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Do Interventions at School Level Improve Educational Outcomes? Evidence from a Rural Program in Colombia

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Summary. — This paper evaluates the impact that the "Rural Education Project—PER" had on Colombian rural schools. This supply-side scheme program included the implementation of flexible educational models adapted to the needs of the rural community and the provision of specialized didactic material and teacher training. We find positive and significant effects on measures of efficiency (dropout, passing, and failure rates) and quality in the schools where PER was implemented. The estimation is based on census information comprising more than 21,000 rural schools and is robust to three different methodologies of estimation and different comparison groups.

Key words — South America, Colombia, education, rural, program evaluation

1. INTRODUCTION

Recent studies by FAO and UNESCO (2004a, 2004b) contend that rural zones are an underdeveloped sector inside developing countries. Approximately 75% of the 1.2 billion people who live in abject poverty (receiving less than $1 a day) are rural dwellers. More importantly, it is believed that these people are subject to a poverty trap. Their lack of access to suitable services of education, health, and nutrition does not offer them the necessary conditions to escape poverty. Thus, it is estimated that in 2020, 60% of the poor will continue to be found in rural areas.

Backwardness in the rural areas of developing countries is particularly evident in an analysis of the educational sector. [1] Taking into account the significant effects of education on individual development, programs aimed at improving the education of the rural population become an efficacious tool to reduce the existing gaps and combat poverty and inequality in these zones. [2] Normally, such education programs can be classified into two categories: subsidies to stimulate demand and supply-side interventions. The former are based on providing a certain sum of money to households on the condition that the children attend school. The latter ones, on the other hand, attempt to improve school characteristics through higher spending on inputs such as educational material, teacher training, and infrastructural improvements.

During the past decade large investments in the education sector of developing countries have concentrated in demand subsidies programs minimizing the implementation of supply-side interventions. [3] Such tendency may be explained in part by the strong association found between the socioeconomic characteristics of the students with their school performance, as well as the lack of robust evidence on the effects that school resources and infrastructure have on the main indicators of education. However, recently Banerjee, Cole, Duflo, and Linden (2007) show that supply-side subsidy programs can have significant effects on the academic achievement of students. In a randomized experiment in India, the authors find that supply-side inputs help to correct the poor quality of education, provided that the programs designed for this purpose take into account the specific needs of each group of students they serve. [4]

This article contributes additional evidence suggesting that supply-side intervention programs, specially designed in accordance with the characteristics and needs of the target population, are a viable and successful alternative to reduce educational inequities in the rural areas of developing countries. Specifically, we show that the Rural Education Project (PER), implemented in Colombia since 2002 with the support of the National Government and the World Bank, has had a positive impact on educational efficiency and quality in the country's rural schools. Considering the particular characteristics of rural students, the PER is based on the implementation of flexible educational models with materials and methodologies that are more suited to their needs, replacing traditional educational models designed for urban students. Providing specialized material for rural students' learning needs and a proper training of teachers, by 2006 this project had served more than 435,000 students in nearly 6,500 rural schools in Colombia.

Although previous studies have evaluated the effects of different educational programs this paper contributes to the literature in several respects. First, very few focus on programs specifically directed at the rural sector. [5] Moreover, unlike previous studies, this evaluation uses census information of rural public schools to determine program impact instead of relying on samples of

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control and treatment groups. The availability of measures of educational efficiency and quality, complemented with information on the socioeconomic characteristics of students and the municipalities where they live, allows the construction of a balanced panel of more than 21,000 rural schools for the years between 2000 and 2005, constituting 65% of Colombia's rural schools. In addition, we also have the results of a survey conducted to a random sample of PER schools that permits the identification of the channels through which the program has achieved the improved performance. Finally, it should be further mentioned that this is the first comprehensive program evaluation done to the PER Program.

In order to reduce the possible problems that arise from self-selection of rural schools into the program we evaluate its impact using fixed effects at the school level and difference in difference (DID), DID under common support and DID matching methodologies. The results of the evaluation are robust across the different empirical methodologies and show the beneficial aspects of supply-side intervention programs at school level that take into account the specific needs and conditions of students. The estimations based on DID matching and the complete balanced panel show that the program increased the passing rate by 4.7 percentage points, decreased the failure rate by 1.4 percentage points, and lowered the drop-out rate by 3.2 points. No effect on total enrollment is found under any of the three methodologies. The evidence suggests that the program also improved test scores of a standardized exam in the language area. The main findings are maintained when the intervention is divided according to the school level the PER model implemented targeted. Specifically, the results are positive and significant for education models directed to primary and secondary levels which account for almost 80% of all implementations. [6]

Recent evidence from Hiseh and Urquiola (2006) show the important effects that education programs can have in the sorting of students across schools. Even though in principle the positive results found in this paper could be driven by the transfer of students across PER and Non-PER schools, we argue that such a scenario is not likely to have occurred. On the first hand, it should be kept in mind that school transfers in the rural Colombian sector are both difficult and costly. Students in the rural areas do not have the possibility to choose which school to attend and they normally study in the closest or only one available. Moreover, we find no effect of the program on the measures of student enrollment suggesting that a significant transfer did not take place under the period studied. Finally, as robustness check we carried out the three estimation methodologies using alternative control and treatment groups. The results are robust across the different groups and provide evidence in favor of the hypothesis that the positive effect that this supply intervention had was not driven by any sorting of students or self-selection of schools.

The article is divided into eight sections. Section two presents a brief description of the PER, whereas section three introduces the empirical methodology used in the evaluation. Section four describes the data, sections five and six present the results obtained and some robustness checks, while section seven analyzes the PER's pathways of success. Section eight is dedicated to conclusions.

2. THE INSTITUTIONAL ORGANIZATION OF THE RURAL EDUCATION PROJECT

In its original conceptualization, PER hoped to design and implement flexible educational projects in rural schools to achieve four main objectives: (i) increase enrollment rates and quality in the rural areas; (ii) strengthen the management capacity of municipalities and educational institutions in order to identify needs, handle information and engage in planning and evaluation of educational projects; (iii) improve security and co-existence in rural schools; and (iv) assess the issues and problems of rural technical middle school education. The PER's total cost was estimated in US$ 120 million, of which 50% would be supplied by the World Bank and the remainder financed by the Colombian National Government (37%) and the regions where it was implemented (13%).

Each different level of government (national, departmental, and municipal) had a defined role in the planning, implementation, and evaluation of the project. The Municipal Operating Units (UOMs) were set up at the local level, and Departmental Strategic Alliances (AEDs) were created at the departmental level. Finally, the National Coordinating Unit made up of technical personnel from the Ministry of Education (MEN) worked at the national level.

At the beginning of the project, the UOMs, whose members were local officials and members of the education sector, assessed the conditions of rural education in the municipality in order to establish priorities and carefully choose the most needed interventions in their rural schools. Specifically, the UOM could choose among nine different groups of flexible educational models, depending on the needs of the municipality. The models are designed to achieve different goals, such as improving the quality of basic education, expanding preschool enrollment, and helping over aged students to catch up. [7]

Once this first stage was completed, the UOMs designed and presented a project based on the municipality's needs and available educational models to the AED for its evaluation and possible selection. If a given project was chosen, the UOMs would assist the selected school in its implementation and monitoring. Under the program, each rural school that was selected to participate received a basket of goods that according to the model would include educational guides, libraries, laboratory equipment, televisions, videotape players, videos, and desks and chairs for the students. In addition, the school's teachers also received specialized training to implement the chosen model. The PER is designed so that only one implementation per model is needed in each school. This particular characteristic reduces any possible perverse incentive of teachers or school directors to change efficiency measures or to help students in test-scores. [8]

Officials of the municipal and departmental governments and representatives of the region's private sector (business, NGOs, universities, and so forth) comprise the AEDs. These alliances give technical and economic support to ensure the long-term sustainability of PER. In addition, the AEDs determine the goals for each department and pinpoint the most appropriate municipalities to participate in PER. The projects were selected for funding based on educational, socioeconomic, and institutional indicators of the municipality. Specifically, according to the CONPES document 3056 (Departamento Nacional de Planeación, 1999), which approved the government loan to start the project, three basic characteristics at the municipality level were taken into account when evaluating each proposal: illiteracy rate, poverty rate measured by basic unsatisfied needs and the percentage of rural population. Finally, the National Coordinating Unit guided and supported the PER implementation process in the departments. A technical group in the Ministry of Education (MEN) coordinated the training activities and the acquisition of materials for the PER's models and was in charge of the overall supervision of the project.

Even though the project was formally approved in 1999, given the extensive planning it involved in its early stages, the implementations across the rural sector only began in the year 2002. [9] By 2005 PER had been implemented in 27 of the 32 departments of Colombia, in 487 municipalities and in more than 6,000 rural schools. The overall number of intervened students during this period was over 400,000.

3. EMPIRICAL STRATEGY

As in many empirical program evaluations, when estimating the average effect that the PER had on efficiency and quality variables at the intervened schools (the average impact of treatment on the treated—ATT) we suffer from a missing data problem. To illustrate, we follow the common notation in the literature and let D be a zero–one indicator variable that equals one if school i was intervened by the PER; $Y_{i,t,0}$ the outcome of interest if school i is not intervened in period t; and $Y_{i,t,1}$ the outcome if school i was part of the PER in period t. Then, the outcome observed for school i in period t will be given by $Y_{i,t} = DY_{i,t,1} + (1 - D)Y_{i,t,0}$ and the average gain for participating schools that have characteristics $X_{i,t}$ will be given by: $E(Y_{i,t,1} - Y_{i,t,0}|D = 1, X_{i,t,}) = E(\Delta|D = 1, X)$.

Given that $Y_{i,t,0}$ is not observed for schools that participated in the program we need an econometric methodology that allows us to obtain a reliable estimate of it. Specifically we use three different methodologies that attempt to control for any possible bias that may arise from self-selection of rural schools into the program: difference in difference (DID), DID under a common support and DID matching.

One of the most common non-experimental estimators used in the empirical literature to infer ATT effect when pre-program information is available is the DID estimator. It has been shown that such estimator will provide an unbiased estimate of the treatment effect under the assumption that, in absence of the treatment, both groups would have followed parallel trends. This is the first method used in the present paper where the natural control group are all the rural public schools in Colombia not intervened by the PER program. It is argued that one of its advantages is that it controls for self-selection into the program assuming it was based on observable and unobservable, but constant in time rural schools characteristics.

Nonetheless, it has been pointed out that this estimator could be subject to several potential sources of bias. The first drawback relies on the fact that the controls used to infer the counterfactual outcome may have very different characteristics as those from the treatment group, weakening the assumption of parallel trends effectively taking place. In order to control for this first source of bias, we follow Galiani, Gertler, and Schargrodsky (2005) in our second empirical strategy. We estimate propensity scores from a probit model of PER participation as a function of the number of students enrolled in each rural school in the year 2000, municipal characteristics of that same year, as well as student's average socioeconomic characteristics during the year 2005. We denote this conditional probability of participation in the PER program as $P_s = P(D = 1/X_s)$. [10] The second estimator will be that obtained by applying a DID methodology to those rural schools whose propensity scores lie on the common support.

However, even after assuring that observations belong to a common support, a second source of bias relies on the fact that the distribution of characteristics inside it could be significantly different. Furthermore, DID estimators assume a specific functional form of the outcome in terms of the treatment and observable characteristics, making it also susceptible to misspecification bias. Heckman, Ichimura, and Todd (1998) present the advantages of a matching DID estimator that encompasses the nonparametric methods of traditional matching estimators, permits selection to be based on potential program outcomes and allows selection on unobservable as the DID does. As demonstrated by the authors, such estimator could in principle reduce the three possible types of biases caused by the use of non-experimental data: difference in common support between treatment and non-experimental control group, differences in the distribution of the control variables over the common support among the two groups and differences in outcomes due to selection on unobservables.

Following Todd (2008), letting S_p be the region of common support of the propensity scores and assuming that $E(Y_{i,t,0} - Y_{i,t',0}/X_{i,t}, D = 1) = E(Y_{i,t,0} - Y_{i,t',0}/X_{i,t}, D = 0)$, the conditional difference in difference estimator will be given by:

$$\widehat{CDID} = \frac{1}{n_1}\sum_{i\in I_1\cap S_p}\left((Y_{j,t,1} - Y_{j,t',1}) - \sum_{i\in I_0\cap S_p} W_{i,j}(Y_{j,t,0} - Y_{j,t',0})\right),$$

where I_1 denotes the set of program participants, I_0 the set of non-program participants, n_1 the number of persons in the set $I_1 \cap S_p$ and $W_{i,j}$ correspond to local linear weights. [11] This is the third and last methodology we apply in this study.

Recent literature has compared the performance of estimators obtained using experimental and non-experimental data. Using information from a major job training program, Heckman *et al.* (1998) provide evidence that the conditional DID estimator described above, gives a fairly close impact estimate as that obtained under a randomized evaluation and is superior to the DID and other matching estimators. The authors argue that with a sufficiently rich data set three sources of bias caused by the use of non-experimental data are largely controlled for.

In the education literature, only one paper compares retrospective and prospective estimators. [12] Glewwe, Kremer, Moulin, and Zitzewitz (2004) using data from a flipchart program in Kenya find that retrospective estimators suffer from an upward omitted variable bias. It should be noted however that such conclusion is based on the use of a random effects model and that such differences are reduced once a DID approach is undertaken. The authors do not use a conditional DID approach as the one proposed by Heckman *et al*. (1998) and used in this paper.

4. DATA

Available data for the estimation of the impact of PER on the rural education system include census data on enrollment (total number of students enrolled in each school), indicators on efficiency and quality of Colombian rural schools. This information is complemented with data on the average socioeconomic characteristics of the students and the municipalities in which they reside. Although information exists for more than 35,000 rural schools, it was decided to work with a balanced panel of 21,207 schools for the years 2000–05, comprising 68% of all rural schools in the country as of 2005. [13] The data and results that are described below belong to this panel. It is worth mentioning that using the information from the non-balanced panel, in other words using almost every rural school in the country, the descriptive statistics and the results reported are maintained.[14]

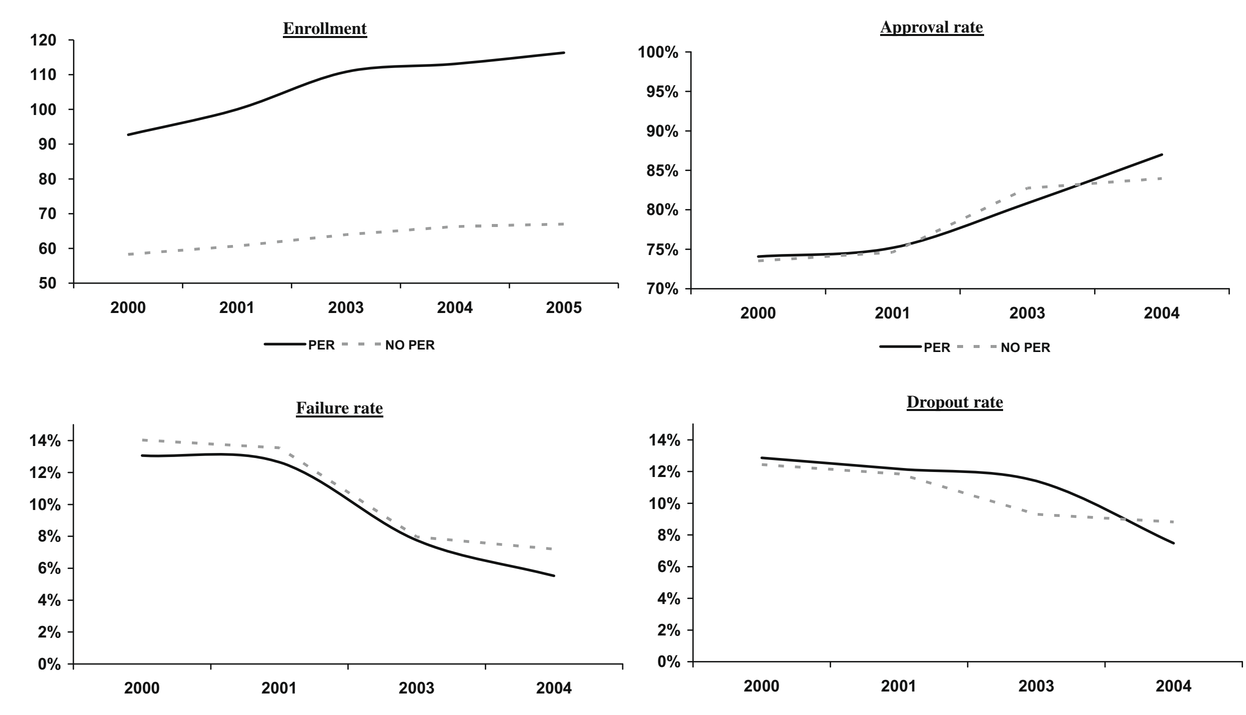
The data on the implementation of PER's flexible educational models in the country's rural schools come from a software data collection instrument managed by the National Coordinating unit at the Ministry of Education. This instrument contains information that details for each PER implementation the treated school name and code, the year, and the model implemented as well as the basket of goods delivered. We find that a total of 4,485 rural schools (14%) experienced at least one intervention by 2005 covering more than 390,000 students. Most of the experiences have concentrated in the New School (Escuela Nueva), Formal Pre-school, and Post-primary models. Thus, during 2002–04 nearly 60% of interventions were targeted to primary school students, 17% to secondary school and 12% to pre-school (see Appendix, Table A2).[15]

The enrollment and efficiency data come from the Ministry of Education. These include total enrollment and the passing, failure, and dropout rate for each school for the years 2000, 2001, 2003, and 2004.[16] Graph 1 shows the evolution of enrollment and the different efficiency variables for rural schools. It can be observed that, with the exception of enrollment, PER and Non-PER schools were quite similar in the year 2000. Furthermore, although the efficiency indicators in all rural locations improved significantly during these years, the schools where PER operated had much better results at the end of 2004.

Table 1 confirms the information presented in the graph. With the available information, it was possible to construct changes of the variables of each school for two distinct periods: 2000–01 and 2003–04. These time periods were chosen because the first one covers the changes in the variables prior to the implementation of PER and the second one corresponds to the post-treatment period. In the case of enrollment we use the percentage change in the total number of students attending each rural school, whereas for efficiency we worked with the absolute change in the rates. Simple differences show that at least during the two years before any implementation started there were no significant differences between PER and Non-PER Schools. However, once the program took off the situation clearly changed and significant differences appear. Again, the only exception is for total enrollment which shows that PER schools have always been bigger than Non-PER schools. Even though previous data on these variables could provide further evidence that no pre-existing trend between PER and Non-PER schools was present, observing no significant differences in the pre-treatment period reduces such possibility and enable us to carry out the empirical strategies.

Finally, information on educational quality comes from the results of the 2002–03 and 2005 SABER tests given to all Colombian fifth graders in the areas of mathematics, sciences, and language. Nevertheless, the number of schools for which information is available drops significantly to 4,437 (2002 data) and 6,408 (2005 data).[17] Based on the existing information, simple statistics present no difference between the academic results of pupils from the PER and Non-PER schools, both before and after the program.[18] However, as with the data on efficiency, it is necessary to employ econometric techniques to evaluate the possible impact of PER on quality.

In order to isolate municipal-level differences in the schools' environment a number of control variables were introduced in the econometric exercises. Specifically, we include two of the three measures used by AEDs to select PER projects: poverty rates measured as unsatisfied basic needs (UBNs) and the proportion of the population living in urban areas. We also include the *per capita* municipal spending on education to capture local governments' preference for the sector, the Gini coefficient of land lot prices to proxy inequality and the number of beneficiaries of the Familias en Acción program as a proportion of the total municipal population which is the major demand education program in the country. Finally we



Graph 1. *Evolution of enrollment and efficiency indicators in Colombian rural schools. Source: Software data collection instrument PER and MEN.*

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Table 1. *Observed changes in variables studied*

Dependent variable	Year	No PER	PER	Differences in changes
Enrollment	2000–2001	7.08%	11.72%	−4.65%
		(0.596)	(0.747)	*t*-stat = −3.5384
	2003–2004	20.50%	29.56%	−9.06%
		(2.048)	(3.991)	*t*-stat = −1.7595
Passing rate (%)	2000–2001	1.09%	1.12%	−0.03%
		(0.196)	(0.178)	*t*-stat = −0.090
	2003–2004	1.24%	6.16%	−4.92%
		(0.187)	(0.177)	*t*-stat = −13.5249
Failure rate (%)	2000–2001	−0.49%	−0.42%	−0.07%
		(0.155)	(0.133)	*t*-stat = −0.2396
	2003–2004	−0.76%	−2.23%	1.47%
		(0.129)	(0.109)	*t*-stat = 5.9369
Dropout rate (%)	2000–2001	−0.60%	−0.70%	0.11%
		(0.140)	(0.134)	*t*-stat = 0.3926
	2003–2004	−0.48%	−3.93%	3.45%
		(0.141)	(0.134)	*t*-stat = 12.5839
Observations		18,172	3,035	

Standard deviation in parentheses.

included the rate of attacks of illegal armed groups (per 100,000 inhabitants) which Rodriguez and Sanchez (2009) show affect schooling investments in the country.

Finally, to control for the socioeconomic characteristics of the students information was extracted from the SISBEN 2003 database.[19] Specifically, we matched the names list of enrolled students in each rural school provided by the Ministry of Education, with the information on household characteristics from SISBEN. For each rural school, we constructed the average educational level of household head and spouse, the average *per capita* income of the household and the average of a housing quality index.[20] It is observed that PER schools exhibit better socioeconomics indicators than Non-PER schools. Thus, PER schools are found in municipalities with lower levels of poverty, inequality, and violence. In addition, the students in PER schools belong to families that are, on average, more educated, they have higher *per capita* income and live in better housing.[21]

5. RESULTS

(a) *Enrollment and efficiency*

As mentioned above, the variables used to measure the impact of the PER on rural schools in Colombia are the percentage change in the total number of students and the absolute change in the passing, failure, and dropout rates of students for each rural school in the country between the periods 2000–01 (prior to the program) and 2003–04 (post program).

(i) *Difference-in-differences*

The first econometric exercise attempts to obtain the effect of PER on enrollment and efficiency, using DID with fixed effects at the school level.[22] We find that as expected, schools in municipalities with higher per pupil spending on education, a higher proportion of urban dwellers, and a lower unsatisfied basic needs have better results for both enrollment levels and changes in the efficiency rates. On the contrary, the rural schools located in more violent municipalities, or those with greater inequality as measured by the Gini index of land ownership, have poorer results. In the case of the approval and the dropout rate, those municipalities with a larger number of families in the program Familias en Acción experienced smaller absolute changes in these rates.[23]

The main results on the effectiveness of PER are summarized in the first panel of Table 2. The coefficients obtained with a DID model indicate that the effect of PER is positive for passing, failure, and dropout rates. We find that the schools where PER was applied had a 4.5 percentage points higher increase in the passing rate than the rest of the rural schools. In addition, PER reduced failure rates in nearly 1.6 percentage points and dropout rates close to 3 percentage points in addition to the decrease experienced by the rest of schools.[24] Analyzing the results on the percentage change in total enrollment it is evident that the PER caused no impact on this variable. In a certain degree this result gives further robustness to the effects found in the efficiency variables given that the possibility of a significant transfer of students between schools is rejected.

(ii) *Difference-in-differences using common support*

As explained in section three, when the control group used to infer counterfactual results has very different characteristics than those of the treatment group, the coefficient estimated may be subject to significant bias. To control for this problem, we estimated DID only for those schools in the common support of PER treatment schools.[25] The second column of Table 2 gives the results of the DID estimations using as controls only those schools in the common support. It can be seen that despite the reduction in the number of observations, both the magnitude and the significance of the coefficients associated with PER hold. Again, PER improved the passing, failure, and dropout rates of the treatment schools *vis-à-vis* the controls; while no effect on enrollment is found.

(iii) *Difference-in-differences matching*

The estimations reported above remain subject to two further likely sources of bias. First, it is possible that the distribution of characteristics observed in the treated and control

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Table 2. *Estimation of impact of PER on efficiency and quality indicators using different methodologies*

Dependent variable	Estimated PER effect under		
	DID	DID common support	DID matching
Efficiency variables			
% Change in enrollment 2004	0.031	−0.002	0.020
	[0.072]	[0.068]	(0.067)
% Change in passing rate 2004	0.045***	0.045***	0.047***
	[0.008]	[0.008]	(0.006)
% Change in failure rate 2004	−0.016***	−0.016***	−0.014***
	[0.005]	[0.005]	(0.003)
% Change in dropout rate 2004	−0.029***	−0.029***	−0.032***
	[0.006]	[0.006]	(0.003)
No. schools	21,193	20,249	17,297
Quality of education			
Sciences	0.469	0.422	0.004
	(0.419)	(0.461)	(0.008)
Language	0.789**	0.830**	0.016***
	(0.375)	(0.417)	(0.006)
Mathematics	0.732	0.447	−0.004
	(0.516)	(0.569)	(0.008)
No. schools	3,079	2,865	2,762

For models (1) and (2) robust standard errors clustered by municipality in parentheses. For model (3) bootstrap standard errors are reported.
*Significant at 10%.
**Significant at 5%.
***Significant at 1%.

schools are different. In addition, a problem of specification may exist in the model given the assumption of a linear effect of PER on measures of efficiency. To overcome these possibilities, we use the DID matching estimator introduced by Heckman *et al.* (1998). This is our preferred estimation methodology.

The DID matching methodology confirms the results obtained in prior estimations. As shown in the third column of Table 2, the differences between the evolution of the efficiency variables of treated and untreated schools (the latter having characteristics that would have made them susceptible of treatment) is significant. Specifically, it can be concluded that the passing rate in the PER schools increased by 4.7 percentage points more than in the untreated units. The failure rate fell 1.4 percentage points more and the dropout rate fell 3.2 percentage points more in the PER schools. These are considerable effects amounting to 23%, 10%, and 23% of their respective standard deviations. Again, no significant change in enrollment is found. Looking at the coefficients from Table 2, we can observe that they are relatively stable across the different specifications. This may suggests that the specification of both DID and DID with common support estimations neutralized most of the likely sources of bias.

(b) *Educational quality*

As mentioned in Section 4, the impact of PER on the quality of education in the rural schools was estimated using the results of the fifth grade SABER tests for 2002 and 2005. Information is available for a reduced sample of 3,079 schools, of which 26% were treated schools. Hence, caution should be taken when interpreting the results. The second panel in Table 2 presents the results obtained using the three methods of estimation. Unlike the results for efficiency, we observe that the value of the coefficients across the different methodologies greatly varies and significance is only obtained in one of the exam areas. Such differences may imply that the sources of bias in the case of quality of education are only partially controlled with the DID and DID with common support. According to the DID matching methodology PER had a significant impact only on the language area, increasing by 0.16 points the average score in PER schools above that of Non-PER schools. This is, however, a small gain equivalent to a change of 0.03 standard deviations.

(c) *Differences in impact across flexible educational programs*

As mentioned before, the PER consisted in the implementation of different flexible educational programs which allowed supply-side interventions that were directed to the specific needs in each municipality and school. As each program has different aims and target population there is no reason to believe that the effects on efficiency and quality measures are the same in all of them. [26] Hence, to analyze differences on the impact across programs we divided them into four groups according to the level of education each one targeted: primary, secondary, pre-school, or adult education. [27] Table 3 presents the DID matching estimates obtained for each PER intervention according to the type of students targeted and the efficiency or quality variables of interest. As can be observed, it appears that the positive effects above found are driven by those programs associated with primary and secondary education. Specifically, PER programs directed to primary education increases passing rates by 8 percentage points and decreases failure and dropout rates by 2.3 and 5.7 percentage points, respectively. Those programs directed to secondary education increases passing rates in 5.1 and decreases dropout rates in 4.4 percentage points. The flexible models directed to pre-school or adult education have no significant effect on the efficiency or quality measures of the schools where they were implemented.

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Table 3. *DID matching estimation of impact of PER on efficiency and quality indicators under different PER implementations*

Dependent variable	Primary programs implementations	Secondary programs implementations	Pre-school programs implementations	Adult education programs implementations
Efficiency variables				
% Change in enrollment 2004	−0.066	−0.068	0.363	0.150
	(0.035)	(0.057)	(0.336)	(0.227)
% Change in passing rate 2004	0.08***	0.051**	0.003	0.060
	(0.009)	(0.022)	(0.015)	(0.044)
% Change in failure rate 2004	−0.023***	−0.007	−0.001	−0.034
	(0.007)	(0.017)	(0.010)	(0.040)
% Change in dropout rate 2004	−0.057***	−0.044***	−0.002	−0.026
	(0.007)	(0.017)	(0.011)	(0.023)
No. schools	16,384	15,748	15,913	15,708
Quality of education				
Sciences	0.004	0.013	−0.014	−0.073
	(0.008)	(0.025)	(0.013)	(0.067)
Language	0.016***	0.004	0.004	−0.048
	(0.005)	(0.016)	(0.010)	(0.047)
Mathematics	−0.004	−0.043	−0.011	−0.132
	(0.009)	(0.025)	(0.015)	(0.072)
No. schools	3,003	2,583	2,656	2,546

Bootstrap standard errors are reported in parentheses.
*Significant at 10%.
**Significant at 5%.
***Significant at 1%.

The results of Table 3 should be analyzed taking into account two important facts that need to be stressed out. First, as observed in Table 2 of the Appendix almost 80% of the rural students were intervened either by a primary or a secondary program. This implies that most of the resources of the PER are being spent in the highest impact programs. Second, the estimates presented in the above tables are lower bound estimates of the effect the program may have. As previously mentioned, both the efficiency and quality variables used are measured at the school level. Hence, we find that a *primary* PER intervention is impacting the efficiency variables of the *whole* school. It is expected that if information on efficiency variables at each separate level of education was available, the impact of PER could be even higher. Unfortunately, information at such a disaggregated level is not available.

Finally, the lower panel of Table 3 presents the effect of PER implementations on quality. As can be observed, only primary level targeted interventions have a positive effect on the language test score. This is an expected result given that as mentioned before the SABER tests used in this study are those directed to fifth graders who are precisely those in primary level. There is no reason why to expect that a secondary or an adult education program should influence this exam results.

6. ROBUSTNESS

As observed, we obtained similar coefficients under the three alternative methods of estimation. However, there may be two circumstances that could potentially bias the results: transfers of students between schools and time varying unobservables correlated with school performance and with PER interventions of schools and municipalities.

Transfers of students across schools could occur when concerned parents in municipalities that have PER schools decide to transfer their children from untreated to treated schools. It would be expected then that students with good academic results or with concerned parents move from Non-PER to PER schools within the same municipality, augmenting the efficiency indices in the former and lowering them in the latter. Although such a scenario could be possible, we argue that for the rural students in Colombia transfer among schools are not only difficult but also costly. Most of the time rural schools are chosen by parents not because of their specific characteristics but because it is the closest or even the only one available for their children to attend. Moreover, indicative evidence that no transfer of students occurred is given by our own finding that PER had no impact on enrollment. [28]

However, as a robustness check and in order to avoid this first source of bias, the same regressions were performed using municipalities as the treatment subject. That is we assume that the treatment is being located in a PER municipality. We argue that this alternative control and treatment group could control for the possible transfer of students assuming that no transfer across municipalities would occur. One thing is to transfer a student from one school to another within the same municipality and another very different is for rural families to change their living locations in order to transfer their children to a PER school. [29]

The second case that can bias the results is if municipalities in which the program operated experienced time varying positive educational changes different to those of PER. In this case, such changes could be wrongly reflected in the coefficients associated with the program. To avoid this second possible bias, we used as control group only those untreated schools that are located in municipalities where the program was implemented.

Finally, the obtained coefficients could still be biased if there are unobservable time varying characteristics in PER schools that are driving the results. Although we cannot directly control for such source of bias if we assume that there are common time varying unobservables among PER schools an alternative control group emerges. Specifically, our third and final control group consists of schools that became PER schools in either 2005 or 2006 but were not treated in the period of our study. That is we use as control schools only those that will eventually enter into the PER program.[30]

(a) *Alternative treatment: PER municipalities versus Non-PER municipalities*

The first panel of Table 4 show the estimations of DID matching methodology with this first alternative control group. As can be observed, the impact of PER for all efficiency indicators remains. Indeed, efficiency indicators in PER municipalities improved much more than in Non-PER municipalities. Moreover, the effect holds for all PER programs. This could also suggest then that the academic benefits of the program percolated to all the schools in the treated municipalities. One explanation of this result is that often—as established in qualitative field work—the material supplied to a school by the program was photocopied and shared with Non-PER schools in the municipality, probably also improving their efficiency indicators. As can be observed no significant difference in the number of students across municipalities is found suggesting that no transfer of students occurred.

Table 5 presents the results concerning PER's effect on educational quality. In line with those reported in Table 2, we find that PER significantly influenced student results on language.

(b) *Alternative control group 2: rural schools in PER municipalities*

Using as control groups schools that were not treated by PER but are located in PER municipalities reduces the size of the panel to 9,593. The second panel of Table 4 presents the results of estimating the impact of PER using this control group. The positive impact of PER is again visible in the treated schools for those that implemented either a primary or a secondary flexible model. Although the impact is lower, possibly as a result of the spillover effect mentioned above, there is a significant difference in the evolution of the passing and failure rate between treated and untreated schools in PER municipalities. This suggests that the program did in fact influenced schools' efficiency indicators and that the results previously found were not driven by unobservable time varying characteristics of PER municipalities. By contrast, when using the information for schools located only in PER municipalities, the effects on quality disappear. Again this may be due to the above-mentioned spillover effects or the much smaller number of schools for which information is available.

Table 6 provides further evidence of such spillover by separating the municipalities depending if the percentage of PER schools in them is higher or lower than the country mean. When the treatment is being located in a PER municipality,

Table 4. *DID matching estimation of PER effect on efficiency indicators across PER program implementations and alternative control groups*

Dependent variable	All implementations	Primary programs implementations	Secondary programs implementations	Pre-school programs implementations	Adult education programs implementations
Alternative control group 1—treatment is being in a PER municipality					
% Change in enrollment 2004	0.023	−0.034	−0.028	0.035	−0.039
	(0.026)	(0.018)	(0.026)	(0.042)	(0.039)
% Change in passing rate 2004	0.042***	0.045***	0.046***	0.052***	0.036***
	(0.003)	0.005	0.005	0.005	0.007
% Change in failure rate 2004	−0.014***	−0.013***	−0.009***	−0.014***	−0.002
	(0.003)	0.004	0.003	0.003	0.005
% Change in dropout rate 2004	−0.028***	−0.032***	−0.037***	−0.037***	−0.035***
	(0.003)	0.004	0.004	0.004	0.005
No. schools	17,297	16,384	15,748	15,913	15,708
Alternative control group 2—only schools from PER municipalities					
% Change in enrollment 2004	0.153	−0.043	−0.010	0.450	0.133
	(0.070)	(0.040)	(0.061)	(0.385)	(0.142)
% Change in passing rate 2004	0.026***	0.053***	0.039	−0.014	0.043
	(0.007)	0.010	0.026	0.018	0.047
% Change in failure rate 2004	−0.006	−0.012	−0.007	0.010	−0.027
	(0.004)	0.008	0.020	0.010	0.035
% Change in dropout rate 2004	−0.019***	−0.040***	−0.032**	0.004	−0.017
	(0.005)	0.007	0.015	0.013	0.024
No. schools	7,625	6,763	6,125	6,259	6,087
Alternative control group 3—PER versus future PER schools					
% Change in enrollment 2004	−0.182	−0.071	−0.023	0.463	0.124
	(0.147)	0.051	0.077	0.413	0.168
% Change in passing rate 2004	0.038***.	0.050***	0.025**	−0.006	−0.001
	(0.020)	0.013	0.013	0.019	0.019
% Change in failure rate 2004	−0.019	−0.016**	−0.014	0.005	−0.015
	(0.014)	0.008	0.009	0.011	0.013
% Change in dropout rate 2004	−0.019[1]	−0.034***	−0.011[1]	0.001	0.016
	(0.012)	0.008	0.008	0.014	0.014
No. schools	3,255	3,070	3,255	1,518	3,255

Bootstrap standard errors are reported in parentheses.
*Significant at 10%.
**Significant at 5%.
***Significant at 1%
[1] One tail significance.

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Table 5. *DID matching estimation of PER effect on quality indicators across PER program implementations and alternative control group*

Variable de interés	All implementations	Primary programs implementations	Secondary programs implementations	Pre-school programs implementations	Adult education programs implementations
Alternative control group 1—treatment is being in a PER municipality					
Sciences	0.017***	0.017	0.006	0.001	0.010
	(0.007)	(0.007)	(0.010)	(0.010)	(0.012)
Language	0.020***	0.02***	0.021***	0.02***	0.03***
	(0.006)	(0.006)	(0.008)	(0.006)	(0.010)
Mathematics	−0.004	−0.004	−0.004	0.004	−0.010
	(0.011)	(0.011)	(0.011)	(0.010)	(0.016)
No. schools	3,003	3,003	2,583	2,656	2,546
Alternative control group 2—only schools from PER municipalities					
Sciences	−0.001	−0.001	0.010	−0.011	−0.102
	0.00942	(0.010)	(0.024)	(0.017)	(0.067)
Language	0.005***	0.005	−0.005	−0.004	−0.052
	(0.010)	(0.008)	(0.024)	(0.010)	(0.053)
Mathematics	−0.003	−0.003	−0.037	−0.014	−0.135
	(0.010)	(0.010)	(0.028)	(0.015)	(0.083)
No. schools	1,394	1,394	992	1,057	956
Alternative control group 3—PER versus future PER schools					
Sciences	−0.022**	−0.017	0.005	−0.007	−0.134
	(0.010)	(0.019)	(0.026)	(0.015)	(0.088)
Language	−0.012	−0.020	−0.018	−0.001	−0.032
	(0.015)	(0.020)	(0.026)	(0.013)	(0.037)
Mathematics	−0.048***	−0.061	−0.069	−0.030	−0.154
	(0.016)	(0.022)	(0.036)	(0.018)	(0.079)
No. schools	804	456	402	467	360

Bootstrap standard errors are reported in parentheses.
*Significant at 10%.
**Significant at 5%.
***Significant at 1% tail significance.

Table 6. *DID matching estimation of PER effect on efficiency indicators across PER*

Dependent variable	All implementations	
	No. of schools treated higher than the country Mean	No. of schools treated lower than the country Mean
Alternative control group 1—treatment is being in a PER municipality		
% Change in enrollment 2004	0.089	−0.051
	(0.061)	(0.040)
% Change in passing rate 2004	0.047***	0.041***
	(0.006)	(0.005)
% Change in failure rate 2004	−0.006	−0.023***
	(0.004)	(0.004)
% Change in dropout rate 2004	−0.041***	−0.018***
	(0.004)	(0.004)
No. schools	13,053	13,916
Alternative control group 2—only schools from PER municipalities		
% Change in enrollment 2004	0.134	−0.032
	(0.099)	(0.089)
% Change in passing rate 2004	0.011	0.022**
	(0.010)	(0.010)
% Change in failure rate 2004	−0.011	−0.013
	(0.007)	(0.007)
% Change in dropout rate 2004	0.000	−0.009*
	(0.008)	(0.007)
No. schools	3,881	4,244

Bootstrap standard errors are reported in parentheses.
*Significant at 10%.
**Significant at 5%
***Significant at 1%

the impact of the program is bigger in those schools located in municipalities with above average percentage of treated schools. This is reasonable given that the probability of spill-over effects would be higher. On the contrary, when we compare only schools located in PER municipalities the result, as expected, is exactly the opposite. There is a significant impact of the program only in those municipalities where the percentage of PER implementations is lower than the country mean and a lower spill-over effect is possible.

(c) *Alternative control group 3: future PER schools*

The third panel of Table 4 presents the results of using as control group only those schools that implemented a PER flexible model in either 2005 or 2006. Even though under this scenario the number of schools drops to around 3,000 the main results for the efficiency measures are maintained. PER flexible models implementation increased passing rates and decreased failure and dropout rates for those models that where directed to primary or secondary education (no effect on failure rate is found for the latter). For the quality measures, Table 5 shows that using as control group future PER schools the results are lost and there appears to be a negative impact on both math and science exams. In this case observations drop to 800 and hence these results should be taken with caution.

7. PATHWAYS OF THE PER EFFECTS

The results above presented show that the schools that received a PER intervention performed better in terms of both

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efficiency and quality. However, it is important to identify the channels of transmission through which these positive results were achieved.

To address this question, we first divided the sample into deciles of passing, failure, and dropout rates. Successful PER schools were defined as those belonging simultaneously to the top five deciles of positive change in all three efficiency measures. Using this definition, 24% of the PER schools were classified as successful. We then combine this information with the results of a survey conducted by CEDE to more than 700 principals and 1,000 teachers from both participating and non-participating schools. The possible channels for which we have information in the survey include indicators, among others, of infrastructure; educational material, and training offered by the PER; the quality of the school's management and administration as well as the integration of the school to the community. We standardized the indicators between zero and one depending upon the answers given by teachers and principals. The econometric estimation also included the socioeconomic characteristics of the students in each school and a dummy variable indicating the type of program implemented in each school.

A probit model of success, weighted by the total number of students in a school, was estimated. Results in Table 7 show that PER's success depends on a combination of three factors: good training in the flexible educational models, high quality of educational material provided for the models, and first rate school management. Given the structure and organization of the PER program in which these three variables play an important role, the findings are both expected and encouraging.

Table 7. *Factors associated to PER's success*

	Successful PER school (only PER)	
	Coefficients	Marginal effects
School infrastructure	−1.476**	−0.554**
	[0.642]	[0.238]
Teaching material	1.128**	0.424**
	[0.503]	[0.188]
Training on models	1.062***	0.356***
	[0.252]	[0.072]
Implements productive projects	−0.272	−0.102
	[0.244]	[0.091]
Covenant programs	1.128***	0.379***
	[0.240]	[0.066]
Rating community integration	0.221***	0.083***
	[0.083]	[0.031]
Rating school management and administration	1.482***	0.557***
	[0.462]	[0.172]
Ration municipal management and administration	−0.053	−0.020
	[0.350]	[0.131]
Per capita household income (ln)	1.019**	0.383***
	[0.396]	[0.147]
Educ. attainment (avg. parents)	0.490***	0.184***
	[0.153]	[0.057]
Housing quality indicator	−5.347***	−2.008***
	[1.261]	[0.469]
Observations	238	238

Standard errors in parentheses.
*Significant at 10%.
**Significant at 5%
***Significant at 1%.

In contrast, infrastructure of the school or the presence of pedagogical productive projects did not affect the school's probability of success. In addition, the quality of municipal management does not seem to be related to PER's success. Finally, those schools enrolling students from better educated and higher income homes are on average more successful. Although they are not policy variables affected directly by the program, certainly they have an important effect and future implementations should take this into account.

8. CONCLUSIONS

Using census information on Colombian rural schools and different empirical methods to reduce possible problems of self-selection, this study finds that PER has been a successful supply-side intervention project. By implementing flexible educational models, PER was able to increase the passing rate and lower the dropout and failure rates of students in treated schools. In addition, there is evidence to support the hypothesis that PER also succeeded in positively affecting the quality of education imparted, measured by standardized language tests given to students in the fifth grade. Most of the effect appears to be driven by implementations of models targeting primary and secondary education. The program's success greatly lies on PER's design which took into account the specific characteristics and situation of rural students in each municipality it was implemented. Thus, the application of education models appropriate to the needs of each community has been key for PER's accomplishments.

The organization of the project would facilitate its replication and expansion at low cost. PER fulfilled its objectives by serving more than 400,000 students over a five-year period and demonstrated that a large number of students can be covered with adequate organization. Unlike subsidies to demand that periodically grant cash transfers to treated families, the PER educational material and the teacher training can also be used by new generations of students at a low replacement cost.

Previous authors have shown that both the quantity and quality of education significantly contribute to the increase of agents' income and the reduction of inequality in developing countries. Hence, the improvement of educational provision in rural sectors could reduce the high poverty rates and speed up economic growth in these zones. The positive results of the PER on indicators of both quantity and quality lead to the conclusion that supply-side interventions programs, especially designed for the target population, should be considered as a viable and highly successful policy alternative.

NOTES

1. For instance, according to FAO and UNESCO (2004b), the illiteracy rate for a group of developing countries is on the order of 22% in the urban areas, but it reaches 46% in the countryside.

2. Studies such as Glewwe (2002) and Hanushek and Woessmann (2007), among others, report the importance of education on individuals' incomes, health, and fertility decisions among others.

3. Some examples of these programs include education vouchers in Chile and Colombia, and direct cash payment programs, such as Familias en Acción in Colombia and OPORTUNIDADES in Mexico.

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4. The results of Heckman *et al.* (1998) show that increasing educational inputs does not in and of itself necessarily improve academic performance. Likewise, Glewwe, Kremer, and Moulin (2007) analyze the results of a supply-side subsidy program that is not designed taking into account the specific needs and conditions of the students. They find that the use of new books in Kenyan schools benefits only students who already have the highest averages.

5. Among the few exceptions are the studies of Jimenez and Sawada (1999) and Paqueo and Lopez-Acevedo (2003), which focus exclusively on rural education programs.

6. It should be noted that previous versions of this paper also carried out a cost-benefit analysis. The results show that the program produces an internal rate of return close to 20%.

7. The main goals and characteristics of the models provided by PER are summarized in Table A1 in the Appendix. For additional information please refer to Ministerio de Educación Nacional (2001a, 2001b).

8. There are some cases in which a PER implementation is just an actualization of an already existing program in given schools. There are others in which the same school gets two different models implemented.

9. In 2004 the government decided to increase the number of municipalities participating in the PER project. As a first step, the AED system was eliminated and instead a system of the so-called "Agreements" that did not require the participation of the private sector was established. In addition, the government decided to concentrate its resources and efforts only on the first of the four PER objectives). However, the basic structure and implementation of the flexible education models remained intact.

10. In order to check robustness, all the estimations presented in the following sections were also carried out without the use of these socioeconomic characteristics of students. All the general results are maintained and are available upon request.

11. As detailed in Todd (2008) defining $G(\cdot)$ as a kernel function then the local linear weighting function is given by: $Wi,j = \frac{G_{i,j}\sum_{k\in I_0} G_{i,k}(P_K-P_i)^2-[G_{i,j}(P_j-P_i)]\left[\sum_{k\in I_0} G_{i,k}(P_K-P_i)^2\right]}{\sum_{j\in I_0} G_{i,j}\sum_{k\in I_0} G_{i,k}(P_K-P_i)^2-\left[\sum_{k\in I_0} G_{i,k}(P_K-P_i)^2\right]}$. It has been demonstrated that this local linear estimation has a faster rate of convergence near boundary points and greater robustness.

12. Retrospective estimates are obtained using retrospective data on Kenyan schools. On the other hand, prospective estimates are obtained using data from a randomized evaluation.

13. Some of the reasons why we have an unbalanced panel of schools rely on the fact that some schools may close; others may open while others may merge during the period under study. Furthermore, it is also the case that it is difficult for the MEN to receive information from all of them every year.

14. All the results based on the complete data set are available upon request.

15. Table A2 in the Appendix presents the total number of students and rural schools treated by PER in each specific model according to the level of education targetted.

16. Failure rate is not necessarily equal to one minus pass rate due to the high possibility of school drop-out in rural areas.

17. This loss of information is due to the methodology employed in the SABER testing during the years in question. Unfortunately, not all tests were given in all rural schools in either of the two years. In 2002, the subjects were parceled out to different schools, whereas in 2005, small-enrollment schools were not studied.

18. Table A3 in the Appendix presents these statistics. Although not shown, the evolution of most of the control variables was similar in both PER and Non-PER municipalities. In the specific case they were not (per pupil spending, inequality and poverty) results should be biased against PER municipalities.

19. SISBEN is a government rich socioeconomic information system for the identification, classification, and selection of poor individuals and families, in order to provide access to subsidies and other benefits awarded by the government through its social programs. Given their low income and education levels, most rural households are part of such system.

20. Among the variables used to calculate the housing quality index we included: the type of housing unit, whether it was located in an unsuitable zone for housing, the predominant material of walls and floors, access to public services, and the quality of the services.

21. Detailed information of the municipal variables and the socioeconomic characteristics of the students are presented in Table A4 in the Appendix.

22. Hausman tests were carried out for each dependent variable and the Ho of the appropriateness of a RE model was rejected in all of them. The chi-square for enrollment, passing, failure, and dropout rates was 44, 75, 17, and 85, respectively.

23. Table A5 in the Appendix gives the complete results of this estimation.

24. Regressions also included a variable identifying when the school entered treatment and therefore showed whether the impact of PER persists over time. The results in Table A5 in the appendix show that the effects of the program continued or were greater one year after the intervention, as seen in the case of the dropout rate.

25. In order to obtain the common support, a probit model of PER participation was estimated. Table A6 in the Appendix presents the results of such estimation. As can be observed the program effectively targeted poorer and more rural municipalities as stated in CONPES 3056.

26. We thank an anonymous referee for this suggestion.

27. The specific flexible education programs in each group are: Primary (New School and Accelerated Learning); Secondary (Post-primary, TV Secondary); Pre-school (formal and informal programs), and Adult education (SER, SAT, CAFAM, and Ethno-education).

28. If there was indeed any transfer of students across schools, given the results above presented, it must be the case that the same proportion of students that transferred from Non-PER to PER schools, transferred from PER to Non-PER schools across all of rural Colombia. This of course is highly unlikely.

29. This is highly unlikely not only because rural families depend on their land for receiving income but also they are probably not even aware whether in their own municipality special school programs are

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taking place, let alone in another municipality. It should be remembered that PER education models were based on training on teachers and additional material which are not highly noticeable for the average rural parent.

30. We thank an anonymous referee for this idea. Alternatively, another control group could have been schools that were "close" to being chosen by the Project. However, there is no information on the number or type of projects that applied but were not chosen to participate in PER.

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APPENDIX

See Tables A1–A6.

Table A1. *PER education models Source: MEN.*

Model	Target population	Educational material
Accelerated learning (Brazil)	Children in basic primary who are behind their cohort	Education modules, teacher training, library
New school	Multi-graded basic primary	Education modules, basic library, teacher training
Post-primary	Flexible basic secondary linked	Education modules, audio cassettes, laboratories, selected books, teacher training
TV secondary (Mexico)	Expanded coverage in basic secondary	TV and VHS modules, videos, selected books, teacher training
Rural education service (SER)	Those above 13 who have never studied	Education modules, teacher training
Pre-school (formal or informal)	Children under 6	Education modules, teacher training
Guided learning system (SAT)	Working youths and adults who want to finish basic education and middle school	Education modules, teacher training
Lifelong learning program—CAFAM	Individuals above the age of 13 without any education	Education modules, tests to determine achievement level, games, evaluations, training
Ethno-education	Students from ethnic groups allowing addition of cultural elements	Education modules, training of tutors

Table A2. *Percentage of PER students by model*

	2002	2003	2004	2005	Total
Primary (%)	67.67	60.70	56.84	48.45	56.11
Secondary (%)	12.67	17.67	19.18	22.60	19.22
Pre-school (%)	4.95	15.90	15.61	20.26	15.90
Adult education (%)	14.71	5.72	8.36	8.68	8.77
Total number of students	50,914	78,090	125,348	135,915	390,267

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Table A3. *Average SABER test scores in rural schools. Source: MEN.*

Area of knowledge	SABER 2002/2003		SABER 2005	
	No PER rural	PER	No PER rural	PER
Sciences	50.66	50.35	51.85	51.58
	(5.990)	(5.780)	(7.478)	(6.457)
Language	53.52	54.42	57.12	57.47
	(7.804)	(7.734)	(8.441)	(8.090)
Mathematics	57.44	57.02	57.90	57.62
	(5.172)	(4.969)	(6.389)	(5.720)
Observations	3,259	1,178	4,877	1,531

Standard deviation in parentheses.

Table A4. *Socioeconomic characteristics of rural locations in Colombia Source: CEDE, SISBEN.*

Variable	No PER	PER	Difference (No PER − PER)
Illegal armed activity (per 100.000 inhabitants) (2000)	1.676	1.622	0.054
	(.011)	(.028)	(.030)
Families in action (# de families/pop. mun.) (2000)	0.007	0.011	−0.00392
	(.000)	(.000)	(.000)
GINI (land prices) (2000)	0.538	0.504	0.034
	(.001)	(.002)	(.002)
UBN (2000)	47.843	45.926	1.917
	(.163)	(.363)	(.398)
% Urban population (2000)	0.362	0.308	0.054
	(.002)	(.003)	(.004)
Per pupil municipal spending on education (ln) (2000)	6.800	6.925	−0.125
	(.003)	(.006)	(.006)
Educ. attainment (avg parents)	3.130	3.460	−0.330
	(.008)	(.019)	(.021)
Per capita household income (ln)	9.775	9.891	−0.117
	(.007)	(.015)	(.017)
Housing quality indicator	0.398	0.410	−0.012
	(.001)	(.002)	(.002)
Observations	18,172	3,035	

Standard deviation in parentheses.

Table A5. *DID estimation of PER effect*

	(1) % Change in enrollment	(2) % Change in pass rate	(3) % Change in failure rate	(4) % Change in dropout rate
PER* 2004	0.031	0.045***	−0.016***	−0.029***
	[0.072]	[0.008]	[0.005]	[0.006]
Year 2004	0.082	0.023**	−0.010**	−0.014*
	[0.064]	[0.009]	[0.005]	[0.007]
PER previous year	0.259	0.016	0	−0.016*
	[0.334]	[0.014]	[0.009]	[0.010]
Per pupil municipal spending on education (ln) (2000)	0.003	0.026	−0.008	−0.018
	[0.104]	[0.018]	[0.010]	[0.013]
Families in action (# de families/pop. mun) (2000)	3.346**	−0.349	0.056	0.294
	[1.593]	[0.310]	[0.212]	[0.187]
Illegal armed activity (per 100.000 inhabitants)(2000)	0.03	−0.004*	0.002*	0.001
	[0.022]	[0.002]	[0.001]	[0.002]
GINI (land prices) (2000)	−0.086	−0.127**	0.016	0.112*
	[0.147]	[0.063]	[0.016]	[0.065]
UBN (2000)	0.021	0.002	−0.001	−0.001
	[0.019]	[0.002]	[0.001]	[0.001]
% Urban population (2000)	3.186	0.314*	−0.218**	−0.096
	[3.316]	[0.177]	[0.103]	[0.122]
Constant	−2.101	−0.305*	0.177*	0.129
	[2.189]	[0.169]	[0.104]	[0.122]
No. schools	21,193	21,193	21,193	21,193

Robust standard errors clustered by municipality in parentheses.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

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Table A6. *Probit PER participation*

Dependent variable: PER participation	
Illegal armed activity (per 100.000 inhabitants) (2000)	−0.003
	(0.007)
Families in action (# de families/pop. mun.) (2000)	6.628***
	−(0.693)
GINI (land prices) (2000)	−0.664***
	−(0.088)
UBN (2000)	0.000
	(0.001)
% Urban population (2000)	−0.593***
	(0.068)
Per pupil municipal spending on education (ln) (2000)	0.394***
	(0.040)
Educ. attainment (avg. parents)	0.078***
	(0.012)
Per capita household income (ln)	0.126***
	(0.015)
Housing quality indicator	−0.188
	(0.143)
Enrollment 2000	0.001***
	(0.000)
Constant	−4.727
	(0.355)
No. observations	21,681
LRT	1,047

Robust standard errors in parentheses.
*Significant at 10%.
**Significant at 5%.
*** Significant at 1%.

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