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Targeting and Calibrating Educational Grants for Greater Efficiency

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Using grants programs to induce poor parents to send their children to school has received considerable attention as an instrument to break the inheritance of poverty. Yet, the cost of these programs tends to be quite high so that increasing their efficiency is an important issue that needs to be researched. We use the educational component of Progresa in Mexico to explore alternative targeting and calibrating schemes to achieve this purpose. We show that targeting on risk of non-enrollment instead of targeting on poverty, as currently done, would be implementable and create huge efficiency gains. To start with, this would concentrate grants on secondary school since attendance to primary school is virtually universal, saving 55% of the educational budget. Targeting the population most likely to drop out of school upon completing primary and allowing for variable transfers across beneficiaries would result in a 72% efficiency gain for that cohort over targeting on poverty and making uniform transfers by gender, reducing leakage cost from 85% to 53% of the budget. Even restricting transfers to be uniform across beneficiaries but set at the optimal level would achieve a 65% efficiency gain. However, to make the scheme easy to implement, only observable, transparent, and non-manipulable indicators of risk should be used and discrete levels of transfers offered. This would still result in a 53% efficiency gain over the current scheme.

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I. Introduction

Investing massively in the education of the children of the rural poor, as a way of making a significant dent in world poverty, has recently received considerable attention. The success story that has inspired a number of countries and international development agencies to pursue this approach is Progresa (the Program for Education, Health, and Nutrition) in Mexico. The program is, however, highly expensive. As coverage of the program is being extended in Mexico, and the approach replicated in other countries, it is consequently important to ask whether improved targeting and improved calibration of transfers could not significantly increase the efficiency of such programs. The question is particularly relevant at a time when foreign aid budgets are being modestly increased (UN Monterrey Conference on Financing for Development) and the efficiency of foreign aid programs is increasingly being questioned (Washington Post, 2002).

Most educational assistance programs are explicitly targeted on poor households. The main reasons invoked in doing this are that public resources should not be spent on households that can afford sending their children to school and that poverty is an important determinant of school enrollment (Filmer and Pritchett, 1999 and 2001; see a review of studies in Behrman and Knowles, 1999). The main issue then becomes how to most efficiently identify poor households. There is a large literature on alternative approaches to poverty targeting (Glewwe, 1992; Besley and Kanbur, 1993; Baker and Grosh, 1994; Wodon, 1997; Van de Walle, 1998; Ravallion and Wodon, 1999; Alderman, 2001; Skoufias and Coady, 2002). These approaches generally start with geographical targeting on poor areas (poor villages in rural programs such as Progresa in Mexico and PRAF in Honduras; poor neighborhoods in urban programs such as the voucher program in Colombia) or poor schools (schools in poor districts and with low school budgets per student in the JPS Scholarship program in Indonesia). Most programs limit their targeting to that level on the presumption that further targeting would bring about little savings and create social problems (PRAF in Honduras; voucher program in Colombia). When further targeting on poor households in the selected areas is done, the programs use a household level welfare index (Progresa in Mexico) and/or delegate the selection of beneficiaries to a local committee that can exploit idiosyncratic local information on households' welfare status (Food for Education in Bangladesh, Albania's social assistance program (Alderman, 2002)). Progresa's household selection in fact combines geographical targeting on the basis of a community marginality index with household identification within these localities on the basis of a welfare index and feedbacks from the community to finalize the list of beneficiaries.

However, if increasing educational achievements among rural populations is the objective, grants should be targeted on children most likely not to be going to school, with poverty and its proxies as just one element in assessing such risk. Some programs thus privilege the selection of girls to compensate for a gender differential in enrollment (Progresa; Quetta Urban Fellowship Program in Pakistan). The Indonesian JPS Scholarships program, introduced to prevent negative effects of the crisis on schooling, is an exception in identifying additional determinants of being at risk of not going to school (Cameron 2002). In this case, besides targeting on the basis of geography, welfare, and gender (at least 50% girls), selection also focused on children with physical handicaps, living far away from school, and in single parent and large households.

In this paper, we show that the optimal allocation of grants in educational assistance programs (1) consists in targeting on children predicted with low probability of going to school instead of children predicted in poverty, (2) is feasible, and (3) can help achieve significant efficiency gains in educational achievement per dollar of transfer. Further efficiency gains can also be achieved if transfers are calibrated to maximize enrollment effect per dollar of transfer. To make these calculations of efficiency gains, we use the extensive database collected by Progresa.

II. Progresa as a welfare program

Progresa is more than an educational grant program. It was designed as an anti-poverty program, with the double objective of alleviating current poverty and increasing enrollment among the children of the poor. The program consists in three closely related components for education, health, and nutrition. For education, Progresa offers a monetary grant to each child under 18 years old enrolled in school between the third year of primary school and the third year of secondary school. The health component provides basic health care for all members of the family. The nutritional component includes a monetary transfer conditional on regular visits to the health center, as well as nutritional supplements for children and women in need.

Progresa was introduced in 1997 and, by 2000, was reaching 2.6 million families. The overall budget for that year was 9 billion pesos (US$ 950 million), of which 4 billion (44%) was for educational transfers (Coady, 2000). These transfers benefit approximately 1.6 million children in primary school and 800,000 in secondary school.

The transfers that Progresa families receive result in a significant increase in their incomes, equal on average to 22%. The targeting of Progresa has explicitly been on poor households living in marginal rural areas of Mexico. Our purpose is, therefore, not to question this targeting, which corresponds to Progresa's objective of transferring resources to poor families. We take advantage of the rich information that has been collected for the purpose of monitoring and evaluation of the program to explore alternative targeting schemes for what would be a strictly educational purpose.

To measure its impact, Progresa selected a sample of 506 marginal communities comprising 24,000 households and 17,000 children eligible for transfers, to which a survey was applied before the program started and subsequently every 6 months during three years. Information was collected on individual, household, and community characteristics. The sample design consists in 320 treatment communities and 186 control communities. We restrict our analysis to the children that were still in school in 1997. Indeed, of all the eligible children, 12 percent had left school, some for several years, and, while the program has indeed helped bring them back to school, this one time effect at the onset of the program is not the focus of our analysis. For most of our analysis, we further restrict the sample to the 3,519 children that graduated from primary school in summer 1998 and were facing the decision of whether to continue in secondary school. We use this information to estimate a model of school enrollment that captures, in particular, the impact of Progresa transfers. We then simulate alternative targeting schemes and transfer formulas, and compare their efficiency.

III. Focusing on entry into secondary school

In this section, we make a simple analysis of the overall Progresa budget to suggest that an efficient scheme for school enrollment should strictly focus on the transition from primary to secondary school, a point already made by Coady (2000).

We do not observe the effective transfers made to each particular child, but can compute them based on the program rules. The educational transfers increase as children progress to higher grades, and are higher for girls than for boys in secondary school (Table 1). There is, however, a maximum amount to the transfer that each family can receive, set at 625 pesos/month in 1998 (including the 100 pesos granted for nutrition).[1] This means that the total budget is lower than what the simple sum of all individual transfers would give. In the sample, 13.4% of the eligible children are affected by the household transfer cap rule. Using the proportionality rule that Progresa applies, we calculate the effective transfer to which a child can pretend by scaling down by the same factor all the school subsidies in any household that would surpass the cap. This provides the budget for school subsidies in the treatment villages from the sample as reported in Table 1, with its distribution by grade. Overall, the budgetary saving implied by the cap put on total household transfers represents 17% of the budget with no cap. Taking into account these caps on transfers, primary school accounts for 55.4% of the total educational budget and the first year of secondary school for almost 20% (Table 1).

Table 1. Budget of educational transfers for the Progresa program in the sample villages, 1998

Grade that children could attend	Number of eligible children[1]	Transfers[2] Pesos/month	Continuation rate (percent)	Budget for enrolled children[3] Pesos/month	% of total
Primary 3	1909	70	98.2	114,229	11.8
Primary 4	1811	80	97.8	120,260	12.4
Primary 5	1613	100	97.1	135,626	14.0
Primary 6	1476	135	97.4	166,035	17.2
Secondary 1	1416	200/210	76.7	189,602	19.6
Secondary 2	752	210/235	96.1	134,884	14.0
Secondary 3	551	220/255	96.7	106,028	11.0
Total	9528			966,664	100

[1] Children enrolled in school in 1997 only
[2] Transfers in secondary school are separately given for boys/girls.
[3] Taking into account the cap on total household transfers. With a schedule of 10 monthly transfers per school year and an exchange rate in October 1998 of 10 pesos per US$, all transfers can be read as either in pesos/month or in US$/year

Other studies have shown that Progresa transfers do increase continuation rates at all grades (Berhman et al., 2001; Coady, 2000; Shultz, 2002; Sadoulet et al., 2001; Raymond and Sadoulet, 2002; Dubois et al., 2002). However, as shown in Figure 1, school continuation rates are very high in primary school and again in secondary school. Because of these high continuation rates in primary and secondary school, the gain obtained by the transfers is only of around one percentage point in primary school grades, and one half of one percentage point in the 2nd and 3rd years of secondary school. This suggests that the current transfer system is unnecessarily expensive for these grades. Indeed, while the transfer to a primary school child is approximately $100/year (100 pesos per month over 10 months), 96 school attending children are paid for each child that is retained in school by the transfer incentive, implying that the effective cost per additional child attending primary school is $9,600. Assisting the 3-4% of children that drop out of school at each grade would require a very different program of selective scholarships that we cannot analyze on the basis of the functioning of the current program. Eliminating all transfers to primary school students would in itself save 55.4% of the educational grant budget, or $230 million out of the total budget of $950 million in 2000.

[1] This cap was introduced so the program does not induce a fertility response.

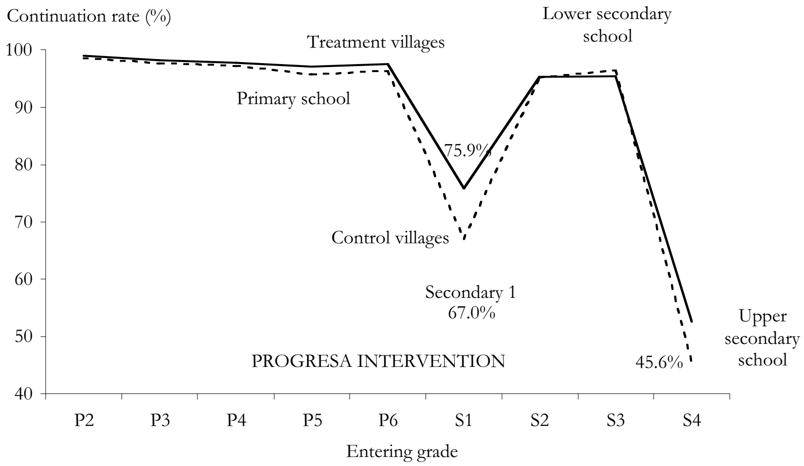


Figure 1. School continuation rates in sample villages

The critical problem in terms of educational achievement occurs at entry into lower secondary school. We, therefore, continue our analysis of the transfer program only for the first year of secondary school.

IV. Achievements under the current poverty-targeting scheme

The current targeting scheme is on the children of poor households. In the sample of 3,519 children finishing primary school (using both control and treatment villages), 2,242 children or 63.7% are predicted poor with the welfare index used and are hence eligible for the program. For the first year of secondary school, the impact of the program has been measured around 9-10 percentage points in different studies, and is estimated at 11.6% by the double difference estimator in Table 2. Note that Progresa produces the remarkable result of erasing the differential in enrollment rates between poor and non-poor.

Table 2. Double difference estimation of the impact of Progresa on continuation in secondary school

Welfare index	Number of observations (3,519)	Enrollment rate: In treatment villages (%)	Enrollment rate: In control villages (%)	Difference (% points)	
Poor	2,242	76.6	63.6	13.0	(1.9)
Non-poor	1,277	74.2	72.9	1.4	(2.5)
Difference (% points)		2.4	-9.2	11.6	
		(2.0)	(2.5)	(3.2)	

Standard errors on differences in parentheses.

In order to control for remaining heterogeneity in the sampling design that could affect the double difference estimator and to be able to design alternative targeting schemes, we build a predictive model of school enrollment:

$$E^* = X\beta + \delta P + u,$$
$$E = 1 \quad \Leftrightarrow \quad E^* \geq 0,$$

where E is a dummy variable for enrollment, E^* is the corresponding latent variable, X are correlates, and P is a program eligibility variable. Note that with the quasi-experimental design used in this evaluation, the variable P is orthogonal to all observed X and unobserved u variables. Hence, even though we use correlates of enrollment that are not necessarily exogenous and orthogonal to unobserved u, the estimation of the program eligibility impact δ is unbiased.

Results reported in Appendix Table 1 show that the main correlates of a child's school enrollment are: gender (positive for boys) and age (negative) of the child, education of each parent and of other adults (positive), mother's indigenous status (positive), number of workers (negative), poverty indicators (negative), and distance to school (negative). The model also includes state dummy variables and a treatment village effect to control for potential placement bias despite randomization. If the transfers were identically the same for all children (by gender) there would be no possibility of determining the marginal effect of a dollar of transfer on enrollment. However, because of the cap imposed on household total transfer, de facto 26% of this group of children received less than the full transfer for their enrollment in first year of secondary school. Field interviews confirm that households understood the proportionality rule. We report results from two models, one in which program eligibility P is represented by a dummy variable and one in which we use the transfer amount T that each particular child would receive. We have chosen a probit model, as it fares much better than a linear regression model for the group of children with high probability of enrollment, and better than a logit model for the kids with low probability of enrollment. The two models give remarkably similar results and children's' enrollment rates are well predicted by both models (Appendix Table 2).

A potential concern is that identification of the impact of the transfer value derives from observations of the children who receive less than the full transfer amount because of the cap on total household transfer. Those children are by definition from households with a larger number of eligible children. To check that the enrollment model of these households is not different in any significant way from that of smaller households, we compare our estimation with a model estimated for these children alone. The estimation is, as expected, more precise with the whole sample, but the parameters are neither individually nor globally significantly different in the two estimations (the t-statistics for the difference on the transfer variable is only 0.22), which confirms that the identification of the transfer value is correct. We also checked the orthogonality of the transfer to all other variables by estimating different models for children in the treatment and control villages, and verify that the parameters are neither individually nor globally significantly different in the two estimations. Hence, the model that we have estimated can be used for predicting behavior in absence of a transfer program.

From these estimates, we predict for each sample child the probability that he/she would enroll with and without transfer. These probabilities represent predicted enrollment rates of groups of similar children in the population at large. The results reported in Table 3 show that, without transfers, the enrollment rate of poor children would be 65%. The transfers increase their enrollment to 76%, an increase of 11 percentage points or 17%. This compares to the enrollment rate of 73.8%

amongst the non-poor. The average impact of the program estimated with these two models confirms the value obtained in the double difference estimation. The gain in enrollment rate is relatively constant across category of children ranked by their initial enrollment rate, except for those with high enrollment rate. Part of this difference may be due to the functional form used for the model. However, it is also evident that children that are already enrolled at a rate of 90% cannot increase their enrollment rate by 15%.

Table 3. Predicted enrollment rates under the poverty-targeted program

		Model with program dummy Enrollment rate			Model with program transfer Enrollment rate		
Welfare index Enrollment rate without program	Number of observations	Without transfer (%)	With transfer (%)	Difference (% points)	Without transfer (%)	With transfer (%)	Difference (% points)
Non-eligible (non-poor)	1,277	73.8	-		73.8	-	
Eligible (poor)							
0-40%	398	26.8	41.0	14.2	26.9	41.0	14.1
40-60%	434	50.8	66.4	15.6	50.8	66.1	15.3
60-70%	310	65.4	78.9	13.5	65.2	79.0	13.8
70-80%	383	75.1	86.1	11.0	75.1	86.0	10.8
80-100%	717	89.5	95.0	5.5	89.5	95.0	5.5
All eligible	2,242	65.0	76.1	11.1	65.1	76.0	11.0
Total[1]	3,519	68.2	75.2	7.0	68.2	75.2	7.0

[1] Total is used for comparative purposes in what follows.

The overall cost of the program for this particular group of children is US$ 332,000 per year, computed as the sum of the value of the transfers given to each child multiplied by his/her probability of effectively attending school. Dividing this total cost by the increase in the number of enrolled children (240 or 249 children, depending on the model) indicates that it costs around $1,350 per year for each child effectively induced by the program to continue in the first year of secondary school.

There are, however, two problems with this poverty-targeted scheme:

- First, transfers are given to all 76% of the poor that attend the first year of secondary school, and this includes the 65% that would have attended school even without transfers. This represents a large leakage, with 85% of the resources “wasted” on children that did not need them to attend school. This is why the effective cost of bringing one child to secondary school is $1,350 per year, while the transfer that the child itself receives is only on average $195 per year.

- All children receive the same transfer of $200 or $210 per year (except for the effect of the household cap). For some children, a smaller amount could have been sufficient to induce their enrollment. For the 24% poor that still do not enroll even with the offered transfer, the amount was insufficient. There is thus room to improve efficiency by adjusting the size of the grants to maximize enrollment with the given budget.

There is a fundamental difference between the design of a targeting scheme for educational grants and targeting on poverty for welfare transfers. Although usually difficult to measure, the income or expenditure of a household is an observable concept. With a given poverty line, the benchmark perfect targeting on the poor is thus well defined, as well as the efficient allocation of transfers to reduce poverty (Glewwe, 1992). In contrast, while children are observed to either go or not go to school, the focus of an educational program is not so much to get back the children that have left school as to prevent those that are at risk of dropping out of school from doing so. The transfers thus need to be targeted on the children that would otherwise drop out of school. This is never observable. Hence, whether specific children should be targeted by the program, and how much transfer can be efficiently offered to induce them to stay in school, can only be inferred from a predictive model. This means that even the benchmark efficient allocation of transfers to increase enrollment rates is based on some estimated behavior. Our benchmark model is the predictive model introduced in the previous section, which is based on all the information available without restriction. We use it to establish the optimal allocation of transfers in the next section. Later, in section VI, we will restrict ourselves to the use of variables that are readily observable, taking on a problem similar to that of welfare targeting when income is not observed (Glewwe, 1992).

V. Efficient schemes of transfer allocation

5.1. Optimal scheme with variable transfers

Denote by $P(g,T)$, with $g = X\beta$, the probability that a child with characteristics X and eligible for a transfer T will enroll in school. Eligibility is denoted by the index function $I \in [0,1]$. Children characteristics are distributed according to the density function $f(g)$.

The allocation problem consists in choosing the eligibility status, $I(g)$, and if eligible, the transfer $T(g)$ to offer to each child g, to maximize the gain in enrollment over the population:

$$\max_{I(g),T(g)} \int_{-\infty}^{+\infty} \left[P(g,T) - P(g,0)\right] I\, f(g) dg \quad , \tag{1}$$

subject to a budget constraint:

$$\int_{-\infty}^{+\infty} P(g,T)\, T\, I f(g) dg \leq B. \tag{2}$$

The first order conditions for the optimal transfer is that for any eligible child $(I = 1)$,

$$P_T - \lambda\left(P_T T + P\right) = 0, \tag{3}$$

where $P_T = \dfrac{\partial P}{\partial T}$ and λ is the Lagrange multiplier associated with the budget constraint. This relationship states that the ratio of cost $(P_T T + P)dT$ to enrollment benefit $P_T dT$ of a marginal increase dT in the offered transfer is equal across children. Hence, the cost of the marginal child brought to school is equal across children types g. Note that the cost has two terms. The first term

$P_T T dT$ is the transfer cost to the marginal children $P_T dT$ brought to school by the increase in transfer. The second term is the cost of giving the increase in transfer dT to all the *P* children from the same class *g*, even though they went to school with the initial transfer *T*. This is the marginal equivalent of the decomposition of the cost of transfer:

$$PT = \left[P(g,T) - P(g,0)\right]T + P(g,0)T,$$

where the first term represents the cost of the transfer to the kids brought to school by the transfer and the second term the cost to the kids of similar observable characteristics who would have gone to school anyway.

Given the optimal transfer conditional on eligibility, what is the optimal eligibility rule? We establish in Appendix A that the maximization problem consists in determining a threshold *G* such that any child with aggregate characteristic $g \leq G$ is eligible:

$$\max_G \int_{-\infty}^{G} \left[P(g,T) - P(g,0)\right] f(g) dg + \lambda \left[B - \int_{-\infty}^{G} P(g,T) T f(g) dg\right] . \tag{4}$$

Maximization of (4) with respect to *G* is determined by the first-order condition:

$$W(G) = P(G,T) - P(G,0) - \lambda P(G,T)T = 0.$$

Hence, the average cost of additional enrollment in this threshold group of children is equal to $1/\lambda$, itself equal to the cost of the marginal enrollment:

$$\frac{P(G,T)T}{P(G,T) - P(G,0)} = \frac{P_T T + P}{P_T}. \tag{5}$$

For all children with lower initial enrollment rate $P(g,0)$, the average cost of enrollment of additional children is lower than the marginal cost:

$$\frac{P(g,T)T}{P(g,T) - P(g,0)} < \frac{P_T T + P}{P_T} \qquad \forall g < G.$$

The optimal allocation of a budget *B* is thus the solution of the system (3), (5), and (2), which we summarize here:

$$\frac{P_T(g,T)T + P(g,T)}{P_T(g,T)} = \frac{1}{\lambda}, \quad \forall g \leq G, \qquad \text{defining transfers to eligible children}$$

$$\frac{P(G,T)T}{P(G,T) - P(G,0)} = \frac{P_T T + P}{P_T}, \qquad \text{defining the threshold } G \text{ of eligibility,}$$

and $$\int_{-\infty}^{G} P(g,T)Tf(g)dg = B,$$ defining λ that ensures the budget constraint.

Implementation of this scheme is reported in Table 4 (column "Variable transfers"). The scheme increases the number of children sent to school by the program by 72% over the poverty-targeted scheme. Due to the budget constraint, eligibility is restricted to children with initial probability of going to school lower or equal to 64.1%. Variable transfers among recipients vary from $228 to $438/year, with an average of $341/year.[2] The effective cost of sending an additional child to school has, however, fallen by 40% to $784/year.

Table 4. Enrollment rates under efficient targeting schemes

Risk level: Probability of enrollment without transfer	Number of observations	(%)	Enrollment rates (%) No program	Variable transfers	Uniform transfer	Transfers (US$/year) Variable	Uniform
0-40%	512	14.5	27.1	71.2	62.1	438	363
40-60%	633	18.0	50.9	77.4	83.5	293	363
60-70%	461	13.1	65.2	71.6	69.9	228	363
70-80%	560	15.9	75.2	75.2	75.2		
80-100%	1353	38.4	90.1	90.1	90.1		
Kids under the variable transfers scheme							
0-64.1%	1314	37.3	43.0	75.3		341	
Kids under the uniform transfer scheme							
0-61.7%	1222	34.7	41.5		74.9		363
Total	3519	100.0	68.2	80.3	79.8		
Cost per additional child enrolled (US$/year)				784	815		
Efficiency gain over poverty targeting (%)				72.0	65.4		

5.2. *Optimal scheme with uniform transfer*

Policy makers frequently object to offering transfers of different values to children, although it should be clear that, even under the current scheme, all households receive different transfers based on the number, gender, and grade of their children. We thus establish in this section the optimal scheme with uniform transfer. The maximization problem is now:

[2] Using transfer amounts that are outside the range of observed transfers ($100–$200 per year) amplifies the issue related to the choice of a functional form for the prediction model. We chose to use a probit model with an index function that is linear in transfer $P(g,T) = \Phi(I = X\beta + \delta T)$. This implies decreasing marginal effect of transfers: $P_T = \varphi(X\beta + \delta T)\delta$ as T increases. In reality, within the range of observed transfers, the best fit is obtained with an exponential form for the index function $I = X\beta + \delta(e^T - 1)$, implying increasing return to transfers in the observed range. Yet, for extending the simulation beyond the range of observed values, we deliberately chose a conservative approach with the linear index function. This avoids the risk of over-estimating the effect of large transfers. By the same token, it pushes up the levels of the optimal transfers and keeps down program efficiency. Short of having observations on a wider range of values than currently available, there is no way to be sure of the correct marginal value of transfers at different levels of transfers.

$$\max_{I(g),T} \int_{-\infty}^{+\infty} \left[P(g,T) - P(g,0)\right] I\, f(g) dg \quad , \tag{6}$$

subject to the budget constraint:

$$\int_{-\infty}^{+\infty} P(g,T) T\, I f(g) dg \leq B.$$

Similar to the previous model, the solution consists in finding a threshold of eligibility G and a transfer T that maximize:

$$\max_{G,T} \int_{-\infty}^{G} \left[P(g,T) - P(g,0)\right] f(g) dg.$$

In this case, the trade-off in defining the threshold G and the transfer level T is obtained by comparing on the one hand the average cost per child from incorporating group G and on the other hand the marginal cost per incorporated child for all $g < G$ with a marginal increase in the transfer level:

$$\frac{P(G,T)T}{P(G,T) - P(G,0)} = \frac{\int_{-\infty}^{G} \left(P_T T + P\right) f(g) dg}{\int_{-\infty}^{G} P_T f(g) dg}. \tag{7}$$

Implementation of this scheme is reported in Table 4 (column "Uniform transfer"). This scheme increases the number of children sent to school by the program by 79.8% over the poverty-targeted scheme. The optimal transfer is \$363/year, close to the average transfer in the variable transfer scheme but substantially above Progresa's current \$210 subsidy. Eligibility is not very different from the variable transfer scheme. This scheme is 10% less efficient than the variable transfer program and the cost of sending an additional child to school is \$815/year.

5.3. Comparing enrollment rates under alternative schemes

Tables 3 and 4 and Figure 2 compare the enrollment rates achieved under the different schemes by children with different probability of enrollment without transfer. We represent in Figure 2 the outer line of the poverty-targeted transfer program ("Poverty targeting"), which is the predicted enrollment of the children that received the full \$210 transfer. All poor children are eligible, and the uniform transfer of \$210 increases their enrollment rate by 5 to 16%, with lowest benefit among those that had an initial high probability of continuing. By contrast, the efficient variable transfer program restricts eligibility to the children that have a probability to continue below or equal to 64.1%, and offers them very unequal transfers. To the 14.5% children with probability of enrollment lower than 40%, large transfers of \$400 to \$500 raise their enrollment rate by 44.1 percentage points from 27.1% to 71.2%. For children with enrollment rate between 40 and 60%, transfers averaging \$293 raise their probability of enrollment to 77.4%. As the initial probability increases, the optimal transfer decreases until we reach the limit of eligibility due to budget constraint at the 64.1% enrollment rate. The efficient uniform transfer scheme offers an optimal transfer of \$363 and restricts eligibility to children with probability to continue school lower than or equal to 61.7%. For comparison, we have reported in Figure 2 the outcome of an equal opportunity scheme that would use the budget to equalize the probability of enrollment of all children. The enrollment rate that can be achieved for all would be 72.5%. We can see that the efficient schemes are not very far from that equal opportunity scheme. They do not quite raise the very low probability to the same level (these are very few children, as seen from the density function of enrollment without program), as getting them to the 72.5% enrollment rate would require very high transfers of \$800. The efficient variable transfer scheme also does not provide small transfers to students with probability higher than 64.1%. Cutting on these two extremes of very high transfers for children most reluctant to go to school and low transfers for children with an already high enrollment rate raises efficiency.

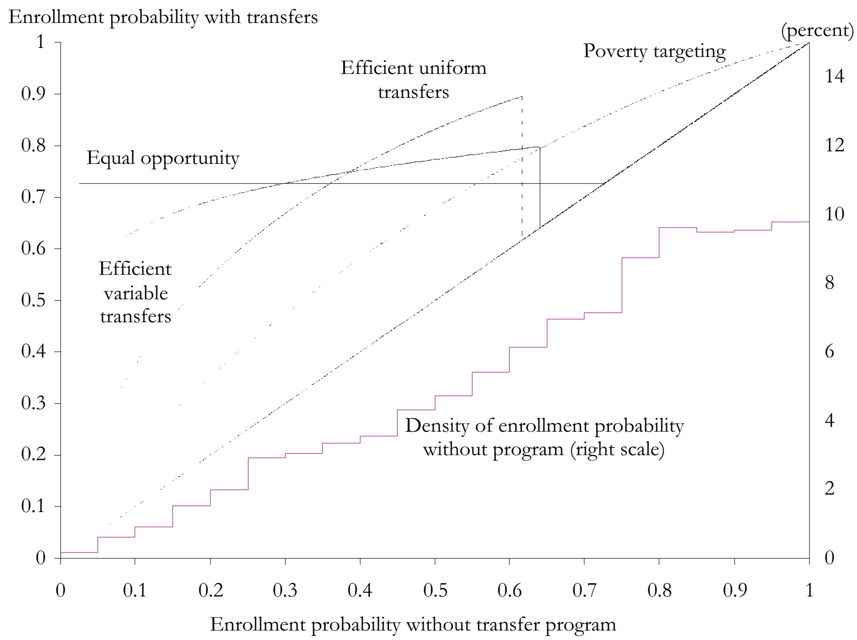


Figure 2. Impact of alternative transfer programs on enrollment rates

5.4. Direct and leakage costs

The average cost of children with characteristics g that are brought to school by the program is equal to the total cost $P(g,T)T$ divided by the increase in enrollment $P(g,T)-P(g,0)$:

$$\frac{P(g,T)T}{P(g,T)-P(g,0)}=T+\frac{P(g,0)T}{P(g,T)-P(g,0)} \quad .$$

This cost is the sum of the direct cost of the transfer T given to a child that enrolls because of the program and the leakage cost, which is the cost of the transfers $P(g,0)T$ given to the children that would have enrolled in school even without transfer. Figure 3 shows this decomposition for the efficient variable transfers scheme. The transfer amount decreases with the initial probability to enroll, from a maximum of \$700 to about \$200. However, as the leakage cost increases even more rapidly, the average cost of sending a child to school increases with its initial probability of enrollment, from around \$700 to \$1100. The cost of the marginal child in each category *g* is, however, equalized to maximize efficiency. The leakage costs increase from 5% for children with the lowest enrollment rate to 80% for children at the threshold of eligibility.

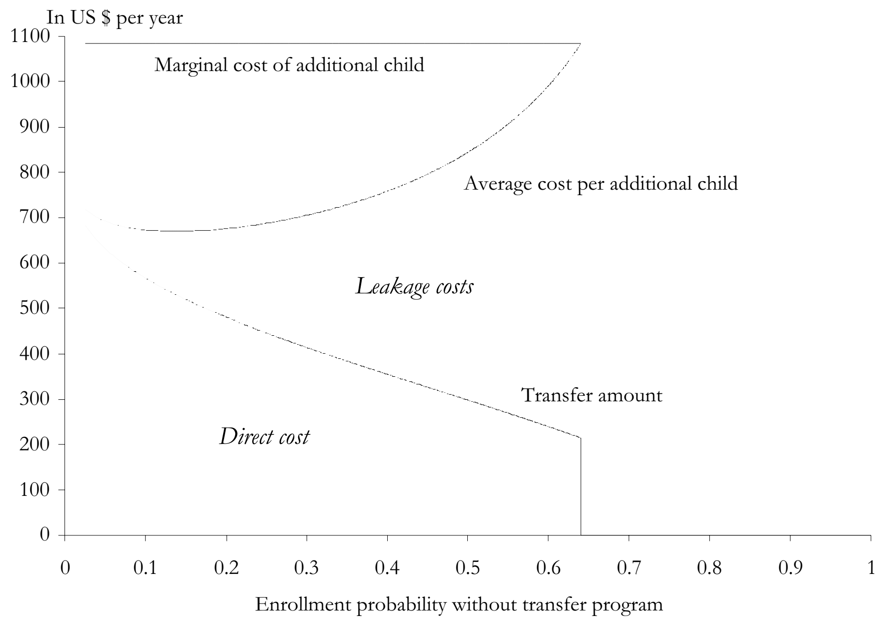


Figure 3. Direct and leakage costs for increasing enrollment rates under the efficient variable transfers scheme

Another way to look at the importance of these leakage cost is by decomposing the total budget allocated to the different groups of children. This is shown in Figure 4 for the poverty-targeted and the efficient variable transfers schemes. As there are relatively few children with probability to enroll less than 0.40, most of the benefits of the program accrue to children with higher probability to enroll. Leakage costs dramatically increase in that population too. The efficient scheme thus reduces the leakage from an average 85.4% to 52.6% by both cutting eligibility beyond a threshold and by increasing the effect of transfers by giving larger sums.

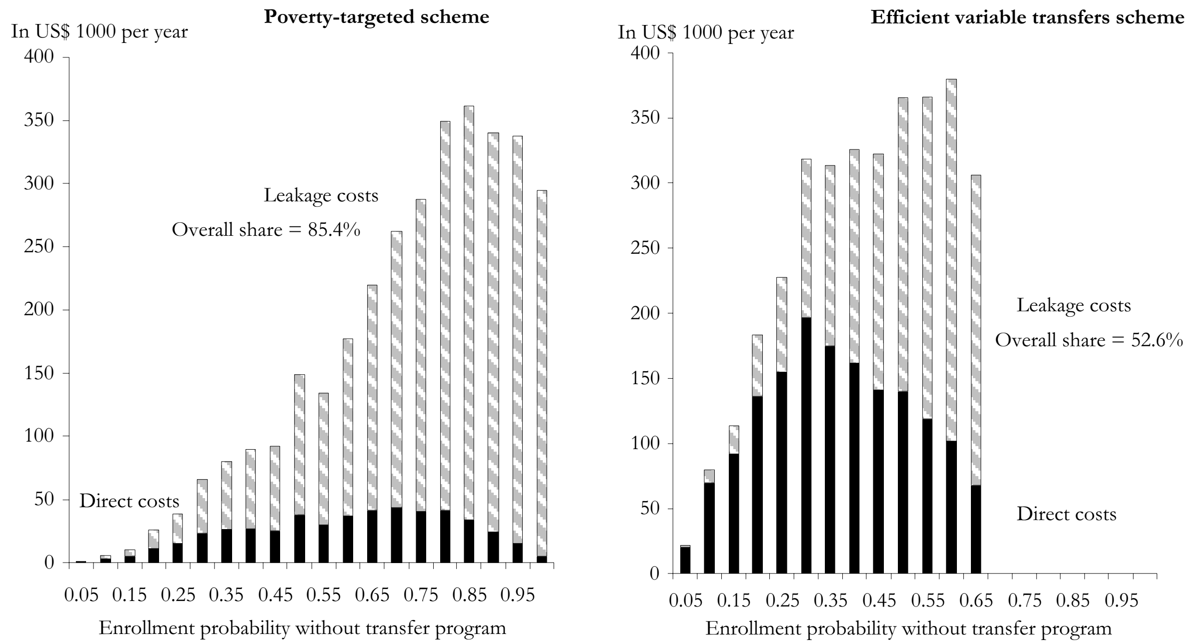


Figure 4. Total direct and leakage costs under the poverty targeted and the efficient variable transfers schemes

VI. An easily implementable efficient scheme

The most efficient targeting scheme relies on the possibility of measuring the probability of non-enrollment for each child based on a large number of indicators, including individual, household, and contextual characteristics as shown in Appendix Table 1. It also relies on giving idiosyncratic transfers to each child. Hence, the 72% efficiency gain is the maximal theoretical gain that could be obtained. An implementable scheme that uses a smaller number of easily observable and non-manipulable indicators and only a few discrete levels of transfers would only achieve part of this potential efficiency gain. This is what we explore in what follows. Besides ease of implementation, this scheme has the advantage of relying on a registration procedure that can be transparent to all, instead of a welfare formula that needs to be kept secret not to be manipulated.

In order to define the best easily implementable measure of risk, we estimate a simplified model of enrollment that does not include any of the income variables (total expenditure and poverty), nor variables that cannot be a priori observed (treatment village). We also remove age, since an eligibility criterion based on age could give rise to perverse behavior of parents delaying their children's entry in secondary school to benefit from a grant. The rank of the child in the family turns out to capture part of this information. We also simplify the characterization of household size by removing the information on jobs held by adults to avoid perverse behavior. We then further delete variables that are not significantly different from zero at 15%. This leads to a model whereby enrollment is predicted by children characteristics (gender and rank), household characteristics (education and some dwelling characteristics), distance to school, state dummies, and value of the transfer offered (Appendix Table 3). Using this simplified model, we can predict children's probabilities of non-enrollment and the efficient transfers they should be offered. We then further simplified the payment scheme by rounding up transfers to be multiples of $50/year. The distribution of transfers offered by the scheme is reported in Table 5. It consists in transfers varying from $250/year to $500/year made available to 37.2% of the potential students, averaging $334/year.[3]

Table 5. An implementable efficient scheme

	Transfers (US$/year)	Eligible students Number	%	Predicted enrollment rates (%) without transfer	with transfer
Non-eligible students		2,210	62.8	80.2	–
Eligible students					
	250	291	8.3	61.1	79.4
	300	400	11.4	53.1	77.7
	350	272	7.7	46.0	76.8
	400	180	5.1	38.0	75.3
	450	119	3.4	29.3	72.1
	500	47	1.3	20.8	67.7
All eligible					
	334	1309	37.2	48.0	76.7
All students		3,519	100.0	68.2	78.9
Cost per additional child enrolled (US$/year)					886
Efficiency gain over poverty targeting (%)					52.5

To evaluate the impact of such a transfer scheme, we return to the best prediction model for enrollment (Appendix Table 1), and calculate the enrollment rate that the scheme would induce. The results are reported in the last two columns of Table 5.

The overall efficiency of the program is quite remarkable, as it increases the enrollment rate to 78.9%, which represents a 52.5% gain over the poverty-targeted program. The loss in efficiency due to the imperfect targeting instrument is thus less than 30%.

VII. Discussion

7.1. Restricting transfers to poor households

The legitimacy of the transfer scheme presented above may be questioned because it excludes 57% of the poor, while including 27% of the non-poor (Table 6).

[3] Like for the other two schemes discussed in the previous section, this threshold has been established by tâtonnement so that the cost of the program, based on children's predicted enrollment rates, be equal to that of the current Progresa scheme ($332,000/year for the sample considered).

Table 6. Comparing predicted poverty and eligibility in the implementable scheme

Percent of observations	Non-poor	Poor	Total
Non-eligible	26.6	36.2	62.8
Eligible	9.7	27.5	37.2
Total	36.3	63.7	100.0

Should one question the legitimacy of grants given to non-poor households in lieu of covering only the poor as poverty targeting does? Table 7 compares the groups of children that are treated differently under the implementable efficient scheme and a poverty-targeted scheme. It shows that the trade-off is between including 340 non-poor children with an average enrollment rate of 49.4% and including 1273 poor children with an average enrollment rate of 78.4%. These non-poor most likely to drop out of school are children from households with less educated parents and living further away from a secondary school. They are also more likely to be girls, to be among the elders in their family, and in larger families. By contrast, poor children with high enrollment rates are more often boys, younger siblings, and they come from more educated households with a secondary school either in their village or located close by. Hence, both preference for school and lower costs of going to school favor these children. While the poverty-targeted transfer scheme would further increase their enrollment rate to 87.2%, the implementable scheme proposed above raises the eligible non-poor enrollment rate by 27.5 percentage points to 76.9%. In a perspective of affirmative action that seeks to equalize children's chances of getting an education (Roemer, 1998), depriving non-poor children of the benefits of going to school, and hence of a better prospect of staying out of poverty in the future, on the basis of their parents' current welfare, is not a socially equitable strategy.

Table 7. Comparison of excluded poor with included non-poor

Variables	Included non-poor	Excluded poor
Number of observations	340	1273
Enrollment rate (%)		
Without transfer	49.4	78.4
With poverty targeted transfers	49.4	87.2
With efficient implementable scheme	76.9	78.4
Individual characteristics[1]		
Gender (male = 1)	0.40	0.56
Rank among kids	1.9	2.2
Household characteristics[1]		
Father's education	1.4	3.3
Father is literate	0.55	0.79
Mother's education	1.3	3.0
No member with more than primary school	0.9	0.7
Mother is indigenous	0.07	0.45
Household size (adult equivalent)	8.15	7.25
Village characteristics[1]		
No secondary school in village	0.97	0.63
Distance to secondary school (kms)	3.27	1.61

[1]All means are significantly different at less than 1%

We, nevertheless, explore a scheme that would efficiently allocate available resources only among the poor (Table 8). In this transfer scheme, grants are allocated to children most likely to drop out and poor, with a variable amount. Staying with the same budget of $332,000/year, the scheme incorporates 1,372 or 61.2% of the 2,242 poor children, with most grants between $200 and $400/year, and averaging $311/year. Overall, the enrollment rate of beneficiaries increases from 53.5% to 78.8%. Compared to the initial poverty-targeted scheme that offered uniform transfer to all poor, this scheme increases the enrollment rate of the poor from 65.1% to 80.6% rather than 76%. This represents a 41.1% increase in efficiency. The cost per child effectively put to school with the program is $958.

Table 8. Implementable efficient scheme for the poor

	Transfers	Eligible students		Predicted enrollment rates (%)	
	(US$/year)	Number	%	w/o transfer	with transfer
Poor students		2,242	100	65.1	80.6
Eligible	311	1,372	61.2	53.5	78.8
Non-eligible	–	870	38.8	83.3	–
Cost per additional child enrolled (US$/year)					958
Efficiency gain for the poor over the initial poverty-targeted program (%)					41.1

7.2. Comparing errors in enrollment risk and in poverty targeting

As mentioned in the introduction, most poverty targeting for educational programs use proxy methods. This is done for two reasons. One reason is that many such programs focus on structural/permanent poverty that is seen as cause for non-school attendance, rather than temporary poverty better addressed by other programs. The second reason is that means testing is expensive to implement. The proxy methods consist in doing out of sample predictions of poverty levels, based on the use of a model estimated on a sample of households. The endogenous variable of the estimated model is usually some measure of expenditures per capita and the correlates are household characteristics and assets, as well as context variables (Ravallion, 2002). For example, the selection of Progresa beneficiaries combines information on dwelling characteristics; dependency ratio; ownership of durable goods, animals, and land; and the presence of disabled individuals.[4] It is well known that proxy targeting is very imprecise, as standard errors on individual predictions are large, and thus entails large errors at the individual level, even when it performs relatively well on average for large groups (Elbers, Lanjouw, and Lanjouw, 2003).

As we will now show, the targeting on school enrollment probability that we suggest has no a priori reason to fare less well than targeting on poverty. In that case, there is no individual measure of the probability of enrollment that can be observed. We can therefore only assess an average performance by groups. We thus proceed to the comparison of group level error in both types of targeting, by estimating a proxy-targeting scheme on poverty in much the same way as we did it for the probability of non-enrollment targeting.

Poverty is defined by comparing household expenditures per adult equivalent to a poverty line. In estimating a welfare index, the model allows to either construct an expected value (with a standard error) to be compared with a threshold, or, equivalently, a corresponding probability that the welfare index is below the threshold of poverty. Targeting is thus de facto based on a probability of being poor. It turns out that the best prediction of poverty status was obtained with a probit estimation on observed poverty, rather than a regression on expenditures. The correlates that we used are essentially the same as those in the base model for enrollment, with more information on household demographics.

Figure 4 reports the results of both predictions. For each decile of predicted probability of being poor, we report the average predicted probability and the observed percentage of poor in the group. Comparing the two curves shows a relatively good average fit, except for the first and second deciles, i.e., for those less likely to be poor. The mean difference between the predicted probability and the percentage of poor over the ten deciles is 2.6 percent. We also report on the graph the curves for the estimation of non-enrollment probability (as estimated by our base model of Appendix 1). The average difference is 1.8 percent. Targeting errors are similar and large in both schemes. If a particular decile is included in the group of beneficiaries, the inclusion error consist in the percentage of individuals from the decile that are not poor (in the poverty targeting) or that would not drop out of school (in the non-enrollment probability targeting). If a particular decile is not included among the beneficiaries, we make similar exclusion errors in both programs. Because the average level of poverty is high at 67% and the average level of non-enrollment is low at 28%, a poverty targeting scheme will tend to have high exclusion errors and low inclusion errors relative to an enrollment probability targeting scheme.

[4] In the case of the Progresa program, discriminant analysis rather than regression analysis was used to construct the welfare index.

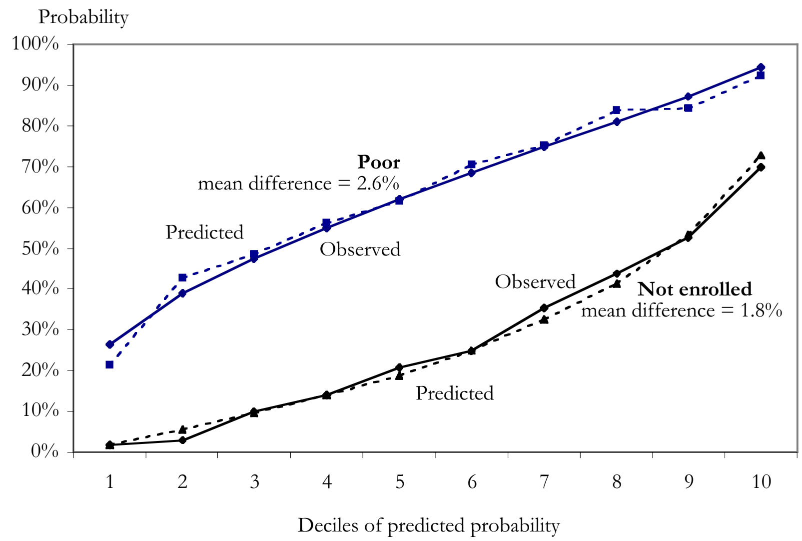


Figure 4. Comparing prediction errors in poverty and risk targeting

7.3. Implementation and piloting

How should one proceed to implement a targeting scheme based on the probability of enrollment in a new program? The proper design of transfers requires assessing for each child the risk of dropping out of school and the efficient amount of transfer. Prediction of the risk of dropping out of school can be done from a predictive model of enrollment independently of any conditional transfer program. This provides a ranking of children for determining eligibility. However, determining the efficient transfer cannot be done as easily. It could be done in either one of two ways. First, estimation of a structural behavioral model of school choice could be used to simulate alternative transfer scheme, provided the model includes some cost or opportunity cost of schooling, and there are variations in these observed costs. The presence of an active labor market and variations in child wages can be used to identify parameters of a behavioral model that is then used to simulate the impact of school subsidies (Todd and Wolpin, 2003; Bourguignon, Ferreira, and Leite, 2002). The weakness of this approach is the strong dependence of the results on the assumptions made to identify the model, and the difficulty of validating these models for out of sample predictions. Alternatively, a pilot program could be implemented with varying levels of transfer. The use of some experimental variation in program design in estimating a behavioral model would greatly enhance the validity of the structural model for simulating alternative program designs. It is important that the pilot program be designed to measure the marginal effect of the transfers, for which it needs to be implemented with varying levels of transfer. While the peculiar feature of the cap imposed on total household transfer in the Progresa program did allow us to infer the incentive effect of various levels of transfer, a pilot program designed for that purpose would give more accurate results.

Another desirable feature explored in this paper is the use of easily monitored indicators for the purpose of targeting. While this restriction induces some loss in efficiency for the program, having rules that can be clearly announced and that allow to make individuals responsible to claim their own beneficiary status (with easy verification from the community) should decrease administrative costs as well as contribute to the development of transparency in the programs.

VIII. Conclusion

While Progresa is avowedly a poverty-oriented program, we used that experience to explore how the educational component of a cash transfers program could be targeted to make transfers more efficient in raising the educational achievement of recipient children. Following the principle of only paying people to make them do what they would not otherwise be doing, 55% of the educational budget could be saved by eliminating all transfers to primary school students since they nearly universally attend school whatever their circumstances. Another approach to recuperating the few children who do not complete primary school would need to be devised. The Program consequently only need make transfers for enrollment in secondary school where the drop out rate in entering the first year is alarmingly high.

Taking as given the current budget spent on the first year of secondary school, we compared the efficiency of different targeting schemes in raising enrollment. For that grade, a uniform transfer targeted on all poor achieves an increase in enrollment rate over the whole population of 7 percentage points (from 68.2 to 75.2%). The cost per child effectively induced to go to school by the transfer received is $1,350/year. 85% of the educational budget leaks to children who would go to school without a transfer. By contrast, the most efficient use of resources would target instead the transfer to the population most likely to drop out of school, and allocate these children varying transfers ranging form $200 to $500. This most efficient scheme would increase enrollment rate to 80.3%, an increase of 72% over the poverty-targeted scheme, and reduce the cost of sending an additional child to school to $784/year. Leakages are reduced from 85% to 53%. Under a scheme restricted to uniform transfer, efficiency is reduced by 10%, and the cost per child effectively brought to school is $815/year.

We also explored an easily implementable scheme with the same budget, where a child's eligibility is established on the basis of a few easily observable, transparent, and non-manipulable indicators characterizing the child itself, its household, and its environment, and where transfers are set at a few predetermined discrete levels. This scheme, which does not rely on a measure of children's poverty status, will achieve an overall enrollment rate of 78.9% of the children finishing primary school, representing an efficiency loss of less than 30% relative to the most efficient scheme. Effective cost per child brought to school is $886/year.

Results thus suggest that there exists considerable scope to improve the efficiency of educational grants programs by redefining the targeting criterion from poverty to probability of dropping out, and by calibrating transfers to specific characteristics of children, while using simple rules that allow self-registration. If public transfers are to be used more efficiently and existing funds are to reach a larger number of beneficiaries, these options deserve to be carefully considered.

Appendix A

The allocation problem consists in choosing the eligibility status, $I(g)$, and if eligible, the transfer $T(g)$ to offer to each child *g*, to maximize the gain in enrollment over the population:

$$\max_{T(g),I(g)} \int_{-\infty}^{+\infty} \left[P(g,T) - P(g,0)\right] I\, f(g) dg \quad , \tag{1}$$

subject to a budget constraint:

$$\int_{-\infty}^{+\infty} P(g,T) T\, If(g) dg \leq B. \tag{2}$$

This requires maximizing the corresponding Lagrangian:

$$\max_{T(g),I(g)} W = \int_{-\infty}^{+\infty} \left[P(g,T) - P(g,0)\right] I\, f(g) dg + \lambda \left\{ B - \int_{-\infty}^{+\infty} P(g,T) TI\, f(g) dg \right\}.$$

a) Optimal transfer T

The optimal transfer is the solution of the first order conditions for any eligible child $(I = 1)$,

$$P_T - \lambda\left(P_T T + P\right) = 0, \tag{3}$$

if it is an interior solution, and T=0 if $P_T(g,0) - \lambda P(g,0) < 0$ without transfer. Let $\overline{P}$ be the solution of $P_T(g,0) = \lambda P(g,0)$, i.e., the upper bound of initial enrollment rate for which the optimal marginal transfer is positive. Hence, transfers will optimally be set to 0 for kids with high initial enrollment rate (and low marginal effect of transfer) above $\overline{P}$.

b) Optimal eligibility schedule

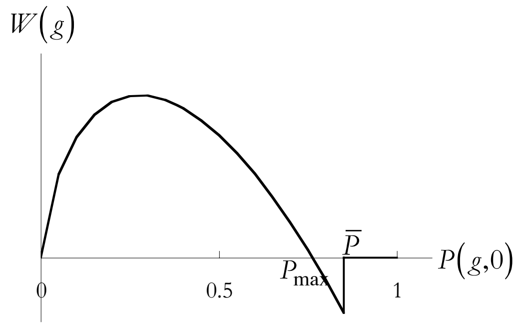
To define the optimal targeting scheme, we analyze the contribution of each eligible child *g* to the Lagrangian:

$$W(g) = P(g,T) - P(g,0) - \lambda P(g,T) T \quad .$$

The first derivative with respect to *g*,

$$\frac{dW(g)}{dg} = P_g(g,T) - P_g(g,0) - \lambda P_g(g,T) T \quad ,$$

is negative except for low value of g. For $g \to -\infty$, which corresponds to $P(g,0) \to 0$, $W(g) \to 0$. Representing this contribution as a function of the initial probability of enrollment $P(g,0)$ gives the following:



The optimum targeting scheme consists in selecting the children from the highest level of contribution, down until the budget constraint is binding.

The optimal eligibility is thus determined by:

$$\max_{G_0,G} W = \int_{G_0}^{G} \left[P(g,T) - P(g,0)\right] f(g)dg + \lambda\left\{B - \int_{G_0}^{G} P(g,T)T\, f(g)dg\right\}$$

where T is the optimal transfer. The first order condition gives:

$$\frac{dW}{dG^*} = P(G^*,T) - P(G^*,0) - \lambda P(G^*,T)T = 0, \text{ for } G^* = G_0, G.$$

The lower value is thus $G_0 = -\infty$, and the upper value is defined by:

$$\frac{P(G,T)T}{P(G,T) - P(G,0)} = \frac{1}{\lambda} = \frac{P_T T + P}{P_T}.$$

This says that the average cost per child G brought to school is equal to the marginal cost of child G. For all other children with $g < G$, or equivalently with initial enrollment rate $P(g,0) < P(G,0) = P_{\max}$, the average cost per child g is lower than the marginal cost of the child.

Appendix B

Appendix Table 1. Predictive model of school enrollment in secondary school

Variables	Model with program dummy variable: Average value	Marginal effect	z	Model with program transfer amount: Average value	Marginal effect	z
Individual characteristics						
Male	0.51	0.099	2.7	0.51	0.101	2.7
Age	12.97	-0.096	-13.8	12.97	-0.096	-13.8
Birth order	2.01	0.012	1.0	2.01	0.014	1.1
Household characteristics						
Head is male	0.92	-0.012	-0.3	0.92	-0.011	-0.3
Has no father	0.13	0.014	0.4	0.13	0.015	0.4
Father's education	0.68	0.029	1.2	0.68	0.029	1.2
Father is literate	2.55	0.012	2.3	2.55	0.012	2.3
Father is indigenous	0.30	0.040	1.1	0.30	0.037	1.1
Has no mother	0.06	-0.023	-0.4	0.06	-0.020	-0.3
Mother's education	0.63	0.021	0.9	0.63	0.022	0.9
Mother is literate	2.47	0.007	1.2	2.47	0.007	1.2
Mother is indigenous	0.31	0.068	2.0	0.31	0.070	2.1
Mother's age	37.0	-0.001	-0.4	37.0	-0.001	-0.4
Household's maximum education	5.5	0.015	4.7	5.5	0.015	4.7
Number of children 0–10 years old	2.2	-0.006	-1.2	2.2	-0.005	-1.0
Number of children 11–19 years old	2.8	-0.006	-0.6	2.8	-0.003	-0.3
Number of agricultural workers	1.3	-0.034	-4.3	1.3	-0.033	-4.3
Number of non-agricultural workers	0.42	-0.026	-2.6	0.42	-0.027	-2.6
Number of self employed	0.24	-0.043	-3.2	0.24	-0.042	-3.2
Number of unpaid family workers	0.35	-0.014	-1.7	0.35	-0.015	-1.8
Number of other working adults	0.11	-0.036	-1.6	0.11	-0.035	-1.5
Dwelling has dirt floor	0.58	0.045	2.5	0.58	0.045	2.5
Persons/room in dwelling	4.57	-0.006	-1.7	4.57	-0.006	-1.6
Dwelling has water	0.39	0.053	3.2	0.39	0.054	3.2
Household is poor	0.64	-0.073	-2.8	0.64	-0.074	-2.9
Total expenditure (pesos/month)	863	0.000	2.1	863	0.000	2.1
Irrigated land (ha)	0.13	-0.003	-0.6	0.13	-0.003	-0.6
Rainfed land (ha)	2.34	0.003	1.2	2.34	0.003	1.2
Herd size	1.04	0.002	0.6	1.04	0.002	0.5
Village characteristics						
Village is in PROGRESA program	0.62	0.024	0.9	0.62	0.024	0.9
No secondary school in village	0.76	-0.123	-3.9	0.76	-0.121	-3.9
Distance to secondary school (ln of kms)	0.72	-0.081	-5.4	0.72	-0.080	-5.4
Distance x Girl	0.38	0.010	0.2	0.38	0.008	0.2
Transfer eligibility						
Dummy	0.40	0.117	3.8	0.40	-0.068	-0.6
Amount of transfer (US$100)				0.77	0.097	1.7
State dummies (reference is Guerrero)						
Hidalgo	0.18	-0.132	-3.0	0.18	-0.127	-2.9
Michoacan	0.13	-0.212	-4.5	0.13	-0.207	-4.4
Puebla	0.16	-0.185	-4.1	0.16	-0.182	-4.1
Queretaro	0.06	-0.336	-6.0	0.06	-0.334	-6.0
San Luis Potosi	0.15	-0.172	-3.6	0.15	-0.166	-3.5
Veracruz	0.26	-0.116	-2.8	0.26	-0.112	-2.7
Number of observations		3519			3519	
Pseudo R2		0.213			0.214	
Endogenous variable (enrolled =1)	0.725			0.725		

Marginal effects are computed for the average value of the other covariates. For dummy variables, computed for discrete change from 0 to 1

Appendix Table 2. Comparison of predicted and observed enrollment rates

Quintile of predicted enrollment rates (%)	Model with program dummy Enrollment rates Predicted (%)	Observed (%)	Model with program transfers Enrollment rates Predicted (%)	Observed (%)
Lowest 20%	37.0	38.7	37.0	38.8
20 – 40	63.2	60.3	63.1	60.5
40 – 60	78.2	77.1	78.2	77.3
60 – 80	88.2	88.5	88.3	88.1
Highest 20%	96.3	97.7	96.4	97.7
Total	72.6	72.5	72.6	72.5

Appendix Table 3. Simplified model of school enrollment in secondary school

Variables	Average value	Marginal effect	z
Individual characteristics			
Male	0.51	0.011	0.3
Rank among kids	2.01	0.125	8.7
Rank x male	1.02	0.033	2.0
Household characteristics			
Father's education	2.5	0.014	2.7
Father is literate	0.68	0.045	2.0
Mother's education	2.5	0.020	5.3
Mother is indigenous	0.31	0.084	4.6
Mother's age	37.0	-0.001	-1.8
No member with more than primary school	0.7	-0.143	-7.8
Household size (adult equivalent)	7.41	-0.011	-2.2
Number of children 11–19 years old	2.76	-0.056	-5.4
Persons/room in dwelling	4.57	-0.008	-2.2
Dwelling has water	0.39	0.060	3.6
Village characteristics			
No secondary school in village	0.76	-0.106	-4.5
Distance to secondary school (ln of kms)	0.72	-0.077	-5.3
Transfer eligibility			
Dummy	0.40	-0.084	-0.7
Transfer amount (US$100)	0.77	0.100	1.7
State dummies (reference is Guerrero)			
Hidalgo	0.18	-0.072	-1.8
Michoacan	0.13	-0.153	-3.5
Puebla	0.16	-0.127	-3.0
Queretaro	0.06	-0.237	-4.6
San Luis Potsi	0.15	-0.107	-2.4
Veracruz	0.40	-0.084	-0.7
Number of observations		3519	
Pseudo R2		0.159	
Endogenous variable (enrolled =1)	0.725		

Marginal effects are computed for the average value of the other covariates. For dummy variables, computed for discrete change from 0 to 1

References

Alderman, Harold. 2001. "Multi-Tier Targeting of Social Assistance: The Role of Intergovernmental Transfers." *World Bank Economic Review* 15(1): 33-53.

Alderman, Harold. 2002. "Do Local Officials Know Something we don't? Decentralization of Targeted Transfers in Albania." *Journal of Public Economics*, 83(3): 307-457.

Baker Judy and Margaret Grosh. 1994. "Poverty Reduction Through Geographic Targeting - How Well Does it Work." *World Development* 22(7): 983-995.

Behrman, Jere, Piyali Sengupta, and Petra Todd. 2001. "Progressing through Progresa: An Impact Assessment of a School Subsidy Experiment", University of Pennsylvania. http://athena.sas.upenn.edu/~petra/research.html

Behrman, Jere, and J.C. Knowles. 1999. "Household Income and Child Schooling in Vietnam." *World Bank Economic Review* 13(2): 211-256.

Besley, Timothy, and Ravi Kanbur. 1993. "The Principles of Targeting." In M. Lipton and J. van der Gaag eds., *Including the Poor*. Washington D.C.: The World Bank.

Bourguignon, François, Francisco H. G. Ferreira, and Philippe G. Leite. 2002. "Ex-ante Evaluation of Conditional Transfer Programs: the Case of Bolsa Escola." World Bank, Policy Research Working Paper N. 2916. http://econ.worldbank.org/files/20843_wps2916.pdf

Cameron, Lisa. 2002. "Did Social Safety Net Scholarships Reduce Drop-Out Rates During the Indonesian Economic Crisis?" Policy Research Working Paper No. 2800. Washington D.C.: The World Bank.

Coady, David. 2000. "The Application of Social Cost-benefit Analysis to the Evaluation of Progresa." Washington D.C.: International Food Policy Research Institute.

Dubois, Pierre, Alain de Janvry, and Elisabeth Sadoulet. 2002. "Effect on School Enrollment and Performance of a Conditional Transfers Program in Mexico." http://www.toulouse.inra.fr/centre/esr/CV/dubois/duboisen.htm

Elbers, Chris, Jean Lanjouw, and Peter Lanjouw. 2003. "Micro-Level Estimation of Poverty and Inequality". *Econometrica*, 71(1): 355-64.

Filmer, Deon, and Lance Pritchett. 1999. "The Effect of Household Wealth on Educational Attainment: Evidence from 35 Countries." *Population and Development Review* 25(1): 85-120.

Filmer, Deon, and Lance Pritchett. 2001. "Estimating Wealth Effects Without Expenditure Data or Tears: An Application to Educational Enrollments in States of India." *Demography* 38(1): 115-132.

Glewwe, Paul. 1992. "Targeting Assistance to the Poor: Efficient Allocation of Transfers When Household Income is Not Observed," *Journal of Development Economics* 38(2): 297-321

Ravallion, Martin, and Quentin Wodon. 1999. "Poor Areas, or Only Poor People?" *Journal of Regional Science* 39(4): 689-711.

Ravallion, Martin. 2002. "Targeted Transfers in Poor Countries: Revisiting the Trade-Offs and Policy Options". Development Research Group, The World Bank, Washington D.C.

Raymond, Mélanie, and Elisabeth Sadoulet. 2002. "Leveling Playing Fields: the Differential Impact of Educational Grants." University of California at Berkeley. http://are.Berkeley.EDU/~sadoulet/

Roemer, John. *Equality of Opportunity*. Cambridge MA: Harvard University Press, 1998.

Sadoulet, Elisabeth, Frederico Finan, and Alain de Janvry. 2001. "Decomposing the Channels of Influence of Conditional Transfers in a Structural Model of Educational Choice." University of California at Berkeley, http://are.Berkeley.EDU/~sadoulet/

Schultz, T. Paul. 2002. "School Subsidies for the Poor: Evaluating the Mexican Progresa Poverty Program." *Journal of Development Economics*, forthcoming, http://www.econ.yale.edu/~pschultz/

Skoufias, Emmanuel, and David Coady. 2002. "Are the Welfare Losses from Imperfect Targeting Important?" Washington D.C.: International Food Policy Research Institute.

Todd, Petra, and Kenneth Wolpin. 2003. "Using a Social Experiment to Validate a Dynamic Behavioral Model of Child Schooling and Fertility: Assessing the Impact of a School Subsidy Program in Mexico." University of Pennsylvania, http://athena.sas.upenn.edu/~petra

van de Walle, Dominique. 1998. "Targeting Revisited." *World Bank Research Observer* 13: 231-248.

Washington Post. 2002. "O'Neill encourages more accountability for aid in developing countries". Wednesday June 5.

Wodon, Quentin. 1997. "Targeting the Poor Using ROC Curves." *World Development*, 25(12): 2083-92.