic performance indirectly. On the other hand, poorer student performance in traditional schools arises from moral hazard problem of unobservable teacher effort. Our interpretation of these findings is admittedly not the only possible interpretation, but is the one that seems most natural.

We also found that community participation increases educational productivity through improving schools inputs. First, the degree of community participation decreases teacher-student ratio or classroom sizes significantly. Together with the production function estimation results which show that a smaller classroom size improves student achievement, classroom size reduction maybe an important transmission mechanism of community participation. Second, the number of books in classroom library is consistently larger in EDUCO schools than that in traditional schools, and we found that positive and significant coefficients of the number of books in the classroom libraries reflected in the student test score regressions. Positive EDUCO effect might be well captured by the positive effects of larger classroom library size on student performance,

The most important contribution of this paper is applications of the agency framework to social sector management issues, together with empirical estimations of theoretical implications. With respect to the estimation methodology, the paper has three contributions. First, in order to select the observed measure of an agent's effort level, the empirical framework employed the econometric approach of the selection of regressor, combined with descriptive statistics and qualitative information of the parental association questionnaire. Second, this paper empirically investigates the consistency between the observed contracts, and the theoretical prediction of the model, the consistency which is still missing in the literature. Third, with respect to the econometric framework, this paper has a methodological innovation in the selection of identifying instrumental variables for the community participation variable, which is endogenously determined. Based on the theoretical condition of the monitoring intensity principle, we select the amount of monetary transfer from the government to the community associations as an identifying instrumental variable.

Recalling equation (16), the community participation is likely to be enhanced by the government's support. Indeed, we found that there is a positive and statistically significant effect of the government's

monetary transfer to the community group on the degree of community participation, the result which is not reported in this paper.[17] Hence, we can plausibly suppose that the level of teacher effort is a positive function of the government's monetary transfer to the community association. This means that monetary transfer to the community is used as a teacher effort extraction device, whereas the direct payment to teachers by MINED does not enhance the level of teacher effort sufficiently. Our empirical results indicate that decentralization of an education system, which involves delegation of school administration and teacher management to a community, results in substantial gains in school productivity.

Our empirical results support the view that participation is necessary for a fully effective social development. Community participation not only utilizes larger sets of relevant information in order to overcome the information problems, but also brings commitment and thus greater effort of agents. Moreover, local-level participation in project implementation ensures consistency between a policy and local demand. Community participation in school management improves educational quality since educational resources are allocated according to local conditions and thus their allocation becomes responsive to parents and communities. Yet, Hanushek (1994) emphasizes that

"the advantages of local decision-making materialize only when local decision-makers have sufficient information, when incentive structure emphasizes performance toward agreed-upon goals, and when there is considerable latitude for making local decisions, and when there is a good system of accountability. Most of school-based management schemes do not meet these conditions; indeed many fail on all conditions (p.101)."

The EDUCO experience suggests that parents' management of the decentralized schools in El Salvador does meet all these conditions. The findings in this paper should shed important light on future efforts to reform education systems in both developed and developing countries.

[17] The results are available from the author.

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Figure 1

The Augmented Production Function Model
with Endogenous Teacher Effort
(Governance Structure of Traditional Schools)

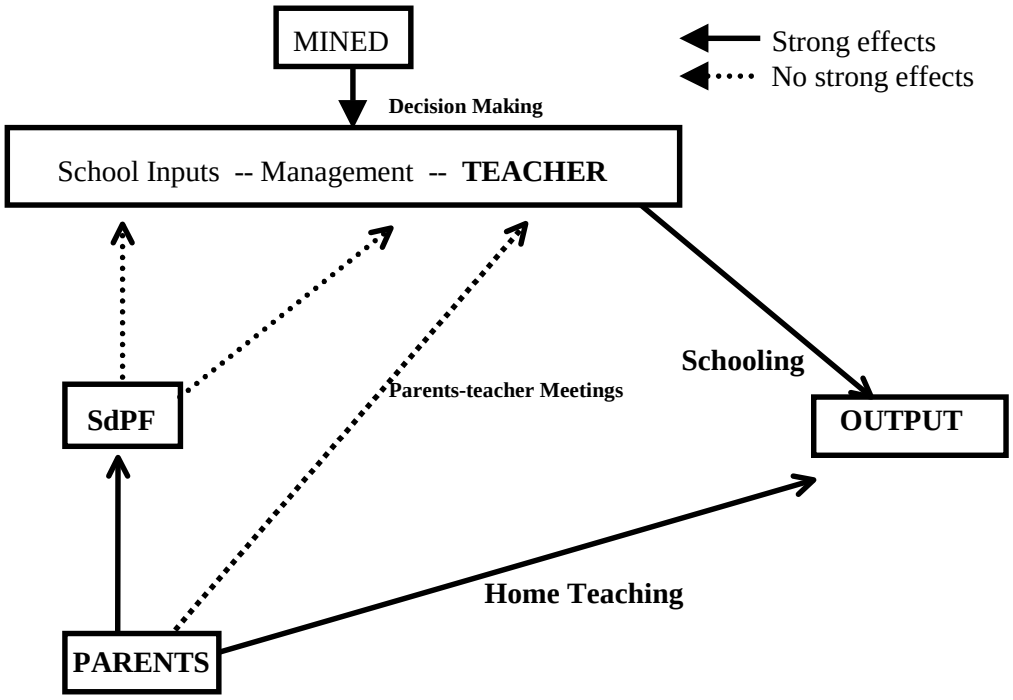

Figure 2

The Augmented Production Function Model with Endogenous Teacher Effort (Governance Structure of EDUCO Schools)

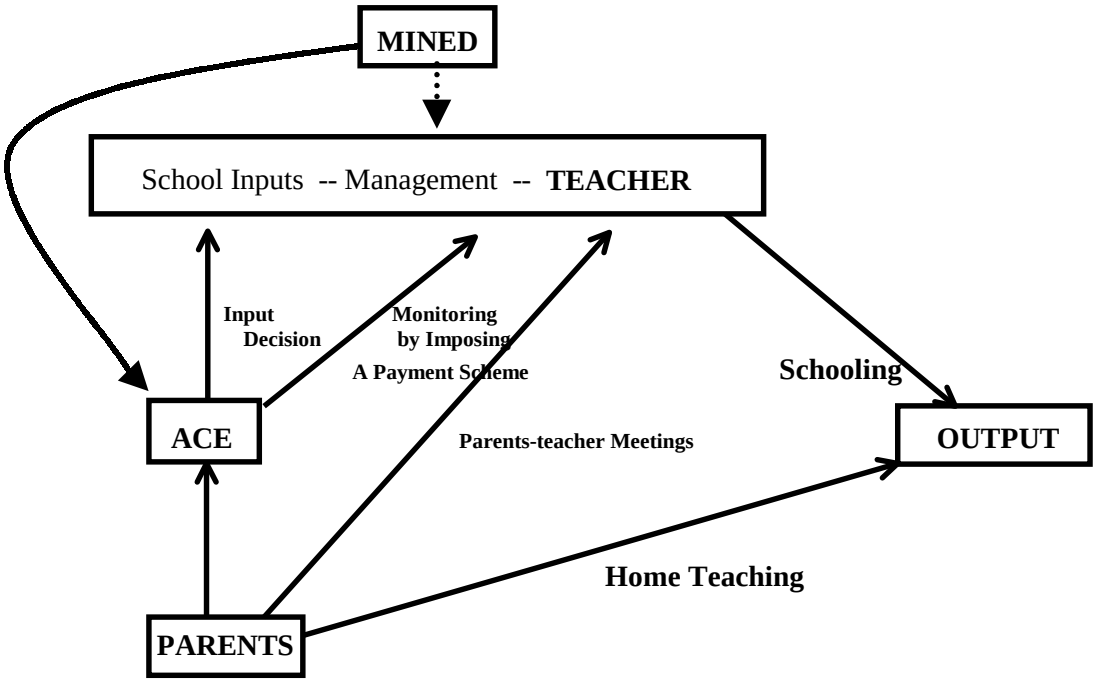

Table 1
Summary Statistics by School Type

Variable definitions	Code	All Schools	EDUCO	Traditional
Cognitive Outcome				
Achievement test score, math (# of subjects taken)	ma3mas	3.70 (2.55)	3.59 (2.77)	3.74 (2.48)
Achievement test score, language (# of subjects taken)	le3mas	1.74 (1.71)	1.73 (1.84)	1.75 (1.66)
Child Generic Chracteristics (CHG)				
Gender (female=1)	a_d_1d	0.51	0.51	0.51
Child's age	childage	10.59 (1.76)	11.01 (1.97)	10.45 (1.67)
Live without parent(s)=1	a_c_1d2	0.14	0.16	0.13
Household Generic Characteristics (HHG)				
Mother enter basic education=1	edl_m	0.53	0.50	0.53
Mother's education missing=1	ed_mm	0.08	0.06	0.09
Father enter basic education=1	edl_p	0.39	0.38	0.40
Father's education missing=1	ed_pm	0.04	0.03	0.04
Number of siblings (age of 4-15)	pa_b3	2.01 (1.54)	2.11 (1.50)	1.98 (1.55)
Household Assets (HHA)				
Own house=1	pa_e1d	0.72	0.68	0.73
Electricity available=1	pa_e81d	0.57	0.28	0.66
Sanitation available=1	pa_e82d	0.18	0.06	0.21
Water available=1	pa_e85d	0.06	0.01	0.08
School Quality (SQ)				
Teaher-pupil ratio (school level)	d_p_all	0.04 (0.06)	0.05 (0.09)	0.03 (0.04)
If sanitation/latrine available at school=1	d_d11d	0.93	0.89	0.94
If electricity available at school=1	d_d12d	0.68	0.30	0.80
If piped water available at school=1	d_d21d	0.31	0.12	0.37
Teacher Quality (TQ)				
=1 if teacher is female	pr_fem	0.71	0.65	0.73
=1 if teacher finish University education	predu_un	0.46	0.75	0.37
Year of teacher experience	pr_year	7.76 (6.44)	4.37 (2.70)	8.83 (6.89)
Year of teacher experience squared				
Age of the teacher	pr_age	32.53 (7.31)	27.55 (4.02)	34.10 (7.41)
Classroom Quality (CQ)				
# of students in the classroom	pr_d2	26.39 (10.75)	20.75 (6.39)	28.15 (11.23)
If all students have math and/or language textbook=1	pr_text			
If textbook data missing=1	text_m			
=1 if teacher teaches in multigrade classroom	pr_d15d	0.24	0.39	0.19
=1 if multigrade information missing	pr_d15m	0.01	0.04	0
# of books in classroom library	books	75.57 (199.37)	114.63 (272.84)	63.29 (168.41)
=1 if classroom library information missing	book_m	0.47	0.24	0.54
Community Participation Variables (CP)				
# of ACE/SpDF's visits to classroom per month	pr_d11	2.38 (4.56)	5.65 (6.59)	1.35 (3.05)
Instrumental Variables				
Transfer from Government to parental association	transf	2317.86 (4780.50)	8325.11 (6215.20)	430.63 (1743.60)
Net average intensity of participation	acp	2.09 (1.25)	2.31 (1.24)	2.02 (1.24)
Number of Observations	N	594	142	452

Note: Standard errors are in parentheses

Table 1 (continued)
Definition, means, and standard deviation of variables by school type
Variables used for teacher wage and effort function

Variable definitions	Code	All Schools	EDUCO	Traditional
Teacher Wage				
Monthly salary of teacher	pr_c2	3025.11	2914.90	3058.60
		(516.44)	(275.35)	(566.74)
Salary per hour	wage	32.98	30.47	33.74
		(23.40)	(17.64)	(24.92)
Teacher Effort Variables				
Teacher's school attendance per month	attend	26.92	26.92	26.62
		(1.37)	(1.16)	(1.43)
Teacher's hours per month meeting with parents	pr_f123	3.41	4.94	2.94
		(2.69)	(3.18)	(2.35)
Number of Observations	N	133	31	102

Table 2
Production Function Estimation with Municipality Fixed Effects
Dependent Variable: Mathematics Test Score

Sample	spec.	1	2	3	4	5	6	7	8
Method of estimation		OLS	OLS	OLS	OLS	IV	IV	IV	IV
Variable definitions	Code	Coef. t	Coef. t	Coef. t	Coef. t	Coef. t	Coef. t	Coef. t	Coef. t
Community Participation Varibale (CP)									
# of ACE/SdPF's visits to classroom per month+	pr_d11+	0.12 (1.75)*	0.12 (1.66)*	0.15 (2.04)**	0.12 (1.48)	0.10 (1.42)	0.11 (1.45)	0.15 (1.96)**	0.09 (1.08)
=1 if EDUCO schools	e_w	-0.91 (1.31)	-0.60 (0.86)	-0.60 (0.82)	-1.13 (1.37)	-0.82 (1.19)	-0.54 (0.79)	-0.61 (0.83)	-1.02 (1.26)
Child Generic Chracteristics (CHG)									
Gender (female=1)	a_d_1d	-0.66 (3.07)***	-0.65 (2.99)***	-0.61 (2.80)***	-0.52 (2.37)**	-0.67 (3.09)***	-0.65 (3.00)***	-0.61 (2.79)***	-0.53 (2.39)**
Child's age	childage	0.18 (2.86)***	0.18 (2.82)***	0.17 (2.71)***	0.17 (2.65)***	0.18 (2.88)***	0.18 (2.83)***	0.17 (2.70)***	0.17 (2.66)***
Live without parent(s)=1	a_c_1d2	0.41 (1.17)	0.39 (1.13)	0.42 (1.20)	0.47 (1.36)	0.41 (1.17)	0.40 (1.14)	0.42 (1.20)	0.48 (1.36)
Household Generic Characteristics (HHG)									
Mother enter basic education=1	edl_m	-0.05 (0.22)	-0.05 (0.19)	-0.09 (0.36)	-0.06 (0.23)	-0.06 (0.23)	-0.05 (0.19)	-0.09 (0.36)	-0.06 (0.25)
Mother's education missing=1	ed_mm	-0.14 (0.31)	-0.23 (0.52)	-0.25 (0.56)	-0.02 (0.05)	-0.14 (0.32)	-0.23 (0.53)	-0.25 (0.56)	-0.02 (0.05)
Father enter basic education=1	edl_p	-0.05 (0.19)	-0.07 (0.27)	-0.04 (0.16)	-0.07 (0.30)	-0.05 (0.20)	-0.07 (0.28)	-0.04 (0.16)	-0.08 (0.32)
Father's education missing=1	ed_pm	0.58 (0.93)	0.44 (0.69)	0.45 (0.72)	0.44 (0.70)	0.57 (0.92)	0.43 (0.68)	0.45 (0.72)	0.43 (0.69)
Number of siblings (age of 4-15)	pa_b3	-0.04 (0.52)	-0.03 (0.44)	-0.03 (0.46)	-0.02 (0.25)	-0.04 (0.54)	-0.03 (0.46)	-0.03 (0.45)	-0.02 (0.27)
Household Assets (HHA)									
Own house=1	pa_e1d	-0.16 (0.61)	-0.15 (0.57)	-0.12 (0.44)	-0.22 (0.84)	-0.16 (0.62)	-0.15 (0.57)	-0.12 (0.44)	-0.22 (0.86)
Electricity available=1	pa_e81d	0.03 (0.10)	-0.04 (0.12)	-0.03 (0.08)	0.05 (0.15)	0.03 (0.11)	-0.04 (0.11)	-0.03 (0.08)	0.06 (0.18)
Sanitation available=1	pa_e82d	0.56 (1.71)*	0.50 (1.49)	0.51 (1.52)	0.56 (1.65)*	0.57 (1.73)*	0.51 (1.50)	0.51 (1.52)	0.57 (1.68)*
Water available=1	pa_e85d	-0.30 (0.64)	-0.22 (0.46)	-0.25 (0.52)	-0.20 (0.42)	-0.31 (0.66)	-0.22 (0.47)	-0.25 (0.52)	-0.21 (0.44)

Note 1) Huber-White consistent robust standard errors are reported. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.
Note 2) + indicates endogenous variable. Instrumental variables are composed of all exogenous variables, the government's monetary transfer (M), and average community participation (ACP).

Table 2 (continued)
Production Function Estimation with Municipality Fixed Effects
Dependent Variable: Mathematics Test Score

Sample	spec.	1	2	3	4	5	6	7	8
Method of estimation		OLS	OLS	OLS	OLS	IV	IV	IV	IV
Variable definitions	Code	Coef. t	Coef. t	Coef. t	Coef. t	Coef. t	Coef. t	Coef. t	Coef. t
School Quality (SQ)									
Teaher-pupil ratio (school level)	d_p_all		-36.70 (1.59)	-34.19 (1.47)	-28.70 (1.17)		-37.14 (1.62)*	-34.05 (1.47)	-30.17 (1.25)
If sanitation/latrine available at shool=1	d_d11d		0.51 (0.80)	0.72 (0.98)	1.39 (1.61)		0.51 (0.80)	0.71 (0.97)	1.43 (1.63)
If electricity available at school=1	d_d12d		0.36 (0.71)	0.04 (0.08)	0.55 (0.93)		0.34 (0.67)	0.05 (0.09)	0.55 (0.93)
If piped water available at school=1	d_d21d		-0.15 (0.32)	-0.28 (0.59)	0.06 (0.11)		-0.14 (0.30)	-0.28 (0.59)	0.07 (0.13)
If library available	pr_d55d								
Teacher Quality (TQ)									
=1 if teacher is female	pr_fem			-0.29 (0.56)	-0.28 (0.47)			-0.29 (0.56)	-0.26 (0.44)
=1 if teacher finish University education	predu_un			-0.92 (1.99)	-0.76 (1.40)			-0.92 (1.95)	-0.72 (1.28)
Year of teacher experience	pr_year			0.04 (0.59)	0.06 (0.86)			0.04 (0.58)	0.06 (0.90)
Age of the teacher	pr_age			-0.02 (0.51)	-0.06 (1.04)			-0.02 (0.50)	-0.06 (1.09)
Classroom Quality (CQ)									
# of students in the classroom	pr_d2				-0.05 (1.43)				-0.05 (1.48)
If all students have math and/or lanugage textbook=1	pr_text				-0.13 (0.28)				-0.13 (0.28)
If textbook data missing=1	text_m				1.50 (1.68)*				1.52 (1.70)*
# of books in classroom library (unit=100 books)	books				0.25 (2.45)**				0.26 (2.47)**
If # of books data missing=1	book_m				0.60 (0.85)				0.63 (0.89)
=1 if teacher teaches in multigrade classroom	pr_d15d				0.14 (0.19)				0.07 (0.11)
=1 if multigrade information missing	pr_d15m				0.27 (0.13)				0.47 (0.23)
Constant	_cons	2.81 (3.09)***	2.83 (2.00)**	3.44 (2.16)**	4.31 (2.17)**	2.81 (3.09)***	2.85 (2.02)**	3.43 (2.18)**	4.43 (2.24)**
R-squared	R^2	0.28	0.29	0.30	0.32	0.28	0.29	0.30	0.32
Number of Observations	N	594	594	594	594	594	594	594	594

Note 1) Huber-White consistent robust standard errors are reported. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.
Note 2) + indicates endogenous variable. Instrumental variables are composed of all exogenous variables, the government's monetary transfer (M), and average community participation (ACP).

Table 3
Production Function Estimation with Municipality Fixed Effects
Dependent Variable: Language Test Score

Sample	spec.	1	2	3	4	5	6	7	8
Method of estimation		OLS	OLS	OLS	OLS	IV	IV	IV	IV
Variable definitions	Code	Coef. t	Coef. t	Coef. t	Coef. t	Coef. t	Coef. t	Coef. t	Coef. t
Community Participation Varibale (CP)									
# of ACE/SdPF's visits to classroom per month+	pr_d11+	0.10 (2.04)**	0.11 (2.15)**	0.15 (2.70)***	0.12 (2.00)**	0.11 (2.21)**	0.12 (2.26)**	0.16 (2.82)***	0.11 (1.83)*
=1 if EDUCO schools	e_w	-0.13 (0.28)	-0.17 (0.34)	-0.35 (0.70)	-0.78 (1.41)	-0.19 (0.40)	-0.20 (0.41)	-0.43 (0.85)	-0.76 (1.38)
Child Generic Chracteristics (CHG)									
Gender (female=1)	a_d_1d	0.03 (0.20)	0.04 (0.25)	0.05 (0.30)	0.08 (0.52)	0.03 (0.22)	0.04 (0.26)	0.05 (0.32)	0.08 (0.51)
Child's age	childage	0.04 (0.91)	0.04 (0.86)	0.04 (0.90)	0.03 (0.70)	0.04 (0.90)	0.04 (0.86)	0.04 (0.88)	0.03 (0.70)
Live without parent(s)=1	a_c_1d2	0.48 (1.89)*	0.47 (1.87)*	0.49 (1.95)*	0.51 (2.04)**	0.48 (1.88)*	0.47 (1.86)*	0.49 (1.94)*	0.52 (2.04)**
Household Generic Characteristics (HHG)									
Mother enter basic education=1	edl_m	0.06 (0.36)	0.06 (0.35)	0.06 (0.37)	0.07 (0.40)	0.06 (0.36)	0.06 (0.35)	0.06 (0.37)	0.07 (0.40)
Mother's education missing=1	ed_mm	0.23 (0.80)	0.26 (0.90)	0.19 (0.65)	0.31 (1.03)	0.23 (0.81)	0.26 (0.91)	0.20 (0.66)	0.31 (1.03)
Father enter basic education=1	edl_p	0.15 (0.91)	0.15 (0.87)	0.13 (0.79)	0.08 (0.51)	0.15 (0.92)	0.15 (0.87)	0.13 (0.79)	0.08 (0.50)
Father's education missing=1	ed_pm	-0.51 (1.34)	-0.52 -1.33)	-0.49 (1.26)	-0.46 (1.17)	-0.51 (1.33)	-0.52 (1.32)	-0.48 (1.24)	-0.46 (1.18)
Number of siblings (age of 4-15)	pa_b3	-0.01 (0.23)	-0.01 (0.15)	-0.02 (0.39)	-0.02 (0.32)	-0.01 (0.21)	-0.01 (0.14)	-0.02 (0.37)	-0.02 (0.33)
Household Assets (HHA)									
Own house=1	pa_e1d	0.02 (0.12)	0.01 (0.03)	0.01 (0.06)	-0.07 (0.34)	0.02 (0.13)	0.01 (0.03)	0.01 (0.06)	-0.07 (0.34)
Electricity available=1	pa_e81d	-0.02 (0.07)	-0.05 (0.24)	-0.08 (0.37)	-0.01 (0.03)	-0.02 (0.08)	-0.05 (0.25)	-0.08 (0.40)	-0.01 (0.02)
Sanitation available=1	pa_e82d	0.30 (1.27)	0.28 (1.21)	0.30 (1.25)	0.32 (1.31)	0.29 (1.25)	0.28 (1.19)	0.29 (1.22)	0.32 (1.31)
Water available=1	pa_e85d	-0.45 (1.16)	-0.47 (1.21)	-0.45 (1.18)	-0.44 (1.15)	-0.44 (1.15)	-0.46 (1.21)	-0.44 (1.16)	-0.44 (1.16)

Note 1) Huber-White consistent robust standard errors are reported. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.
Note 2) + indicates endogenous variable. Instrumental variables are composed of all exogenous variables, government's monetary transfer (M), and average community participation (ACP).

Table 3 (continued)
Production Function Estimation with Municipality Fixed Effects
Dependent Variable: Language Test Score

Sample	spec.	1	2	3	4	5	6	7	8
Method of estimation		OLS	OLS	OLS	OLS	IV	IV	IV	IV
Variable definitions	Code	Coef. t	Coef. t	Coef. t	Coef. t	Coef. t	Coef. t	Coef. t	Coef. t
School Quality (SQ)									
Teaher-pupil ratio (school level)	d_p_all		5.87 (0.36)	13.32 (0.83)	13.04 (0.78)		6.14 (0.38)	14.04 (0.88)	12.77 (0.77)
If sanitation/latrine available at shool=1	d_d11d		-0.22 (0.43)	-0.59 (1.10)	0.05 (0.08)		-0.22 (0.43)	-0.59 (1.10)	0.06 (0.09)
If electricity available at school=1	d_d12d		0.24 (0.66)	0.04 (0.11)	0.39 (0.96)		0.25 (0.69)	0.06 (0.16)	0.39 (0.96)
If piped water available at school=1	d_d21d		-0.18 (0.57)	-0.30 (0.93)	-0.20 (0.57)		-0.18 (0.58)	-0.31 (0.97)	-0.20 (0.56)
Teacher Quality (TQ)									
=1 if teacher is female	pr_fem			0.01 (0.03)	-0.05 (0.14)			0.00 (0.01)	-0.05 (0.13)
=1 if teacher finish University education	predu_un			-0.72 (2.24)**	-0.62 (1.73)*			-0.74 (2.26)**	-0.61 (1.67)*
Year of teacher experience	pr_year			-0.06 (1.46)	-0.05 (1.08)			-0.06 (1.51)	-0.05 (1.06)
Age of the teacher	pr_age			0.06 (1.92)*	0.04 (1.36)			0.06 (1.96)*	0.04 (1.33)
Classroom Quality (CQ)									
# of students in the classroom	pr_d2				-0.03 (1.53)				-0.03 (1.54)
If all students have math and/or lanugage textbook=1	pr_text				-0.31 (1.10)				-0.31 (1.10)
If textbook data missing=1	text_m				0.59 (1.02)				0.59 (1.03)
# of books in classroom library (unit=100 books)	books				0.20 (2.41)**				0.20 (2.41)**
If # of books data missing=1	book_m				0.10 (0.23)				0.10 (0.24)
=1 if teacher teaches in multigrade classroom	pr_d15d				0.19 (0.41)				0.17 (0.39)
=1 if multigrade information missing	pr_d15m				1.65 0.94				1.68 0.95
constant	_cons	2.65 (4.16)***	2.76 (2.74)***	2.08 (1.86)*	2.98 (2.21)**	2.65 (4.17)***	2.75 (2.74)***	2.05 (1.84)*	3.01 (2.26)**
R-squared	R^2	0.23	0.24	0.25	0.27	0.23	0.24	0.25	0.27
Number of Observations	N	594	594	594	594	594	594	594	594

Note 1) Huber-White consistent robust standard errors are reported. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.
Note 2) + indicates endogenous variable. Instrumental variables are composed of all exogenous variables, government's monetary transfer (M), and average community participation (ACP).

Table 4
Estimation Results of Wage Compensation Scheme
Dependent Variable: Wage Payment Per Hour

Specification		I	I	I	I	II	II	II	II
Method of estimation		OLS	IV	OLS	IV	OLS	IV	OLS	IV
		Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
		t	t	t	t	t	t	t	t
= 1 if EDUCO	e_w	-5.50	-7.84	-7.53	-15.84	-3.18	-1.11	-5.64	-7.48
		(1.30)	(2.19)**	(1.66)*	(1.28)	(0.77)	(0.27)	(1.04)	(0.88)
Teacher's days of attendance per month+	attend+	-2.43	-2.48			-2.89	-5.66		
		(0.96)	(0.59)			(1.09)	(1.53)		
pr_d11*attend+	a2OE2+	0.04	0.04			0.04	0.04		
		(2.12)**	(2.07)**			(2.17)**	(2.21)**		
Teacher's meeting with parents +	pr_f123+			-0.39	3.65			-0.48	1.21
				(0.53)	(0.52)			(0.58)	(0.33)
pr_d11*pr_f123 +	a2OE+			0.19	0.06			0.17	0.10
				(1.96)**	(0.31)			(1.79)*	(0.88)
Mincer equation variables									
= 1 if female teacher	fem					-2.09	-2.31	-1.33	-0.56
						(0.37)	(0.39)	(0.24)	(0.10)
=1 if finish technical school	predu_tc					7.25	7.44	6.75	6.48
						(0.79)	(0.80)	(0.74)	(0.74)
= 1 if finish collage	predu_un					0.47	0.40	1.41	2.61
						(0.05)	(0.04)	(0.15)	(0.27)
Years of past teaching experience	pr_year					1.27	1.56	0.77	1.03
						(1.16)	(1.24)	(0.66)	(0.83)
Years of past teaching experience squared	year2					-0.04	-0.05	-0.02	-0.03
						(1.17)	(1.31)	(0.63)	(0.80)
constant	_cons	91.99	234.71	29.51	20.57	91.68	163.18	20.01	14.95
		(1.36)	(2.46)**	(4.17)***	(1.04)	(1.24)	(1.68)*	(1.55)	(0.85)
Number of observations		133	133	133	133	133	133	133	133
R-squared		0.12	0.05	0.13	0.00	0.15	0.13	0.14	0.13
RSS (in thousands)		63.43	69.00	62.85	72.30	61.23	62.68	61.66	63.15
Amemiya's Prediction Criterion (in thousands)		85.64	93.15	85.10	97.89	89.58	91.70	90.21	92.34
Akaike's Information Criterion (in thousands)		86.89	94.53	86.10	99.05	90.62	92.77	91.25	93.46
Test statistics for Mincer wage equation variables (F-value for the null hypothesis of all β's are zero)						0.69	0.81	0.30	0.31
						[0.63]	[0.54]	[0.91]	[0.90]

Note 1) Huber-White consistent robust standard errors are reported. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.
Note 2) + indicates endogenous variable. Instrumental variables are composed of all exogenous variables, government's monetary transfer (M), M squared, average community participation (ACP), ACP squared, and M-ACP interaction variable.

Table 5
Estimation of Teacher Effort Function
by Department Fixed Effects Estimation
Dependent variable:
Teacher's days of school attendance or hours meeting with parents (per month)

Dependent variable		attend		pr_f123	
Method of Estimation		OLS	IV	OLS	IV
		Coef.	Coef.	Coef.	Coef.
		t	t	t	t
constant	_cons	26.25	26.25	2.74	1.96
		(57.31)***	(57.49)***	(2.41)**	(2.47)**
=1 if EDUCO	e_w	0.43	0.44	1.49	1.51
		(1.35)	(1.39)	(2.81)***	(2.69)***
# of ACE/SpDF's visits to classroom per month^{+}	pr_d11^{+}	0.05	0.05	0.15	0.15
		(2.09)**	(1.82)*	(2.28)**	(2.13)**
R-squared	R^2	0.23	0.23	0.26	0.26
Number of Observation	N	133	133	133	133

Note 1) Huber-White consistent robust standard errors are reported. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.
Note 2) + indicates endogenous variable. Instrumental variables are composed of all exogenous variables, government's monetary transfer (M), and average community participation (ACP).

Table 6
Fixed Effects Estimation of Classroom-level Input Demand Function

Dependent Variable		# of students in classroom (pr_d2)		=1 if all students have math and/or language textbooks		# of books in classroom library		=1 if multigrade classroom	
Estimation Method		Within Department Estimator with Robust Standard Errors		Conditional logit		Within Department Estimator with Robust Standard Errors		Conditional logit	
Specfication		1	2	1	2	1	2	1	2
		Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
		t	t	z	z	t	t	z	z
constant	_cons	37.78	38.16			-3.17	-10.39		
		(8.36)***	(8.44)***			(0.26)	(0.73)		
=1 if EDUCO	e_w	-7.12	-6.18	0.64	0.95	62.69	44.71	0.80	0.62
		(4.33)***	(3.49)***	(1.01)	(1.25)	(1.31)	(0.81)	(1.62)	(1.24)
# of ACE/SpDF's visits to classroom per month	pr_d11		-0.22		-0.06		4.26		0.07
			(2.30)**		(0.83)		(1.16)		(1.39)
R-squared	R^2	0.18	0.18	0.01	0.02	0.11	0.11	0.02	0.04
Number of Observation	N	133	133	103	103	133	133	124	124

Note 1) The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively
Note 2) Logit model with department fixed effects is estimated consistently by maximizing conditional likelihood function.