THE WORLD BANK ECONOMIC REVIEW, VOL. 16, NO. 2 297–319

Impact Evaluation of Social Funds

The Allocation and Impact of Social Funds: Spending on School Infrastructure in Peru

Christina Paxson and Norbert R. Schady

Between 1992 and 1998 the Peruvian Social Fund (FONCODES) spent about US$570 million funding microprojects throughout the country. Many of these projects involved constructing and renovating school facilities. This article uses data from FONCODES, the 1993 population census in Peru, and a 1996 household survey conducted by the Peruvian Statistical Institute to analyze the targeting and impact of FONCODES investments in education. A number of descriptive and econometric techniques are employed, including nonparametric regressions, differences in differences, and instrumental variables estimators. Results show that FONCODES investments in school infrastructure have reached poor districts and poor households within those districts. The investments also appear to have had positive effects on school attendance rates for young children.

Public Disclosure Authorized

Since the creation of the Emergency Social Fund in Bolivia in late 1986, social funds have been established in dozens of countries, often with support from multilateral organizations and international donors. Social funds like Bolivia's were originally put into place to mitigate the social costs of structural adjustment programs. Since then they have been proposed as a safety net for the poorest people; as a means of generating employment and transferring income; as an efficient mechanism for constructing small-scale infrastructure, especially in outlying, traditionally neglected areas; and as a way of building on (or generating) local social capital by involving communities in choosing, preparing, operating, and maintaining projects (Rawlings and others 2002).

This article analyzes the targeting and impact of investments by the Peruvian Social Fund (Fondo Nacional de Compensación y Desarrollo Social, or FONCODES) between 1992 and 1998. Specifically, we look at the investments FONCODES made in education, addressing two questions. First, who benefited

Christina Paxson is Professor of Economics and Public Affairs and Director, Center for Health and Wellbeing at Princeton University. Norbert R. Schady is Senior Economist, Latin America and the Caribbean Region at the World Bank. Their e-mail addresses are cpaxson@princeton.edu and nschady@worldbank.org, respectively. For helpful comments and suggestions, the authors thank François Bourguignon, Angus Deaton, Olivier Deschenes, Rutheanne Deutsch, Esther Duflo, John Gallup, Doug Miller, Martin Ravallion, Julie van Domelen, and Juliana Weissman; participants in a World Bank seminar and in the Northeast Universities Development Conference at Harvard University on October 8–9, 1999; and two anonymous referees. They are also grateful to staff at FONCODES and INFES and to Livia Benavides for providing data. An earlier version of the article was issued as World Bank Policy Research Working Paper 2229.

from FONCODES education investments? This is a question of targeting. FONCODES aims to transfer resources, including investments in education, to poor areas and poor households within those areas. The article evaluates the extent to which it was successful in doing so. Second, did FONCODES transfers improve education outcomes? This is a question about how investments in school facilities affected measures of school attendance.

Although the article describes and evaluates a specific program, it adds to an ongoing debate about the relationship between education inputs and outcomes (for a summary see Hanushek 1995 and the response by Kremer 1995). A growing body of literature suggests that expenditures on school facilities have high rates of return in many developing economies (for example, Duflo 2001, Glewwe and Jacoby 1994, Glewwe and others 1995, Hanushek 1995, Hanushek and Harbison 1992). The results here suggest that expenditures on school infrastructure in Peru improved the attendance rate of young children. Because expenditures by FONCODES on education were well targeted toward poor districts and (though less clearly) poor households, improvements in attendance rates were concentrated among the neediest.

I. The Setting

Peru made substantial economic progress between 1992 and 1998. After a brief recession following the adoption of stringent stabilization and adjustment measures in 1990, growth was generally strong, inflation low, and poverty reduction sustained (World Bank 1996, 1999). Investments in the social sectors increased dramatically. The Peruvian government attempted to target these social investments to the poor—though with only partial success (World Bank 1999).

FONCODES was created in 1991 with the stated objectives of generating employment, helping to alleviate poverty, and improving access to social services (World Bank 1998). Between 1992 and 1998 FONCODES funded almost 32,000 community-based projects for an aggregate outlay of about 760 million soles.[1] These community-based projects included initiatives in health, education, agriculture, community centers, rural electrification, and water and sanitation. Most of those in education entailed constructing and renovating classrooms (table 1). Before 1995, however, FONCODES also had education projects focusing on constructing and renovating sports facilities and providing textbooks and other educational materials to students. In addition, FONCODES executed a series of centrally designed special projects. Those in education included a school breakfast program and the distribution of uniforms for schoolchildren. Between 1992 and 1996 FONCODES spent about 160 million soles on all special projects, including those in education.

1. All reported expenditures are in 1992 soles, unless otherwise noted. The December 1992 exchange rate was 1.63 soles to the U.S. dollar.

TABLE 1. FONCODES Projects and Project Funding, 1992–98

	All projects		Projects to construct and renovate classrooms			Other education projects		
Year	Number of projects	Funding (m 1992 soles)	Number of projects	Funding (m 1992 soles)	Funding (percent total)	Number of projects	Funding (m 1992 soles)	Funding (percent total)
1992	2,813	102.7	1,185	26.2	25.0	386	6.9	6.7
1993	5,238	144.9	2,327	49.4	34.1	430	8.0	4.0
1994	4,551	110.4	2,380	48.7	44.1	100	1.3	1.2
1995	3,056	79.3	1,037	24.7	31.0	42	0.7	0.9
1996	4,222	83.4	987	15.0	18.0	14	0.3	0.4
1997	5,807	114.8	607	11.0	9.6	9	0.2	0.2
1998	6,088	123.8	636	12.0	9.7	1	0.0	0.0
Total	31,775	759.2	9,160	187.1	24.6	981	13.0	2.0

Note: Includes only expenditures on community-based projects.
Source: FONCODES.

FONCODES has much in common with other social funds in the region. Two features particularly important for this article are the demand-driven and targeted nature of its projects. FONCODES projects are demand-driven in that communities themselves choose a project and prepare a proposal for funding. FONCODES then functions as a financial intermediary: rather than execute projects itself, it approves proposals and releases funds to the *nucleo ejecutor*—a group of community members elected for that purpose.

To target its investments, FONCODES uses a poverty map to allocate resources (for details, see section on targeting). FONCODES staff members also conduct an informal on-site assessment of the poverty of a community requesting a project. Since 1993 the demand for FONCODES projects has far exceeded the program's budget. As a result FONCODES has had a backlog of project proposals and has had to ration its investments. Although decisions about which projects to fund within a district have often been ad hoc, an attempt is made to give preference to projects in communities that the FONCODES evaluators deem to be poorer. However, no attempt is made to target households within a community.

II. The Data

The evaluation of the targeting and impact of FONCODES expenditures on school infrastructure uses several sources of data. These include district-level information on the geographic distribution of FONCODES allocations and expenditures, kept by FONCODES, and on district characteristics from a 1993 Population and Housing Census. The analysis also uses household-level information from a household survey conducted by the Peruvian Statistical Institute (Instituto Nacional de Estadística e Informática, or INEI) in 1996 and from two Living Standards Measurement Study (LSMS) surveys, conducted in 1994 and 1997.

District-Level Data

Monthly records on the number of FONCODES projects and amounts spent in each district are available for 1992 through 1998. Expenditures do not include administrative and overhead costs and are available only for the community-based projects, not the special projects. Similar information is available for expenditures by a second school infrastructure program in Peru, Instituto Nacional de Infraestructura Educativa y de Salud (INFES), but only for 1995. Though both INFES and FONCODES are central government programs, an important difference is that INFES has (mainly) built or renovated secondary schools in urban areas, whereas FONCODES has (mainly) renovated primary schools in rural areas. INFES has also spent considerably more on school infrastructure than FONCODES: in 1995 it spent about 350 million soles on school infrastructure, whereas FONCODES spent 25 million soles.

An important district-level variable for the analysis is the FONCODES index, a district-level poverty measure. This index forms the basis of the poverty map that FONCODES has used to allocate resources. Specifically, since 1992 FONCODES

has allocated resources to each of its 24 regional offices in a two-step process. First, FONCODES makes a "referential allocation" to each district (before 1996, to each province) by weighting the population of that district by the FONCODES index.[2] The allocation to district *i* is given by:

$$\text{Allocation}_i = \frac{\text{Index}_i * \text{Population}_i}{\sum_{j=1}^{n}\left(\text{Index}_j * \text{Population}_j\right)} \quad (1)$$

Second, it sums these referential allocations over the districts covered by a FONCODES regional office. This determines the budget for each office. Regional offices are instructed to follow the original allocations across districts as closely as possible. Because these instructions require the regional offices to favor poorer districts in the allocation of funds, the FONCODES index provides a useful measure of the priority that projects in any given district should be given.

The FONCODES index is an ad hoc composite of different measures—including access to schooling, electricity, water, sanitation, and adequate housing and measures of illiteracy and chronic malnutrition. (All these are drawn from the Population and Housing Census conducted in 1993, except the rate of chronic malnutrition, which is based on a census of height and age among schoolchildren also conducted in 1993.) Composite indexes invariably involve some arbitrary weighting of indicators. FONCODES standardizes each indicator in its index by dividing it by the lowest value measured, multiplies the rate of chronic malnutrition by seven, and then adds all the indicators.[3] For ease of interpretation, FONCODES then standardizes the index by dividing all index values by the lowest value. The resulting index ranges from 1 to 36.38.

Another district-level measure, used in the analysis of targeting, is imputed per capita income, constructed by INEI. In Peru there are no survey-based estimates of income or expenditures at a level more disaggregated than the department: for example, household surveys conducted by INEI, which generally have samples of 15,000–20,000 households, can be used only to compare income across "natural regions" and departments.[4] INEI has attempted to get around this prob-

2. Provinces and districts correspond to the two levels of local government in Peru. In 1997 there were 194 provinces and 1,812 districts in Peru (Webb and Fernández Baca 1997, p. 112). The median population of a district is about 4,000, but the population size varies considerably: rural districts can have fewer than 500 people, whereas urban districts can have more than 100,000.

3. This procedure had the unintended consequence of giving the greatest weight to the indicators with the greatest variance. Thus although the intended weights were 50 percent for the rate of chronic malnutrition and 7.14 percent for each of the seven other measures, the actual weights in the index turned out to be 15.3 percent for chronic malnutrition, 3.4 percent for illiteracy, 2.2 percent for school attendance, 3.0 percent for overcrowding in homes, 38.3 percent for inadequate roofing on houses, 8.8 percent for access to water, 7.4 percent for access to sewerage, and 21.6 percent for access to electricity (World Bank 1996, p. 7).

4. These natural regions are Lima and the urban and rural areas of the coast, the sierra (highlands), and the selva (jungle).

lem by combining variables common to both the 1993 census and one such survey conducted in 1995 and imputing district-level measures of income and poverty (INEI 1996).[5] Although crude, the imputed income measure provides a useful measure of district-level welfare.

Schady (2002) shows that in Peru various district-level measures of welfare (including the INEI income measure and the FONCODES index) are highly correlated with one another and do not differ significantly in their ability to separate poor from nonpoor districts. To make the analysis of geographic targeting more easily comparable to the analysis of household targeting, which is based on household per capita income, this article uses this measure of district per capita income rather than the FONCODES index for the targeting results.

Household-Level Data

The main source of household information used is the 1996 INEI survey, a standard multipurpose survey. It has a relatively large sample—more than 18,000 households in 403 districts. The INEI survey collected information on household income, education levels, other household characteristics and benefits from various social programs. Households with at least one member attending public school were asked about recent improvements in school facilities and whether these had been carried out by (separately) FONCODES, INFES, or the local parents' committee (akin to the parent-teacher associations in the United States). These data are used to evaluate the household-level targeting of FONCODES investments in school facilities.

To test the robustness of the results of this evaluation, some of the results are reproduced using two LSMS surveys, conducted in 1994 and 1997. The LSMS surveys are both smaller than the INEI survey—covering about 3,500 households each, in 199 districts (1994) or 228 districts (1997). But they offer an advantage in that a very similar questionnaire was applied in both years. The LSMS data set includes a panel covering just over a quarter of the households in the two samples.

Because the INEI and LSMS surveys were not designed specifically for an evaluation of FONCODES, they have some shortcomings for the analysis. Three are worth noting. First, the surveys did not collect information on the quality of education as measured by, for example, scholastic achievement, pupil–teacher ratios, and the amount of time spent in school. Second, there appears to be a large amount of measurement error in the FONCODES "treatment" variable in the 1996 INEI survey, a point to which we return. Third, in the 1996 INEI sur-

5. Specifically, INEI estimated income in 1995 on the basis of the household survey and then regressed income in every department on its correlates—household composition, education levels, access to basic services (water, sewerage, electricity), ownership of durable goods (radio, TV, refrigerator), and other variables included in both the census and the survey. The coefficients from the 24 department-level regressions were then used to impute average income in every district and the fraction of the population in each district below an income-based poverty line. The methodology applied by INEI for these imputations is similar in spirit to that proposed in Hentschel and others (2000), although there are differences in how it was applied (Schady 2002).

vey, questions about benefits from FONCODES programs were asked only of families with children in school. The survey results therefore cannot be used to determine whether children not in school had access to a FONCODES-improved school.

III. The Targeting of FONCODES Investments in Education

Targeting education resources is important in Peru because there are large differences in measures of educational attainment across regions and income groups. At any given age, children in the poorest 25 percent of districts lag behind those in the richest 25 percent in years of schooling attained (figure 1). The differences across quartiles increase with age, so that by age 16 there is almost a 2-year difference between children in the poorest and richest districts.

A host of factors probably contribute to differences in the educational attainment of children, including differences in income, ethnicity, employment opportunities, and the education of other household members. Many of these factors cannot be changed through public policies in the short run. But educational attainment is also likely to be a function of the quantity and quality of teachers, learning materials, and classrooms in a community. Poor districts and poor households may therefore need additional resources, including resources spent on school facilities, to catch up with their better-off counterparts.

Geographic Targeting

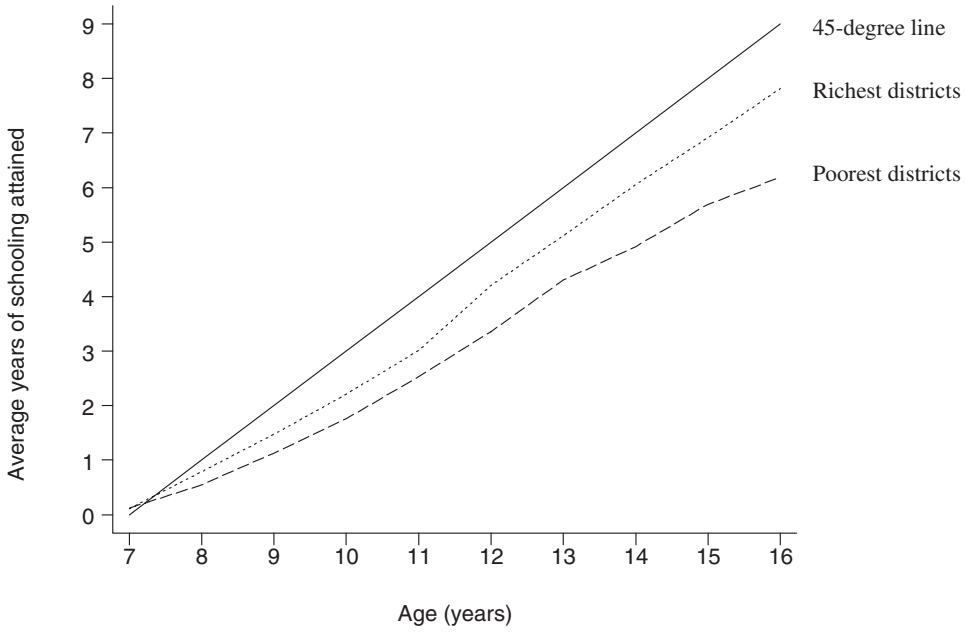
Has FONCODES effectively reached poor districts? Two aspects of the geographic targeting of FONCODES investments in school infrastructure are considered: changes in targeting over time, and district-level expenditures by FONCODES compared with those by INFES.

Regression results show that FONCODES expenditures on school infrastructure were targeted to poorer districts. A regression of per capita FONCODES expenditures on education, summed over 1992–98, on the log of district per capita income indicates that a 10 percent increase in district per capita income is roughly associated with a 1 sol decrease in per capita expenditures. (The regression coefficient on log income is –10.69, with a standard error of 0.52.)[6] Moreover, targeting appears to have improved over time. Nonparametric regressions of per capita FONCODES expenditures on school infrastructure on log per capita income in three typical years—1992, 1995, and 1998—show that districts with lower per capita income clearly received more FONCODES education expenditures, especially in 1995 and 1998 (figure 2).[7]

6. All regression results reported are weighted by district population. Alternatively, per capita expenditures could have been regressed on the (imputed) poverty rate for each district. Ravallion (2000) shows that if there is no targeting within districts, so that poor households within a district are equally likely to receive a transfer whether they live in relatively "rich" or "poor" communities, the coefficient on such a regression can be interpreted as the difference between spending on the poor and spending on the nonpoor.

7. All nonparametric regressions are Fan regressions with a quartic kernel (see Fan 1992).

FIGURE 1. Average Years of Schooling Attained, by Age, for Children in the Poorest and Richest 25 Percent of Districts in Peru, 1996



Source: Authors' calculation based on the 1996 INEI survey.

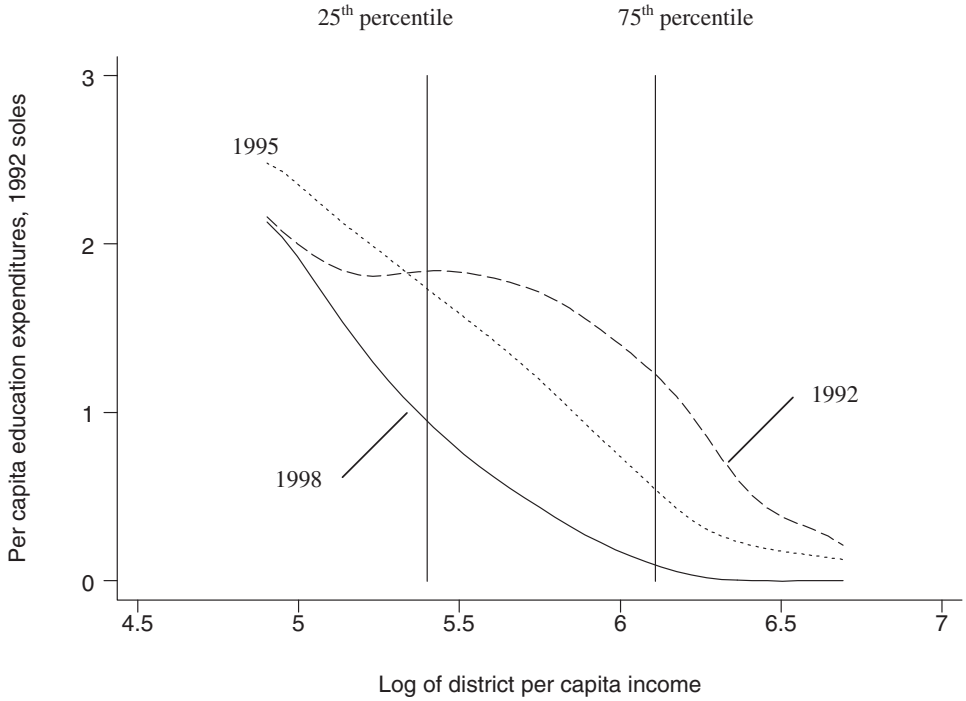
How well do FONCODES targeting outcomes stand up to those of a comparable program? In regressions of per capita expenditures by FONCODES and INFES in 1995 on the log of district per capita income, the coefficient on FONCODES expenditures is significantly negative (–1.60, with a standard error of 0.18), whereas the coefficient on INFES expenditures is positive though insignificant (1.30, with a standard error of 0.80). Nonparametric regressions show that per capita expenditures on education infrastructure by INFES in 1995 were much larger but much less well targeted. Per capita expenditures by FONCODES decreased monotonically with district per capita income, and those by INFES were concentrated in the middle of the distribution and were lowest for the districts with the lowest per capita income (figure 3).

Household-Level Targeting

In Peru there is considerable heterogeneity in the distribution of welfare within districts. For example, a simple decomposition of the variance in per capita income in the 1996 INEI survey into inter- and intradistrict components suggests that only 22 percent of the variance is explained by differences across districts. Reaching poor districts is therefore only a weak proxy for reaching poor households.

To examine household-level targeting, the household-level incidence of FONCODES benefits is calculated using information from the 1996 INEI survey

FIGURE 2. Geographic Targeting of FONCODES Education Projects, Various Years

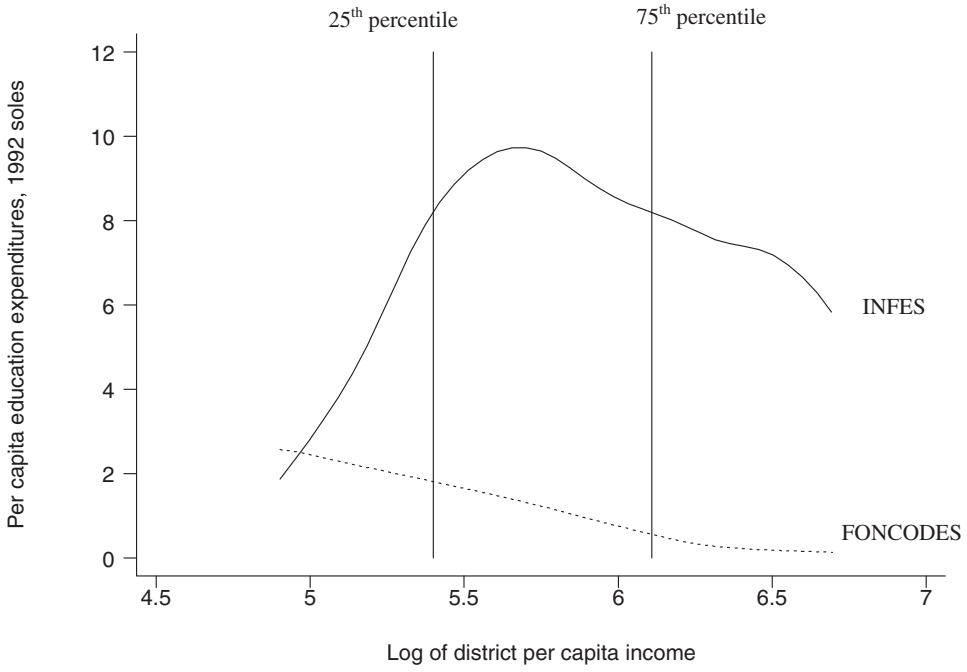


Note: The top and bottom 1 percent of the distribution of log per capita income have been trimmed.
Source: Authors' calculations based on FONCODES data.

on access to education infrastructure and per capita income. Three separate variables are defined that take the value of one for households that reported having benefited from spending by FONCODES, INFES, and the parents' committees. These variables are regressed on the log of household per capita income. The weighted logit regression results (with the weights given by the expansion factors in the survey) suggest that poorer households are more likely than better-off households to benefit from FONCODES investments: the estimated marginal effect of the log of household per capita income on the probability that the household benefits from FONCODES is –0.010 (with a standard error of 0.001). Although poorer households are also more likely than better-off households to benefit from parents' committees, the marginal effect of income on the probability of benefiting is –0.005 (standard error of 0.002), only half as large as the estimate for FONCODES. Poorer households are less likely than better-off household to benefit from INFES: the marginal effect of income is 0.009 (standard error of 0.001).

Nonparametric regressions are used to capture possible nonlinearities in the relationship between investments and log income. The results confirm that households with lower per capita income are more likely to benefit from FONCODES

FIGURE 3. Geographic Targeting of FONCODES and INFES Education Projects, 1995



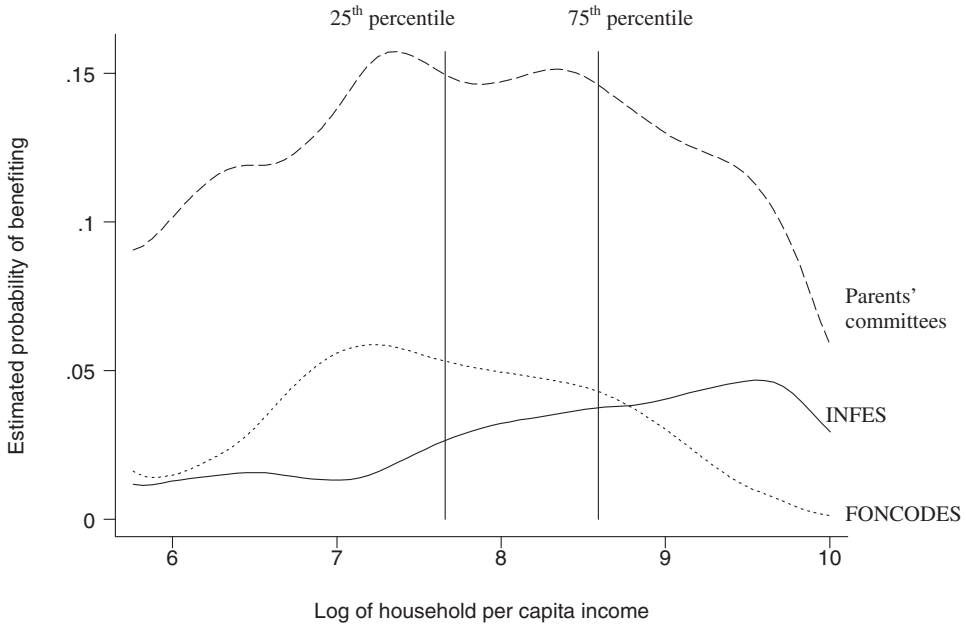
Note: The top and bottom 1 percent of the distribution of log per capita income have been trimmed.
Source: Authors' calculations based on data from INFES and FONCODES.

spending than from INFES spending (figure 4). To some extent this no doubt reflects INFES's emphasis on secondary school infrastructure in urban areas and FONCODES's emphasis on primary school infrastructure in rural areas: in Peru, as in many other countries, the poor are less likely to send their children to secondary school and more likely to live in rural areas.[8] The nonparametric regressions also show that the FONCODES distribution slopes upward at very low levels of (log) per capita income: the poorest 7 percent of households are less likely than their (slightly) better-off counterparts to benefit from FONCODES investments in education infrastructure.

Measurement error is an important concern for the estimates of household targeting. Rural households in Peru are likely to have little choice of primary school. In the absence of measurement error, one would therefore expect a high

8. This also helps explain why the fraction of households that reported having benefited from INFES (2.6 percent) is smaller than the corresponding fraction for FONCODES (3.6 percent), despite the massive differences in the programs' budgets. In Peru projects to repair primary schools have tended to be small and relatively inexpensive (with low-cost materials and community participation in construction), whereas projects to construct or repair secondary schools are more expensive because they are larger and more elaborate (with higher-end materials and payment of all labor costs for a contractor).

FIGURE 4. Household-Level Targeting of School Infrastructure Expenditures by FONCODES, INFES, and the Parents' Committees, 1996



Note: The top and bottom 1 percent of the distribution of log per capita income have been trimmed.
Source: Authors' calculations based on the INEI survey.

degree of consistency in the answers given by households within a rural community to questions about the presence of FONCODES-funded education projects. Unfortunately, this is not always the case. Consider households in rural areas that have only children attending primary school. In 4 rural communities in the sample all such households reported that FONCODES had financed improvements to the local school, and in another 107 all such households reported that FONCODES had not financed improvements. But in 46 rural communities different households provided different responses, suggesting that households in the 1996 INEI survey did not always report program benefits accurately. Measurement error of this sort will bias the estimates of program incidence if it is correlated with income so that richer (or poorer) households are more (or less) likely to report that they benefited from FONCODES.

To further explore issues related to measurement error, the analysis tests whether households that did not respond to questions about infrastructure improvements in the 1996 INEI survey differed systematically from responding households. The INEI survey first asked households whether any member attended a public school and, for those answering affirmatively, whether they had "knowledge of any improvement to this public school in the last 12 months." Next, the survey asked about the kind of improvement undertaken and finally about the

agency that financed it. About 15 percent of households with a child in public school did not recall whether there had been a recent improvement, and about 10 percent with knowledge of school improvements did not know who financed them.

The analysis finds that nonresponding households differed in some ways from responders, but the differences tended to be small. For example, the mean education of the household head was 7.1 years for households knowing of school improvements and knowing who financed them, 7.1 for households knowing of school improvements but not knowing who financed them, and 6.57 for households not knowing whether there had been any school improvements. For these same groups of households, the log of household per capita income was 8.04, 7.94, and 8.04.[9] Although these differences are sometimes significant, they are small and do not invalidate the analytical approach used.

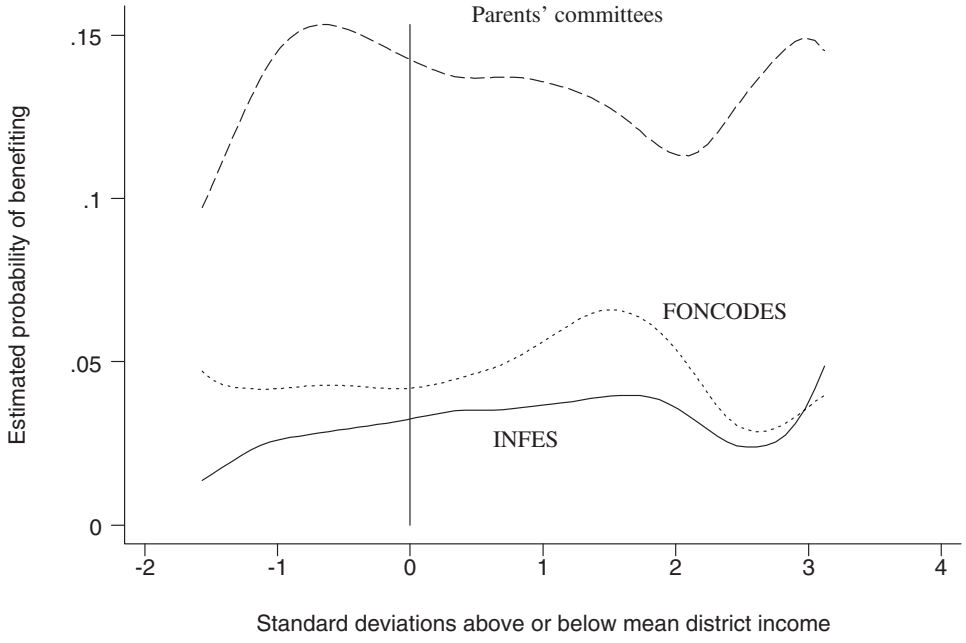
FONCODES has placed a great deal of importance on geographic targeting and less on other forms of targeting, such as means testing (World Bank 1996). A comparison of figures 2 and 4 suggests that it has done better reaching the poorest districts than it has reaching the poorest households. To explore this issue further, the estimated probability of benefiting from school investments by INFES, the parents' committees, and FONCODES is graphed on the number of standard deviations that the income of household *i* in district *j* is above or below the mean income in district *j* when both household and district incomes are calculated using the 1996 INEI survey. (Both the mean and the standard deviations are district-specific.) The nonparametric regression line for FONCODES school infrastructure is humped, peaking at about 1.5 standard deviations above mean district income (figure 5). Within a given district households that are somewhat better off than their counterparts are more likely to benefit from FONCODES investments in school infrastructure. This suggests that there was essentially no (positive) intradistrict targeting of FONCODES resources in 1996.

This finding adds to a debate about the relative importance of central and community-level targeting and about the level at which targeting decisions should be made (for example, Alderman 1998 and Galasso and Ravallion 2000). FONCODES is a central government program that has chosen how to allocate resources across districts from the center. Largely, decisions about which community projects to finance have been left to employees in FONCODES's regional offices—a much more aggregate level than the provinces and districts that form the basis of the poverty map. This targeting scheme has been effective at reaching poor districts but not at reaching the worst-off households within those districts.

Without more information—such as a comparison with a similar small-scale infrastructure program using community-based targeting within districts—it is hard to know whether FONCODES's within-district targeting performance is better or worse than the alternatives. The analysis does suggest, however, that there

9. The authors thank an anonymous referee for this suggestion to analyze differences in the characteristics of responding and nonresponding households.

FIGURE 5. Probability of Benefiting from School Infrastructure Expenditures by Number of Standard Deviations of Household Income Above or Below Mean District Income



Note: The top and bottom 1 percent of the distribution of log per capita income have been trimmed.
Source: Authors' calculations based on the INEI survey.

are limits to the extent to which central government programs can reach poor households without such targeting mechanisms as indicator targeting or self-targeting through the provision of inferior infrastructure.

IV. The Impact of FONCODES Investments in Education

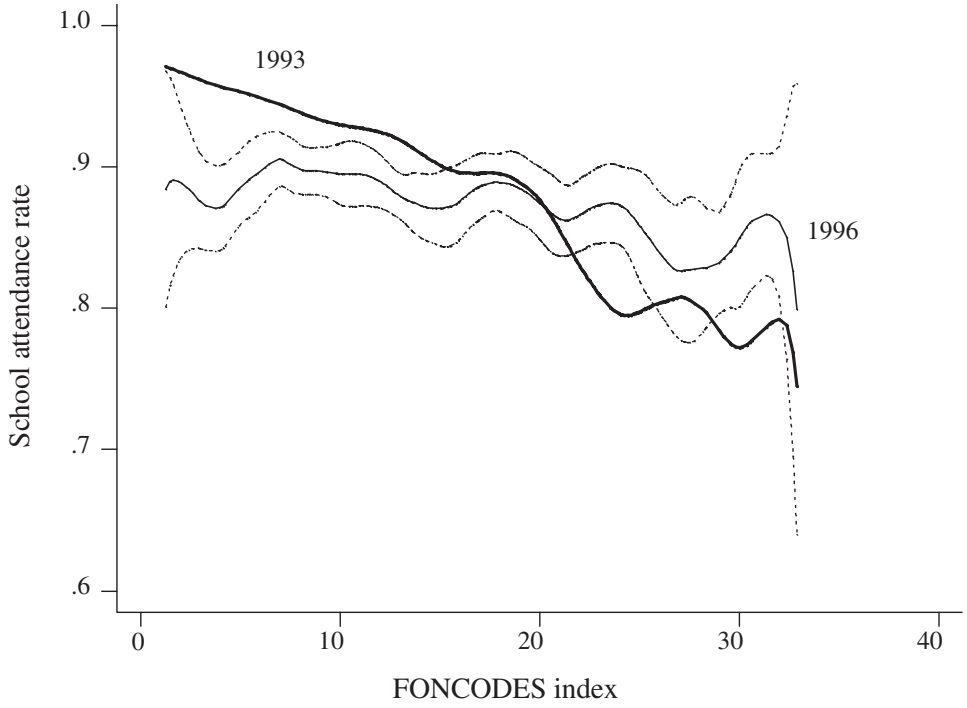
Although it is too early to assess the long-term impact of FONCODES education investments, the program has been in existence long enough to have had short-run effects, such as increasing school attendance rates. In this section district-level data are used to examine the relationship between school attendance rates and FONCODES spending on school infrastructure. Using school attendance data from the 1993 census and the 1996 INEI survey, the analysis shows that there is a positive association between FONCODES education funding and gains in primary education: districts that received the largest per capita allocations of FONCODES funds for education experienced the largest increases in school attendance for children ages 6–11.

The analysis begins by looking at the associations between district-level school attendance rates for children ages 6–11 and the FONCODES index. As noted ear-

lier, the FONCODES index is higher for poorer districts, which were given priority in FONCODES funding decisions. To avoid a mechanical relationship between the FONCODES index and school attendance, the analysis modifies the index to exclude one of its usual elements—the fraction of children ages 6–11 who are not attending school. This is done by replacing the district value of the fraction of children ages 6–11 who are not attending school with the countrywide average. Otherwise the index is identical to that used by FONCODES.

Nonparametric (Fan) regressions of attendance rates in 1993 (based on the census data) and 1996 (based on the INEI survey data) on the modified FONCODES index, using observations on 349 districts, indicate that the relationship between attendance rates and the FONCODES index changed during the period (figure 6). As might be expected, there is an obvious negative relationship between school

FIGURE 6. Nonparametric Regressions of District School Attendance Rate on (Modified) FONCODES Index



Note: Figure is based on regressions that use a bandwidth of three and are weighted by the population of children in the district so that less-populated districts get less weight. The confidence intervals for the 1996 results (shown as dotted lines) were computed using a bootstrap procedure: drawing random samples (with replacement) from the original INEI sample (with the probability of being drawn proportional to the sampling weight), estimating the nonparametric regressions 50 times using the micro-level data, and computing the standard deviation of the estimate at each value of the FONCODES index on the x-axis. The confidence lines show the point estimate at each value of the FONCODES index plus and minus two standard deviations.

Source: Authors' calculations based on 1993 census data and 1996 INEI household survey data.

attendance and the FONCODES index in 1993, so that poorer districts—with higher index values—have lower attendance rates. But this negative relationship is much less pronounced by 1996. In other words, worse-off districts had large gains in school attendance, but better-off districts did not.

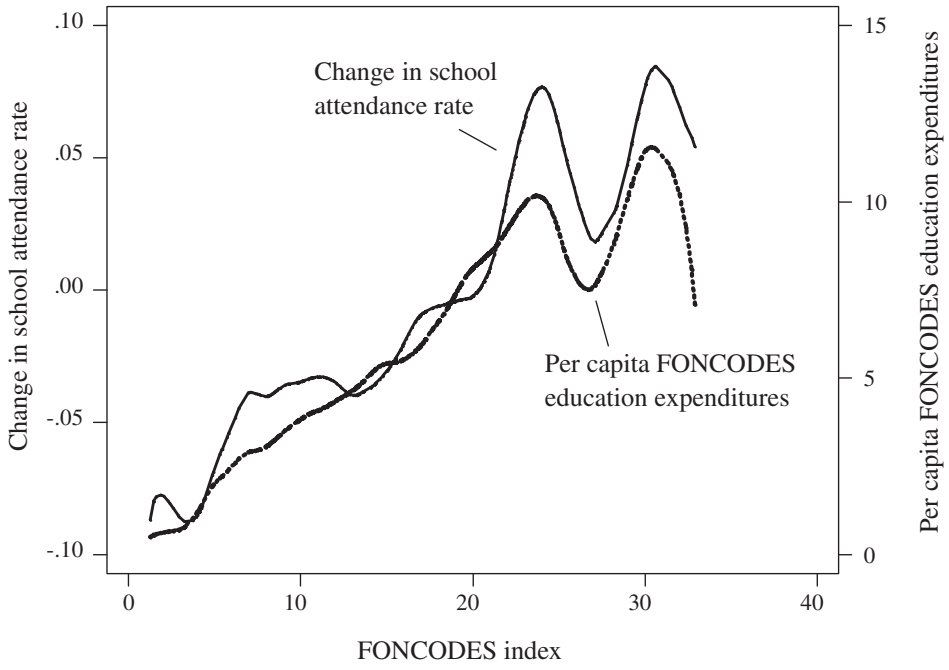
One puzzling feature of figure 6 is that attendance rates appear to have declined for children in well-off districts between 1993 and 1996. But this decline may at least in part reflect the timing of the surveys, coupled with the fact that both surveys explicitly asked about school attendance rather than school enrollment. In Peru the school year runs from April to December. The 1993 census data were collected in June, relatively early in the school year, whereas the 1996 INEI survey data were collected in November. Attrition in attendance over the school year could account for the lower mean attendance rates in 1996.

The LSMS surveys provide some evidence that attrition does affect measures of district-level school attendance rates. The 1994 LSMS survey, conducted between June and August, shows a drop in attendance rates of primary-school-age children of two percentage points (from 96.6 percent to 94.6 percent) between June and July, after which attendance rates appeared to stabilize. The 1997 LSMS survey, conducted between September and November, shows no systematic decline in attendance. The decline from June to July 1994 was concentrated among children in poorer districts with a higher FONCODES index value. For example, for children in districts with a FONCODES index greater than 14 (roughly the median), the attendance rate declined from 96 percent to 92 percent between June and July. Because the 1993 census was conducted in June, part of the high attendance rate in 1993 (shown in figure 6) may reflect the higher attendance early in the school year. Moreover, because attrition after June is more likely for poorer children, the results may understate the gains made by children in poor districts relative to those in rich districts between 1993 and 1996.[10]

Were the districts that experienced the largest gains in school attendance also those that received the most FONCODES funding for school infrastructure? Figure 7 graphs both the change in the school attendance rate and the total per capita FONCODES expenditures on school infrastructure in 1992–95 as a function of the FONCODES index. (FONCODES expenditures are summed over 1992–95 rather than 1993–96 because it is assumed that expenditures on school infrastructure cannot affect attendance until the year after they are made.) This figure shows that poorer districts that experienced greater gains in school attendance also received more funding for school improvements. The degree of comovement between attendance gains and school funding is striking. A regression of the predicted value of the attendance gain on the predicted value of school expenditure

10. To double-check the results, the analysis of figure 6 was repeated using the 1994 and 1997 LSMS surveys, including and excluding observations from June. Although the results based on the LSMS surveys are somewhat noisier, because there are fewer districts, they are similar to those based on the census and the INEI survey. Excluding observations from June has almost no effect on the relationship between the gain in attendance and the FONCODES index.

FIGURE 7. Nonparametric Regressions of Change in District School Attendance Rate and Per Capita FONCODES Education Expenditures in 1992–95 on (Modified) FONCODES Index



Source: Authors' calculations based on 1993 census data, the 1996 INEI household survey data, and FONCODES data.

yields a coefficient of 0.0151, which implies that a one-standard-deviation (9.6) increase in per capita FONCODES spending on school infrastructure is associated with a gain in the attendance rate of 14.5 percentage points.

Another interesting feature of figure 7 is that the relationships it shows are nonlinear and nonmonotonic. Districts with FONCODES index values between 22 and 26 had greater attendance gains and higher school infrastructure spending than did poorer districts with index values between 26 and 28. Both measures increased again for even poorer districts with index values greater than 28. These nonlinear patterns are not the result of few observations at very high values of the FONCODES index. About 15 percent of districts (accounting for 14 percent of children) had FONCODES index values between 22 and 26, 6.3 percent of districts (4.7 percent of children) had index values between 26 and 28, and 9.6 percent of districts (8.4 percent of children) had index values greater than 28. Furthermore, these nonlinearities remain even when a wide range of bandwidths is used for the nonparametric regressions. Although these nonlinearities are striking, it is not clear what drives them. The districts with index values between 26 and 28 were allocated more FONCODES funds than the wealthier

districts with slightly lower index values but apparently did not apply or receive approval for greater funding for school infrastructure projects.

Figures 6 and 7 show that there is a positive association between gains in school attendance and FONCODES spending on school infrastructure. A key question is whether these gains in school attendance were caused by FONCODES spending. Two features of the program make causality difficult to ascertain. First, FONCODES is demand-driven, with community groups supplying proposals for specific projects. The unobserved characteristics that prompt community groups to apply for funds may be correlated with the outcomes of interest. For example, a poor district in which people begin to care more about education may have larger increases in school attendance rates and generate more proposals for FONCODES school funding than an equally poor district in which preferences for education do not change. In this example the positive association between gains in school attendance and FONCODES education spending is driven by a third, unobserved factor—changes in district-level preferences about education—and there may be no causal relationship between FONCODES spending and gains in attendance.

Second, FONCODES funding was targeted to poorer districts. There was no explicit randomization of FONCODES funds across districts, and no obvious natural experiment that resulted in different funding levels across similar districts. It is therefore difficult to assess whether the gains in attendance in the poorer districts that received greater FONCODES funding were driven by FONCODES or by unobserved factors correlated with district-level poverty. For example, it is possible that returns to education increased more in poorer districts than in wealthier districts over this period, prompting more parents in poorer districts to send their children to school.

The analysis turns to instrumental variables techniques to deal with these two problems. The first problem—that changes in district-level tastes for education may be correlated with applications for FONCODES funds for school infrastructure—is the more easily handled. The district-level gain in school attendance is regressed on FONCODES spending on school infrastructure, with the infrastructure spending instrumented with the FONCODES index and with a set of variables reflecting the political preferences of the district population, as measured by the fraction voting for Alberto Fujimori in the 1990 and 1993 national elections. Because the FONCODES index was used by regional offices to prioritize allocations, it should be correlated with district-level spending on school infrastructure. Moreover, because the FONCODES index is based on measures of a district's unmet needs in 1993, it is plausibly uncorrelated with unobserved changes in tastes for education between 1993 and 1996. The use of the political variables as instruments is motivated by previous research indicating that districts that moved against Fujimori between 1990 and 1993 were subsequently treated more generously by FONCODES, presumably in an attempt to regain votes (Schady 2000). Under the assumption that the political preferences of districts were not correlated with changes in preferences for education, the political measures are valid instruments.

The second problem—that district-level poverty may be correlated with unobserved factors that affect attendance rates—is more difficult to handle convincingly. The fact that FONCODES spending was targeted to poorer districts—combined with the possibility that there could have been other, unobserved reasons that poorer districts experienced larger attendance gains—suggests that the FONCODES index may not be an appropriate instrument for FONCODES spending on schools. Results are presented in which the FONCODES index is included as an explanatory variable in the second-stage regressions. This specification allows initial district-level poverty to have an independent effect on the subsequent gain in school attendance and relies solely on the political variables as instruments. For this strategy to be valid, the political variables must not have affected other resource flows to districts that had an effect on school attendance. Although no conclusive evidence is available on this point, the analysis examines whether school infrastructure spending by INFES in 1995 is related to the political measures and to attendance gains. These results are discussed.

Table 2 shows ordinary least squares and instrumental variables estimates of regressions of the district-level gain in school attendance on FONCODES spending on school infrastructure. Because the school attendance rate is bounded between 0 and 1, the gain in attendance between 1993 and 1996 is measured as the (approximate) change in the log odds that a child ages 6–11 attends school. Specifically, the gain in school attendance is measured as

$$Gain = \ln\left(\frac{p96}{1-p96}\right) - \ln\left(\frac{p93}{1-p93}\right) \approx \frac{p96 - p93}{p93(1-p93)} \tag{2}$$

where $p96$ and $p93$ are the fractions of children ages 6–11 who attended school in the district in each year. Because the measure of $p96$ is derived from the INEI survey rather than the census, there are some districts in which the observed fraction of 6–11-year-olds attending school equals 1. It is for this reason that the analysis uses the approximation of the change in the log odds, which does not require division by $1 - p96$.[11]

In panel A of table 2 the assumption is maintained that the FONCODES index affects gains in attendance only through its effect on FONCODES spending. (This assumption is loosened in panel B.) The first column in panel A shows the ordinary least squares estimate from a regression of the gain in attendance on per capita spending on school infrastructure. The point estimate indicates that a 1-sol increase in per capita FONCODES spending on school infrastructure increases the log odds that a child attends school by 0.059. This corresponds to a gain in the attendance rate of about 0.75 percentage point for districts with an initial attendance rate of 85 percent (about 25 percent of children were in districts with at-

11. All regressions shown were also estimated using $p96 - p93$ as the dependent variable. These estimates are qualitatively similar to those using the log odds specification, although they are sometimes slightly less precise.

TABLE 2. Effects of FONCODES Expenditures on District-Level Gain in School Attendance

Variable	(i) OLS	(ii) IV	(iii) OLS	(iv) IV
A				
Per capita FONCODES school infrastructure expenditures	0.059	0.195	0.056	0.152
	(0.011)	(0.027)	(0.010)	(0.033)
Per capita FONCODES "other" expenditures			0.014	0.032
			(0.004)	(0.016)
χ^2 test of overidentifying restrictions (degrees of freedom in parentheses, *p*-values in brackets)		7.62 (6) [0.267]		4.16 (5) [0.526]
B				
Per capita FONCODES school infrastructure expenditures	0.022	0.109	0.023	0.145
	(0.011)	(0.069)	(0.011)	(0.080)
Per capita FONCODES "other" expenditures			0.008	0.031
			(0.004)	(0.019)
FONCODES index	0.068	0.035	0.062	0.004
	(0.009)	(0.027)	(0.009)	(0.036)
χ^2 test of overidentifying restrictions (degrees of freedom in parentheses, *p*-values in brackets)		3.69 (5) [0.595]		3.48 (4) [0.480]

Note: Columns (i) and (iii) are based on ordinary least squares regressions, and columns (ii) and (iv) on instrumental variables regressions. Standard errors in parentheses. The dependent variable is the approximate gain in the log odds that a child ages 6–11 attends school, as given by $Gain = (p96 - p93) / (p93\,[1 - p93])$, where $p93$ and $p96$ measure the fractions of children attending school in 1993 and 1996. Each regression is estimated using data from the 349 districts for which the political measures and 1996 school attendance measures were available. The instruments for the instrumental variables regressions in panel A include the FONCODES poverty index, the fraction of pro-Fujimori votes in the province in 1990 and in the district in 1993, and interactions of the two vote measures with the FONCODES poverty index. The instruments in panel B include the vote measures and interactions with the FONCODES index but not the FONCODES index itself (which is included as an explanatory variable in the second-stage regressions). All regressions are weighted by the number of children in the district in 1993.

Source: Authors' calculations.

tendance rates equal to or less than 85 percent in 1993). This effect is large, given that median per capita spending on school infrastructure was 6.06 soles.

The second column shows the instrumental variables estimate of the effect of school infrastructure spending on the attendance gain. The instruments in the first-stage regressions include the FONCODES index, the fraction of the vote received by Fujimori in the province in 1990 and the district in 1993 (in logs), and interactions of the two vote variables with the FONCODES index. (District-level voting data are not available for 1990.) The first-stage regressions indicate that districts with a smaller share of pro-Fujimori votes in 1993, holding the province-level vote in 1990 fixed, received more FONCODES funding between 1993 and 1996. The positive association between the erosion in the pro-Fujimori vote and FONCODES expenditures is stronger for wealthier districts. The instruments in the first-stage regressions are jointly significant ($F[7,341] = 15.12$, $p = 0.0000$),

and the test for the validity of overidentifying restrictions is easily passed. The instrumental variables estimate of the effect of school infrastructure spending on the gain in school attendance is 0.195 and is significantly different from zero. This point estimate implies that a 1-sol increase in per capita FONCODES spending on school infrastructure would result in an increase in the attendance rate from 85 percent to 87.5 percent.

In addition to spending on school infrastructure, FONCODES also funded noneducation spending, and results in the third and fourth columns of panel A examine whether other spending affected school attendance. It is possible that "other" spending could have had a positive effect on school attendance: although most of this spending went to noneducation infrastructure, a small portion went to school supplies and other education inputs. Moreover, the income gains associated with general FONCODES spending could have increased attendance. But other spending is unlikely to have had as large an effect on school attendance as school infrastructure spending. Consistent with expectations, the ordinary least squares results indicate that although other spending was associated with gains in school attendance, the effect was a quarter of the size of the effect of school infrastructure spending. The instrumental variables estimates also indicate that the effect of other expenditure was substantially smaller.

Thus the results in panel A show that FONCODES spending on school infrastructure had a substantial impact on school attendance for children ages 6–11 and a much larger effect than other FONCODES spending. But the instrumental variables estimates do not account for the potential problem of unobserved factors that may have resulted in increased attendance in the poorer districts that received more FONCODES funds. This line of reasoning suggests that the FONCODES index should be made an explanatory variable in the second-stage regressions, and this is done for the results in panel B. Removing the FONCODES index from the list of instruments and including it in the second stage comes at a cost: the political variables that remain in the list of instruments, although related to FONCODES expenditures, are fairly weak instruments, especially for school infrastructure expenditure. The *F*-statistic for the political variables is $F(4,343) = 2.60$ ($p = 0.036$) in the school infrastructure equation and $F(4,343) = 5.53$ ($p = 0.0003$) in the other expenditure equation. The instrumental variables results in panel B should therefore be treated with caution.

The results provide some evidence that, even controlling for poverty in 1993 (as measured by the FONCODES index), districts that had higher school infrastructure spending had greater gains in school attendance. The effects of FONCODES school infrastructure spending are generally smaller and less precisely estimated than those in panel A. For example, the ordinary least squares estimate of the effect of infrastructure spending is cut in half when the FONCODES index is included. But the instrumental variables estimates in the last column of panel B (which includes both infrastructure and other spending) indicate that the effect of school infrastructure spending is nearly equal to that in the corresponding

column of panel A, though with a much larger standard error. In this specification neither the FONCODES index nor other spending is significant.

The instrumental variables results in panel B are identified through the effects of the political variables on FONCODES spending. It is possible that voting patterns across districts affected flows of other resources—for example, education expenditure by INFES. Unfortunately, no data are available on how INFES spending changed over time, so it is impossible to assess whether districts that moved away from Fujimori between 1990 and 1993 received increases in INFES spending. Data are available on district-level INFES spending in 1995, however, and the models shown in table 2 were reestimated with a measure of per capita INFES spending in that year. In no case was the coefficient on INFES spending significant, and it had minimal effect on the size and significance levels of the other parameter estimates. The instrumental variables models were also reestimated with INFES spending as an additional (although exogenous) regressor, with similar results. INFES expenditure could not be instrumented, because the sets of instruments used in table 2 were not significantly related to INFES spending.

V. Conclusion

This article analyzes the targeting and impact of FONCODES projects in the education sector. Nonparametric regressions are used to evaluate the geographic and household incidence of FONCODES investments. The findings show that FONCODES reached poor districts and, to the extent that they lived in those districts, poor households. The targeting of FONCODES projects in education compares favorably with the targeting of a comparable public-sector program. Geographic variation in expenditures and school outcomes is used to analyze the impact of FONCODES spending on school attendance rates. The results show that districts with the highest levels of FONCODES spending on school infrastructure between 1992 and 1995 had the biggest improvements in attendance between 1993 and 1996.

The results in the article are consistent with a causal relationship between spending on school facilities and improvements in attendance, especially of poor children. An earlier version of the article reached similar conclusions through analyses that used household-level data from the 1994 and 1997 LSMS surveys.[12] The results thus add to a growing literature that finds evidence of a positive association between school-based inputs and measures of educational attainment (for example, Angrist and Lavy 1999, Case and Deaton 1999, Glewwe and Jacoby 1994, Krueger 1999). Nonetheless, the analysis in this article was constrained by important limitations in the data. Three areas deserve attention.

First, the usefulness of the instrumental variables results hinges on the validity of the identifying assumptions—in this case that the political variables and

12. These results are available from the authors on request.

(in panel A of table 2) the FONCODES index are determinants of FONCODES spending in a district but are uncorrelated with unobserved factors that affected school attendance. Although these assumptions are plausible, an evaluation based on a randomized treatment and control strategy would have been preferable. Because applications for FONCODES funds have exceeded the amounts available, an opportunity exists for randomization in the allocation of funds (across equally poor districts). The successful use of randomization in the Bolivian Social Fund and in Programa de Educación, Salud y Alimentación (PROGRESA) in Mexico highlights the benefits of randomization for program evaluation. (On the Bolivian Social Fund see Newman and others 2002; on PROGRESA see Behrman and Todd 1999, Schultz 2001.)

Second, as a result of the absence of credible village-level measures of FONCODES funding, all the estimates of the impact of education projects are based on district-level measures of FONCODES expenditures. Further disaggregation could be important, especially in urban districts, which can be very large. Moreover, village-level measures of "treatment" would make it possible to use statistical matching as an estimation strategy.

Third, lack of disaggregated information on such measures as scholastic achievement, pupil–teacher ratios, and the time children spend in school precluded analysis of the impact of FONCODES education projects on school quality. Collecting such data and understanding the mechanisms whereby improvements in school infrastructure in Peru interact with other school-level changes to result in more learning should be priorities in future research.

References

Alderman, Harold. 1998. "Social Assistance in Albania: Decentralization and Targeted Transfers." LSMS Working Paper 134. World Bank, Washington, D.C.

Angrist, Joshua, and Victor Lavy. 1999. "Using Maimonides' Rule to Estimate the Effect of Class Size on Scholastic Achievement." *Quarterly Journal of Economics* 114(2):533–75.

Behrman, Jere, and Petra E. Todd. 1999. "Randomness in the Experimental Samples of PROGRESA." International Food Policy Research Institute, Washington, D.C.

Case, Anne, and Angus Deaton. 1999. "School Inputs and Educational Outcomes in South Africa." *Quarterly Journal of Economics* 114(3):1047–84.

Duflo, Esther. 2001. "Schooling and Labor Market Consequences of School Construction in Indonesia: Evidence from an Unusual Policy Experiment." *American Economic Review* 91(4):795–813.

Fan, Jianqing. 1992. "Design-Adaptive Nonparametric Regression." *Journal of the American Statistical Association* 87(420):998–1004.

Galasso, Emanuela, and Martin Ravallion. 2000. "Decentralized Targeting of an Anti-Poverty Program." Policy Research Working Paper 2316. World Bank, Development Research Group, Washington, D.C.

Glewwe, Paul, and Hanan Jacoby. 1994. "Student Achievement and Schooling Choice in Low-Income Countries." *Journal of Human Resources* 29(3):843–64.

Glewwe, Paul, Margaret Grosh, Hanan Jacoby, and Marlaine Lockheed. 1995. "An Eclectic Approach to Estimating the Determinants of Achievement in Jamaican Primary Education." *World Bank Economic Review* 9(2):231–58.

Hanushek, Eric A. 1995. "Interpreting Recent Research on Schooling in Developing Countries." *World Bank Research Observer* 10(2):227–46.

Hanushek, Eric A., and Ralph Harbison. 1992. *Educational Performance of the Poor: Lessons from Rural Northeast Brazil.* New York: Oxford University Press.

Hentschel, Jesko, Jean Olson Lanjouw, Peter Lanjouw, and Javier Poggi. 2000. "Combining Census and Survey Data to Trace the Spatial Dimensions of Poverty: A Case Study of Ecuador." *World Bank Economic Review* 14(1):147–65.

INEI (Instituto Nacional de Estadística e Informática). 1996. *Metodología para determinar el ingreso y la proporción de hogares pobres.* Lima.

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

Krueger, Alan B. 1999. ""Experimental Estimates of Education Production Functions." *Quarterly Journal of Economics* 114(2):497–532.

Newman, John, Menno Pradhan, Laura B. Rawlings, Geert Ridder, Ramiro Coa, and Jose Luis Evia. 2002. "An Impact Evaluation of Education, Health, and Water Supply Investments by the Bolivian Social Investment Fund." *World Bank Economic Review* 16(2):241–274.

Ravallion, Martin. 2000. "Monitoring Targeting Performance When Decentralized Allocations to the Poor Are Unobserved." *World Bank Economic Review* 14(2):331–45.

Rawlings, Laura B., Lynne Sherburne-Benz, and Julie van Domelen. 2002. "Letting Communities Take the Lead: A Cross-Country Evaluation of Social Fund Performance." World Bank, Social Protection Network, Washington, D.C.

Schady, Norbert R. 2000. "The Political Economy of Expenditures by the Peruvian Social Fund (FONCODES), 1991–1995." *American Political Science Review* 94(2):289–304.

———. 2002. "Picking the Poor: Indicators for Geographic Targeting in Peru." *Review of Income and Wealth* 48(3):417–33.

Schultz, T. Paul. 2001. "School Subsidies for the Poor: Evaluating the Mexican PROGRESA Poverty Program." Economic Growth Center Discussion Paper No. 834. Yale University, New Haven, Conn.

Webb, Richard, and Gabriela Fernández Baca. 1997. *Perú 1997 en números: anuario estadístico.* Lima: Cuánto.

World Bank. 1996. "Did the Ministry of the Presidency Reach the Poor in 1995?" Country Operations Division I, Country Department III, Latin America and the Caribbean Region, Washington, D.C.

———. 1998. "Implementation Completion Report: Peru, Social Development and Compensation Fund Project (FONCODES)." Country Management Unit for Bolivia, Ecuador and Peru, Human Development Sector Management Unit, Latin America and the Caribbean Region, Washington, D.C.

———. 1999. *Poverty and Social Developments in Peru, 1994–1997.* World Bank Country Study. Washington, D.C.