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Making Conditional Cash Transfer Programs More Efficient

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I. Conditional cash transfer programs and the efficiency question

In recent years, conditional cash transfer (CCT) programs have been introduced for a wide array of different purposes. Applied, for instance, to education and child health in poor countries, they have been hailed as being among the most significant innovations in promoting investment in human capital among the poor. Nancy Birdsall, president of the Center for Global Development, was thus quoted in the New York Times as saying, “I think these programs are as close as you can come to a magic bullet in development. They are creating an incentive for families to invest in their own children’s futures. Every decade or so, we see something that can really make a difference, and this is one of those things” (Dugger, 2004).

CCT impose a behavioral condition on the recipient of a cash transfer that transforms the payment from an income effect (if unconditional) into a price effect (subsidy) on the required condition. The approach is of course nothing new, and has been a main stay in dealing with market failures in public finance. When there are externalities, public behavior diverges from the social optimum. With positive externalities, private decisions lead to under-provision of the corresponding good or service. When property rights rule out coercion or taxation, subsidies (conditional transfers) need to be made. This has been applied to many familiar fields such as education, health, environmental services, research and development, capital accumulation, and the geographical clustering of investments. In all cases, subsidies to the action that generates positive externalities are used to seek reconciliation between the private and the social supply of the action. These interventions thus seek to raise efficiency. What is new with CCT, as praised by Nancy Birdsall, is to use the principle massively in international development programs to induce the poor to change their behavior toward greater demand for educational and health services for their children.

Many CCT programs for investment in human capital have by now been sustained for several years and demonstrated positive results. They include, among others, Progresa in Mexico, Bolsa Escola in Brazil, RPS (Red de Protección Social) in Nicaragua, PRAF in Honduras, PATH in Jamaica, FFE and FEP in Bangladesh, and SUF in Chile (Skoufias, 2003; Morley and Coady, 2003; Rawlings and Rubio, 2003). Some of these projects can be very large and expensive. In 2003, Progresa (now Oportunidades) serviced 4 million families at the annual cost of US$2.2 billion. Bolsa Escola covers 4.8 million families at the annual cost of $700 million. In middle income countries, high cost programs can be afforded, with near universal coverage of the poor. Even there, because costs are high, efficiency in inducing school participation is an issue. It is even more of an issue when implemented in poor countries such as Honduras and Nicaragua where coverage is severely limited by lack of fiscal resources and the extensiveness of poverty. There is consequently a legitimate concern in questioning whether CCT could indeed be made more efficient relative to current experiences. This is the question we address in this paper.

Raising program efficiency requires being clear about the objectives of the CCT program, and there is a fair degree of confusion on this. This is because CCTs can be seen as having a double purpose: immediate poverty reduction through the transfer, and long term efficiency gains through inducing behavioral changes, such as demand for education, via meeting a condition to qualify for the transfer.

Das, Do, and Özler (2004) made a useful contrast between CCTs to address market failures and CCTs in pro-poor redistributive programs. In the second category, which includes workfare and food subsidies, the main objective is the transfer of cash, and the conditionality is used to induce self-selection of beneficiaries. In the first category, the main objective is the conditionality, and transfers are use as incentives. CCT programs for health and education are clearly in this category. Yet, there are typically concerns in those programs with achieving not only efficiency gains, but also meeting equity concerns (and political acceptability). In this case, transfers will be restricted to the poor. The reason for the conditionality is that the income effect achieved through the transfer will buy very little in inducing a change in behavior toward the social optimum. Ex-ante simulations of Bolsa Escola cash transfers show that unconditional disbursements would have no significant impact on school enrollment (Bourguignon, Ferreira, and Leite, 2002). We can thus specify the problem to be solved by a CCT program for investment in child human capital as that of maximizing the increase in education/health by targeting and calibrating cash transfers, confined to the poor and delivered on the condition of school attendance and use of health facilities, under a budget constraint.

This does not mean that the poverty reduction effect of the cash transfer is not considered important. Indeed, many have looked at the redistributive effect of these programs as their main reason to exist. Cash in the hands of a poor mother with school age children can indeed make wonders for family welfare. For this reason, transfers are confined to the poor. However, CCT is a weak instrument for poverty reduction as many of the poor cannot meet the eligibility condition (for example because they have no children, or no children old enough to be of school age) and because the transfer follows rules not related to the depth of poverty.

In this paper, we thus explore whether it is possible to identify targeting and calibrating rules for CCTs to the poor that will maximize efficiency gains. CCT programs have three major difficulties that need to be overcome for this: (1) effective identification of who the poor are, (2) selection among the poor to minimize efficiency leakages when payments are made to categories of children already highly likely of going to school as opposed to children who would be induced to go to school through the transfer, and (3) low uptake because the cash transfer offered is not sufficient to meet the opportunity cost of the change in behavior, or low coverage because part of the budget is wasted offering cash transfers in excess of the amount needed to induce the desired change in behavior. In this paper, we do not address the problem of identifying the poor, but are concerned with situations where the budget constraint is severely binding, forcing to make eligibility choices among the poor. We are concerned with the design of programs that can be easily implemented, with low administrative costs and maximum transparency. And we are concerned with potential tradeoffs between efficiency gains and equity losses among the poor.

II. The efficiency issue in Progresa

2.1. Progresa as a human capital formation program targeted on the poor

In our interpretation, Progresa is a CCT program for human capital formation targeted at the children of the rural poor. It 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, conditional on regular school attendance in grades between the third year of primary school and the third year of secondary school and on regular health visits. 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 a health center, as well as nutritional supplements for children and women in need.

Progresa was introduced in 1997 and, by 2000, had achieved full coverage of marginal rural municipalities, 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 benefited 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 income, 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 not to question this targeting, which corresponds to Progresa's objective of transferring resources to poor families. Our purpose is to explore whether, for a given budget constraint, targeting and calibrating transfers among the poor can help increase efficiency in increasing school participation. We consequently only look at Progresa's educational component, and use it as a laboratory to explore alternative targeting and calibrating rules. The idea is to derive lessons from this richly informed experiment that can be applied to Progresa and to other CCT programs where the targeting issue is critical due to severely limited budgets.

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 the random selection of 320 treatment communities and 186 control communities from among these 506 communities. We restrict our analysis to the children that were in school in 1997. Indeed, among eligible children, 12 percent had left school, some for several years, and, while the program has indeed helped bring some of 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, paying particular attention to heterogeneity of conditions among children. We then simulate alternative targeting schemes and transfer formulas, and compare their efficiency.

2.2. 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 offered 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 eligible children (and 26% of those ready for secondary school) 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).

Other studies have shown that Progresa transfers do increase continuation rates at all grades (Coady, 2000; Berhman et al., 2001; Sadoulet et al., 2001; Shultz, 2004). 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 primary school grades from an efficiency standpoint. 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

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

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. We do not question transfers to children in 2^{d} and 3^{rd} years of secondary school as anticipation of these transfers is part of the expected benefits from entering secondary school.

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 secondary school.

2.3. The efficiency issue in the Progresa school subsidy case

There are two sources of inefficiency in the subsidy program that need to be optimally reduced:

The first is paying people for what they do anyway. As we have seen it, this is obvious in primary school. But the problem also arises in secondary school: 64% of the poor children that graduate from primary school would enter secondary school without a transfer. Reducing this efficiency leakage requires being able to anticipate who might not be going to school. Hence, we rely on the ability to predict the probability that a given type of child will enroll in school. There is thus no possibility to completely avoid this inefficiency.[2] The question, however, is to reduce it by not targeting children most likely to go to school anyway.

The second source of inefficiency comes from offering incentives that are either too high or too low to induce the conditional action. The subsidies offered were sufficient for the 12% that were attracted to enroll in secondary school and would not have done so otherwise. With them, could we have done as well with a smaller transfer? For the 24% that did not take up the transfer offered, the subsidy was not sufficient. Would they have taken the offer had it been at a higher level and, if so, should the transfer be increased if we can identify who they are?

If there were a clear opportunity cost to children's time in school, one could calibrate the subsidy to match this level, provided this is inferior to the social value of the externality. This is the underlying

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[2] This inefficiency concept is analogous to the issue of fungibility with infra-marginal transfers, whereby beneficiaries substitute other consumption for those subsidized by the program, meaning that the program has no real effect on total consumption of the targeted commodity.

reasoning for the calculation of the Progresa transfer. It represents 40% of what children of comparative age earn when they work. However, children's opportunity cost of time at school is not easy to establish. Less than 30% of the children that quit at the end of primary school work during the subsequent 18 months (45% for boys and 10% for girls), increasing to 35% (55% for boys and 12% for girls) the following year. Among the reasons given for not continuing school, lack of money or need to work come first with 57% of the answers, but other important reasons are given such as the school is too far (13%) and the child does not like school or does not learn (23%). What needs to be known is the response function of children to incentives in order to maximize the return to transfers. This is what the Progresa randomized experiment allows us to do. Since there was no design to observe the response to variable transfers, we exploit the particular feature of the cap on total transfer to a household to infer the marginal response to varying transfer amounts.

Dealing with these two sources of inefficiency requires an accurate predictive model of the probability of going to school as a function of the characteristics of the child, the household, and the community and of the amount offered. We concentrate our analysis on entry into secondary school since this is where the CCT can induce an important change in behavior resulting in efficiency gains. However, while children that voluntarily enter secondary school continue in very large number in the second and third year of the cycle, this may not be the case for those that would be brought in. And on that we have no information. The safe bet is that, whatever support is provided for the first year needs to be provided for all three years. And while there are currently many less children in the second and third year of secondary school than in the first year among Progresa children, because it is the first year of the program, these numbers should even up after three years of program implementation. We will thus apply the results of our analysis for the first year to all three years of secondary school.

III. A model of optimal cash transfer

Denote by $P(X,T)$ 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 $f(X)$.

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

$$\max_{I(X),T(X)} \int \left[P(X,T) - P(X,0)\right] I\, f(X) dX \,, \tag{1}$$

subject to a budget constraint:

$$\int P(X,T) T\, I f(X) dX \le B. \tag{2}$$

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 $P_T = \frac{\partial P}{\partial T}$ and λ is the Lagrange multiplier associated with the budget constraint. This relationship states that the ratio of cost $\left(P_T T + P\right) dT$ to enrollment benefit $P_T dT$ of a marginal increase dT in the transfer offered is equal across children. Hence, the cost of the marginal child brought to school is equal across children types *X*. 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 *P* children from the same type *X*, even though they went to school with the initial transfer *T*. This is the marginal equivalent of the decomposition of the cost of transfer:

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

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, the optimal eligibility rule is defined by:

$$I = 1 \text{ if } \left(P(X,T) - P(X,0)\right) - \lambda P(X,T) T \ge 0 \text{ , 0 otherwise .} \tag{4}$$

The optimal allocation of a budget *B* is thus the solution of the system (3), (4), and (2).

In the particular case of a linear probability model that we consider in the following empirical work, the conditional expectation of the enrollment probability is written:

$$EP(X,T) = X\beta + X\delta T \,, \tag{5}$$

where the $X\delta$ term, which includes a constant term, measures the impact of a transfer *T*.

The optimal transfer and eligibility criteria are then given by:

$$T = \max\left(\frac{1}{2\lambda} - \frac{1}{2}\frac{X\beta}{X\delta}, 0\right), \quad (6)$$

where λ is solution to the budget constraint (2). This expression shows that both eligibility and the optimal transfer for any given child is function of its ratio $\frac{X\beta}{X\delta} = \frac{EP(X,0)}{EP_T}$. The numerator is the expected probability that children of characteristics *X* would go to school even without transfer, and the denominator is the marginal effect of the transfer on the expected enrollment probability. Children will thus be eligible and receive high transfers if they have a low initial probability of enrollment and/or a high enrollment response to a transfer.

Implementable scheme

To be useful for program implementation, eligibility rules need to be simple and transparent. Indicators used to determine eligibility and level of cash transfer must be few, easily observable and verifiable, and non-manipulatable. Simplicity and transparency may also be important to ensure the political acceptability of a transfer program (Schady, 2002). Progresa uses grade and gender to adjust transfers (Table 1). The objective is thus to reduce the complexity of the formulae established for the optimal transfer scheme (6) to a linear index based on a few correlates. We, therefore, establish the optimal transfer scheme that is linear in a subset of characteristics *Z* of the children.

The allocation problem consists in choosing the eligibility status and, if eligible, the transfer T to offer to each child to maximize the gain in enrollment over the population (1), subject to a budget constraint (2) and simple linear formulas for eligibility and transfer:

$$T = Z\alpha,$$

and $$I = 1[Z\gamma \geq \gamma_{\min}],$$

where *Z* is a subset of characteristics of the children, and α, γ, and $\gamma_{\min}$ are parameters to be determined. As in the model above, optimal eligibility is defined by the sign of the optimal transfer value:

$$I = 1 \quad \Leftrightarrow \quad T = \max(Z\alpha, 0) > 0. \quad (7)$$

The parameters α are solution of the maximization of a quadratic function:

$$\max_{\alpha} \sum_{i\in E} m_i Z_i \alpha - \lambda\left[B - \sum_{i\in E}(P_{0i} + m_i Z_i \alpha) Z_i \alpha\right], \qquad (8)$$

where E is the set of eligible children, $m_i = X_i\delta$ is the marginal effect of the transfer on child i school enrollment, $P_{0i} = X_i\beta$ is its enrollment probability without transfer, and λ is the Lagrange multiplier on the budget constraint.

IV. Predicting enrollment

We now proceed to build a predictive model of entry into secondary school. Although a probit and a logit perform better at the high and low probabilities, we use a linear model to avoid imposing heterogeneity on the impact of the transfer through the functional form, since this will be an important determinant of the targeting scheme.[3] We use the sample of children finishing primary school and eligible for a Progresa transfer (predicted as poor using the Progresa welfare index) in both the control and treatment villages. The control variables used are child, household, and community characteristics. Note that, even with the very large initial data set, when one restricts the analysis to a specific grade, the sample does not allow to easily detect heterogeneity. For this reason, we use two years of data, giving us a sample of 4,554 children.[4]

In Table 2, the result in column (1) gives the simple difference effect of the Progresa CCT on enrollment. Among qualifying poor, the impact of the program on the probability of continuation into secondary school is 12%. As expected, this is slightly higher than the 8-9 percentage points estimate of impact on enrollment conditional on completed primary school (i.e., including children who had dropped out of school prior to the onset of the program) obtained in other studies (e.g., Schultz, 2004).

Using, in column (2), the value of the cash transfer, which varies across children due to the cap on payments that affects 26% of the qualifying children, we see that a US$200 CCT increases the probability

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[3] In the simulation exercises that follow, we will never encounter a problem of predicted negative probability (the majority of children have predicted probabilities above .40), but we do have some predictions above 1, even without transfers and more when applying transfers. For simulation purposes these will be set equal to 1.

[4] Even with 4,554 observations (2,830 in treatment villages and 1,724 in control villages), the expected standard error on the impact of Progresa on a sub-group that includes about half the sample, such as boys or girls, is .02 and on the difference in impact between the two sub-groups is .028. This shows that we can only detect heterogeneity that is above a 5 percentage points difference in school enrollment.

of enrollment by 13%. Adding a large number of child, household, and community controls in column (3), the increase in the probability of enrollment remains equal to 12.3%, which confirms that controls are orthogonal to the treatment. These results indicate that the main correlates of a child's secondary school enrollment are age of the child (negative), mother's literacy and the household's maximum educational level (positive), the number of agricultural workers and self-employed in the household (negative), total expenditure (positive), and distance to school (negative). State effects are also important.

We then proceed in columns (4) and (5) to explore heterogeneity of impact across categories of children without and with controls, respectively. We focus on aspects of heterogeneity that may be useable for targeting purposes. They are age of the child centered on 12 years old, where 12 is the median age for entry into secondary school, father's ethnicity, and whether there is or not a secondary school in the village. Progresa recognizes gender differences, which we do not find to be important in explaining differential impacts of transfers on the decision to enroll in secondary school. We see from the results that age, ethnicity, and presence of a school in the village all make large differences on enrollment, both directly as controls, and in affecting the impact of the transfer. Because the parameter on the transfer dummy is very small and not significant when the transfer amount and controls are introduced, we keep the results in column (5) with only the amount of the transfer as the predictive model to be used for targeting.

Heterogeneity implies large difference on the impact of a transfer on enrollment across categories of children (Table 3). For a male child of median age, with a non-indigenous father, and a school in the village, the $200 Progresa transfer only increases the probability of enrollment by 4%. If this child is two years behind normal progress, the transfer increases the probability of enrollment by 7%. When this child has an indigenous father or no secondary school in the village, the transfer increases enrollment by 10%. Combining the features of being a boy, 14 years old, with an indigenous father, and in a village with no secondary school, implies that a $200 transfer raises the probability of school enrollment by 19%. These large differences suggest that there can be efficiency gains in using some of these dimensions of heterogeneity for the targeting of transfers, in the same way as Progresa used gender differences in calculating transfers.

A potential concern is that identification of the impact of the transfer value derives from observation of children who receive less than the full transfer amount because of the cap on total household transfer. These children are by definition from households with a larger number of eligible children. To check that the enrollment model of these households does not differ 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 identification of the transfer parameter 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.

V. Comparing alternative transfer schemes

We now proceed to analyze, in Table 4, three alternative targeting and calibration schemes with the purpose of seeing if they can help raise the efficiency of transfers in inducing school enrollment. The different schemes all add up to the same total budget as for implementation of the current Progresa transfers. This budget spent is computed by predicting for each sample child the expected uptake (predicted probability) $\hat{E}P$, and summing up expected transfers $\hat{E}P.T$ over the children. It amounts to a total annual outlay of $653,000 for the 4,554 sample children.

5.1. Emulating Progresa: universal uniform transfers

The school participation rate without transfer is 63.7% ("no program" column in Table 4). Progresa's universal transfers with a cap and with differential cash transfers for boys and girls, raise the participation rate to 74.8%, a gain of 11.1 percentage points. The universal uniform transfers without a cap and without gender differences that we use as a benchmark for the subsequent simulations raise participation to a nearly identical 75.0%, a gain of 11.3 percentage points. Under this scheme, the transfer per child is \$192/year.[5] Because many children receive a transfer even though they would be going to school without it, the cost per additional child enrolled is \$1288/year.

Figure 2 shows how the universal uniform transfers increase the probability of enrollment according to the initial probability of enrollment without a transfer program. The gains are largest for children with a low probability of enrollment (15.5% for those with 0 to 40% enrollment rate without transfer), and they decline as the probability rises, reaching 6.4% for those in the 80-100% category. Gains are hence progressive in terms of the initial likelihood of going to school, even with uniform transfers. This is the Progresa achievement that has been widely acclaimed in the literature. However, can we do better by redefining the targeting and the calibration of transfers?

5.2. Optimal variable transfers

The second scheme implements the optimal variable transfers established in the model, under the same budget constraint and taking into account heterogeneity in probability of enrollment and responses to transfers across children based on all controls and interactions with transfers used in Table 3 column 5. Both eligibility and optimal transfer value are simultaneously determined. This is done by offering the transfer defined in (5) to children of characteristics X, predicting their uptake, and finding by tâtonnement the shadow value λ of the budget constraint that balances the budget. Under this scheme, we should raise the cash transfers to children with a low probability of going to school, and target less the children with high probabilities of going to school because efficiency leakages are particularly high among them. Results in Table 4 show that students eligible to receive a transfer have a probability of enrollment of 76%, compared to 53.9% had they not received a transfer. The non-eligible for a CCT have a probability of enrollment of 82.9%. Overall, among the poor, the probability of school enrollment is now 78.3%, a gain in efficiency of 31.4% over universal uniform transfers. As can be seen in Figure 2, the largest gains in probability of enrollment are captured by those with the lowest initial probabilities. Figure 3 shows how eligibility is concentrated over the children with low initial probabilities. Figure 4 shows that calibration of transfers also favors those with low initial probabilities, trying to induce them to go to school with higher CCT. The transfers decline as the probability of going to school without a transfer rises. Note, however,

[5] The transfer level is determined to match the budget of Progresa, taking into account the expected uptake that it induces.

on Figure 2 (right scale) that there are relatively few children with predicted low probability. The majority of the children are concentrated in the 40-80% enrollment rate range.

Returning to Table 4, we see that 66.3% of the children are eligible for a transfer. The average transfer is $285 compared to the universal uniform transfer of $192, a 49% increase. The optimal scheme thus suggests raising transfers for the beneficiaries while reducing coverage over those with high likelihood of going to school without a transfer. Since there are still efficiency leakages among eligible children, the cost per additional child enrolled is $980, down from $1288 under the universal uniform transfer. Cost saving per additional child enrolled is thus no less than 24%.

5.3. Implementable transfers

Using expressions (7) and (8), we establish the optimal implementable transfer scheme by proceeding as follows. For a given set of explanatory variables, we solve the optimal transfer iteratively[6], and compute the resulting enrollment rate. We explore combinations of characteristics that correspond to the criteria of being easily observable, verifiable, and non-manipulatable, selecting variables that increase the overall enrollment rate. We identified the following characteristics as important in establishing the optimal transfers: birth order of the child, ethnicity, presence of a secondary school in the village, distance to a secondary school if there is not one in the village, and state dummy variables. Using gender alone or in interaction with other variables turned out not to improve the efficiency of the transfer program. Age of the child is not used 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 larger cash transfer. The rank of the child in the family, which cannot be manipulated, turns out to capture part of this information. Every single one of these variables can be easily observed and verified. In fact, instead of secret eligibility formulas as currently used for poverty that give no room for recourse, self-registration is possible, with no possibility of cheating. The results are reported in the first panel in Table 5. The birth order parameter indicates that the transfer is highest for the older child and decreases by $57 for each of the younger siblings. Indigenous children receive a special subsidy of $98. A large premium is given to children that need to travel to

[6] Starting with general eligibility, we solve the optimization problem (8) for α as a function of λ and adjust λ to balance the budget. These parameters are used to compute transfers and define eligibility. We iterate this procedure until there is convergence, i.e., no change in eligibility between two consecutive iterations. This is always achieved in less than 5 iterations.

school, with a lump sum of $303 and an additional increase with distance. Examples of eligibility and transfer amount computed with this simple point system are reported in the lower panel of Table 5. Children with a school in their own village are not eligible; they represent 23% of the sample. Their enrollment rate without transfer is predicted at 81%, which is also the rate observed in control villages with a school. By contrast, all the children who do not have a school in their village are eligible for some transfer. In a non-indigenous household, living 3kms away from a school (which is the mean value among those without school in their village), the oldest child would receive a transfer of $270, while the transfer to the third child would only be $155. In an indigenous household, the oldest child would receive $369. Cumulating all the disadvantages, an indigenous child living 6kms away from school would receive the highest transfer at $436.

Implementation of this transfer scheme is described in the last column of Table 4. There is of course an efficiency loss relative to optimal transfer, the cost to be paid for simplicity and transparency. Enrollment of eligible children rises from 58.5% without a transfer to 75.5% with a transfer. Enrollment rate for the non-eligible is 80.6% and for the population of poor is 76.7% overall. This implies a 16.4% efficiency gain over the universal uniform CCT option. Because we lose targeting power with implementability, more children are eligible than under the optimal scheme (76.5% vs. 66.3%) and transfers are on average lower ($247 vs. $285). Cost per additional child enrolled is $1107, still 14% cheaper than under the universal uniform CCT option, but 13% more expensive than the optimal scheme.

Figure 4 shows that CCT are indeed much more equal across children under the implementable scheme than under the optimal scheme, but not uniform. In Figure 3, we see that eligibility is much higher, but that non-eligibility remains confined among children with an initial high probability of enrollment.

5.4. Comparing direct costs and efficiency leakages under the three schemes

An important determinant of the relative efficiency of different targeting schemes is the importance of their efficiency leakages, namely the magnitude of the cash transfers that go to children that would go to school without the transfer. This is analyzed in a comparative fashion in Figure 5. Differences among the figures are quite telling.

With the universal uniform transfer program, leakages are particularly high, especially among children with a high probability of going to school without a transfer. Altogether, 85.1% of the total budget goes to efficiency leakages, leaving an effective direct cost of only 14.9%. The optimal variable transfer program reduces efficiency leakages by focusing eligibility among low probability children and increasing the magnitude of the cash transfers offered to them. Efficiency leakages are reduced to 60%, implying an effective direct cost of 40%. Finally, the implementable transfer program has an efficiency leakage of 73.9%. Because targeting is simplified and transparent, it is a compromise between the universal and the optimal transfer. The effective direct cost is 26.1%.

We conclude that the optimal variable scheme could offer a significant efficiency gain in school enrollment. It could be implemented through a secret formula as Progresa currently does for poverty. This may, however, be too complex to administer, and secrecy is not a desirable feature as it allows no recourse. The implementable variable transfer scheme results in a modest efficiency gain relative to Progresa. Hence, one must conclude that, with ample budgets to make universal uniform offers to all those who fall below the poverty line, the efficiency loss is small relative to implementable variable transfers. This does not mean, however, that looking into the benefits of implementable variable transfers may not offer large benefits when budgets are tight, as in poorer countries such as Honduras and Nicaragua. This is what we explore in the following section.

VI. Efficiency gains under a tight budget constraint

Progresa was implemented under a non-binding budget constraint. For the established poverty line and the selected communities, all poor households with qualifying children were eligible to receive a CCT. This may not be the case in poorer countries. To explore the efficiency gains from targeting and calibration under these conditions, we consider a situation where the available budget is half what was spent before. There are three options for assigning the available budget that we explore in Table 6.

The first option consists in lowering the poverty line so all poor below that new line (call them the extreme poor) are eligible for a CCT, exhausting the reduced budget.[7] As can be seen in Table 6 (column "Poverty targeting"), this results in making eligible 100% of the households in the lower two poverty

[7] We use the welfare index constructed by Progresa to define eligibility to the program. For reporting in Table 6, the index has been normalized to vary between 0 for the poorest to 100 at the poverty line.

quartiles, and 3.3% in the next quartile. Under this scheme, which we use as a benchmark for the other two schemes, 50.8% of the households previously under the higher poverty line (call them the poor) are eligible, and the percentage enrollment is 69.5% compared to 63.7% without a CCT (and as opposed to 75% under the larger budget). This loss represents the cost of budget austerity. The average transfer per child is $192/year and the cost per additional child enrolled is $1241/year, about the same as under the universal uniform scheme ($1288).

The second option is to use an optimal variable transfer to allocate the restricted budget among all the poor. Here, the optimality rule in targeting and calibrating gives us a lot of leeway since we have many poor and a restricted budget. We see in Table 6 that enrollment rises from 69.5% to 72.6%. The enrollment gain is thus 53.7% larger than under the poverty targeting approach. In this case, the average value of the transfer is $207/year and the cost per additional child enrolled is $807/year. Clearly, efficiency gains are very large.

Shifting to an implementable scheme that uses, as before, simple, easily verifiable, and non-manipulatable indicators such as birth order, ethnicity, presence of a secondary school in the village, and distance to secondary school, enrollment is reduced from 72.6% to 71.3%. The efficiency gain over extreme poverty targeting is still an important 31%.

Is this efficient implementable scheme progressive or regressive among the poor? In other words, are efficiency gains in enrollment achieved at an equity cost? CCT driven by efficiency gains indeed raise the issue that maximally efficient schemes may be inequitable (Das, Do, and Özler, 2004). For this reason, eligibility is restricted to the poor. However, when there is further targeting among the poor due to a severe budget constraint, are the resulting transfers regressive among the poor? Results (not reported) show that this is not the case. With households in poverty ranked by the Progresa welfare index, the individual transfer offered declines with welfare level. The eligibility is, however, neutral to welfare levels and the uptake slightly increasing. As a consequence, the effective transfer by class, which is the product of transfer by eligibility and by uptake, is uniform across welfare levels. Efficient gains in implementing variable transfers are thus not obtained at the cost of rising inequality among the poor.

VII. Conclusions

CCT programs have become a popular instrument to reduce underinvestment in human capital by the poor relative to the social optimum. Indeed, these programs are now widely used, they have attracted large budget outlays, and they have shown success in raising human capital levels among the children of the poor (Schultz, 2004). Underinvestment in human capital by the poor is due to two causes: their current poverty in a context of capital market failures that makes them prefer child labor to investment in the education of their children (Baland and Robinson, 2000); and market failures in human capital investment due to positive externalities. These underinvestments relative to the social optimum justify cash transfers to the poor. However, pure income effects would buy very little in terms of higher levels of school enrollment (Bourguignon, Ferreira, and Leite, 2002). For this reason, cash transfers are made conditional upon school attendance and use of health facilities, transforming the transfer into a price effect on the desired action.

Transfers have an immediate welfare effect on recipients that is far from negligible given the levels of poverty of beneficiaries and the magnitude of the transfers that must cover the opportunity cost of child time on the labor market and school costs. For this reason, and to secure political acceptability of the CCT programs, beneficiaries are confined to the poor. Among the poor, for a given budget constraint, efficiency gains in meeting the conditional action (school enrollment) can be improved by the way eligible poor are selected and by the way transfers are calibrated to insure high levels of uptake. The optimum implementation of a CCT consequently requires defining a targeting and calibration rule that maximizes the gain in human capital subject to (1) confining eligibility to the poor, (2) meeting the project's budget constraint, and (3) enforcing the condition of school attendance and use of health facilities.

Implementing a CCT program for human capital formation thus faces two challenges that require successful resolution. The first is ability to target the poor in offering cash transfers, a problem for which a variety of approaches have been used but that remains difficult to achieve (see, e.g., van de Walle 1998, Alderman, 2001 and 2002, and Ravallion 2003). The second is to establish eligibility and to calibrate transfers for optimum efficiency <u>among the poor</u>. Here also, different programs have used different rules. Progresa does not target among the poor, offering universal transfers to all poor willing to participate in the selected communities. CCTs are adjusted by grade and gender. Bolsa Escola relies on a municipal committee to select the eligible from among the poor. Grants are not calibrated by grade or child characteristics. While the approach has the merit of engaging the community, it risks falling pray to clientelism since, as opposed to Progresa, the number of scholarships is inferior to the number of poor. The scheme that we explored here is designed for maximum efficiency in meeting the condition for the cash transfer. We proposed an optimum scheme to establish eligibility and calibrate transfers, and an implementable version of this scheme where eligibility rules and transfers are only adjusted by ethnicity, distance to school, and birth order. These are all simple, fully transparent, easily verifiable, and non-manipulatable criteria. Secret formulas are not needed, and the right to challenge implementation of the rules can be referred to community councils and to higher judicial orders if needed.

When the budget constraint is tight, and selection of eligible households needs to be made from among the poor, an efficient targeting and calibration scheme buys large efficiency gains. Using the Progresa example, an implementable efficient scheme under budget constraint (set at half the Progresa budget) can raise school enrollment by 31% relative to targeting on extreme poverty. Cost per additional child enrolled is reduced from $1241/year under extreme poverty targeting to $947/year with the efficient implementable scheme, a gain of no less than 24%. These can result in huge savings given the potential magnitude of the programs, allowing to extend coverage of the program, offer other social services to the poor, or simply reduce fiscal burdens. The efficiency gain is achieved with no inequality tradeoff as effective transfers are uniformly distributed among the poor. CCT programs can indeed be made more efficient, and there seems to exist few reasons why not to take advantage of these potential efficiency gains.

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Table 1. Budget for educational transfers, 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.

Table 2. Linear probability model of enrollment

	Mean	(1)	(2)	(3)	(4)	(5)
		Homogeneous impact			Heterogeneous impact	
Transfer dummy	0.62	0.120**	-0.086	-0.011	0.021	
		(0.014)	(0.066)	(0.067)	(0.061)	
Transfer (US$100)	1.19		0.108**	0.067+	0.013	0.020
			(0.034)	(0.035)	(0.034)	(0.015)
Transfer * (Age –12)	1.28				0.009*	0.007
					(0.005)	(0.005)
Transfer * Father indigenous	0.418				0.033*	0.030*
					(0.013)	(0.013)
Transfer * No sec. school in village	0.908				0.024	0.029+
					(0.015)	(0.015)
Child and household characteristics						
Male	0.511			0.038		0.040
				(0.025)		(0.025)
Age	13.1			-0.101**	-0.122**	-0.110**
				(0.005)	(0.007)	(0.008)
Father is indigenous	0.353			0.025	0.054**	-0.011
				(0.029)	(0.020)	(0.033)
Birth order	2.01			0.008		0.007
				(0.010)		(0.010)
Head is male	0.929			-0.037		-0.035
				(0.032)		(0.032)
Has no father	0.108			-0.026		-0.025
				(0.033)		(0.033)
Father is literate	0.675			0.020		0.018
				(0.020)		(0.020)
Father's education	2.54			-0.001		-0.001
				(0.004)		(0.004)
Has no mother	0.044			0.059		0.057
				(0.054)		(0.054)
Mother is literate	0.612			0.038*		0.039*
				(0.019)		(0.019)
Mother's education	2.38			0.003		0.002
				(0.004)		(0.004)
Mother is indigenous	0.371			0.039		0.039
				(0.028)		(0.028)
Mother's age	36.0			0.000		0.000
				(0.001)		(0.001)
Number of children 0-10 years old	2.68			-0.004		-0.004
				(0.004)		(0.004)
Number of children 11-19 years old	2.73			-0.004		-0.004
				(0.008)		(0.008)
Number of agricultural workers	1.24			-0.024**		-0.023**
				(0.007)		(0.007)
Number of non-agricultural workers	0.31			-0.008		-0.007
				(0.010)		(0.010)
Number of self employed	0.19			-0.027*		-0.026*
				(0.011)		(0.011)

Table 2. (continue)

	Mean	(1)	(2)	(3)	(4)	(5)
Number of unpaid family workers	0.32			-0.008		-0.008
				(0.007)		(0.007)
Number of other working adults	0.10			-0.025		-0.025
				(0.020)		(0.020)
Household's maximum education	4.96			0.017**		0.017**
				(0.003)		(0.003)
Total expenditure (pesos/month)	790.7			0.000**		0.000**
				(0.000)		(0.000)
Dwelling has dirt floor	0.702			0.033*		0.031*
				(0.014)		(0.014)
Persons/room in dwelling	5.24			-0.001		-0.001
				(0.003)		(0.003)
Dwelling has water	0.325			0.050**		0.052**
				(0.014)		(0.014)
Rainfed land (ha)	2.06			0.001		0.001
				(0.002)		(0.002)
Irrigated land (ha)	0.05			-0.017		-0.016
				(0.013)		(0.013)
Herd size	0.87			-0.007		-0.007
				(0.004)		(0.004)
Community characteristics						
No secondary school in village	0.767			-0.005	-0.213**	-0.040
				(0.031)	(0.023)	(0.036)
Distance to secondary school (ln of kms)	1.020			-0.112**		-0.113**
				(0.018)		(0.018)
No school in village x Girl	0.374			-0.037		-0.036
				(0.028)		(0.028)
Guerrero	0.169			-0.079**		-0.079**
				(0.030)		(0.030)
Michoacan	0.139			-0.125**		-0.122**
				(0.031)		(0.031)
Puebla	0.153			-0.084**		-0.087**
				(0.029)		(0.030)
Queretaro	0.045			-0.198**		-0.204**
				(0.038)		(0.038)
San Luis Potosi	0.135			-0.108**		-0.108**
				(0.031)		(0.031)
Veracruz	0.287			-0.030		-0.029
				(0.028)		(0.028)
Constant		0.637**	0.637**	2.017**	2.378**	2.181**
		(0.011)	(0.011)	(0.099)	(0.095)	(0.123)
Observations		4554	4554	4554	4554	4554
R-squared		0.016	0.019	0.220	0.173	0.222

Standard errors in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

Table 3. Heterogeneity: Impact of CCT on the probability of school enrollment by type of child

	Homogenous impact			Heterogenous impact	
Type of child	Transfer (1)	Transfer amount (2)	Transfer amount w/controls (3)	Transfer amount (4)	Transfer amount w/controls (5)
Overall effect	0.12	0.13	0.12		
Boy, 12 years old, non-indigenous, with sec. school in village (US$200)				0.05	0.04
Boy 14 years old				0.08	0.07
Boy with father indigenous				0.11	0.10
Boy with no secondary school in the village				0.10	0.10
Boy 14 years old, indigenous, with no school in village				0.20	0.19

Source: Based on results from Table 2, with corresponding columns in parentheses.

Table 4. Enrollment rates under alternative targeting schemes

Risk level: Probability of enrollment without transfer	Number of observations	(%)	Enrollment rates (%)			
			No program	Universal uniform transfers	Optimal variable transfers	Implementable transfers
0-40%	642	14.1	27.6	43.1	68.8	51.9
40-60%	1221	26.8	51.2	64.3	71.9	67.8
60-70%	790	17.3	65.0	76.7	75.3	78.0
70-80%	815	17.9	74.8	85.9	80.9	85.6
80-100%	1086	23.8	89.9	96.3	91.5	93.6
Eligible students						
Without transfer				63.7	53.9	58.5
With transfer				75.0	76.0	75.5
Non-eligible students				–	82.9	80.6
Total	4554	100.0	63.7	75.0	78.3	76.7
Eligibility (%)				100.0	66.3	76.5
Average transfer value (US$/year)				191.6	284.9	247.0
Cost per additional child enrolled (US$/year)				1288	980	1107
Efficiency gain over universal transfers (%)				–	31.4	16.4

Table 5. Optimal implementable scheme

	Transfer (US$/year)
Transfer formula	
Birth order	-57
Father is indigenous	98
No secondary school in village	303
Distance to secondary school (ln of kms)	120
Guerrero	-141
Hidalgo	-161
Michoacan	-82
Puebla	-143
Queretaro	-26
San Luis Potosi	-117
Veracruz	-159
Example for children types (in State of Guerrero)	
School in village	Not eligible
Oldest, non-indigenous, with school at 3kms	270
3rd sibling, non-indigenous, with school at 3kms	155
Oldest, indigenous, with school at 3kms	369
Oldest, indigenous, with school at 6kms	436

Table 6. Alternative schemes under tight budget constraints

	Number of observations	(%)	Welfare indicator	No program Enrollment	Poverty targeting Eligibility	Poverty targeting Enrollment	Optimal variable Eligibility	Optimal variable Enrollment	Implementable Eligibility	Implementable Enrollment
Probability of enrollment without transfer										
0-40%	642	14.1	74	27.6	53.4	35.9	100.0	58.3	96.9	43.1
40-60%	1221	26.8	74	51.2	55.2	58.4	89.6	63.4	86.2	60.8
60-70%	790	17.3	75	65.0	51.4	70.9	43.8	69.6	74.7	72.1
70-80%	815	17.9	76	74.8	49.4	80.2	31.3	77.2	69.1	80.6
80-100%	1086	23.8	77	89.9	45.0	92.8	7.7	90.1	35.2	92.1
Welfare quartiles										
Poorest 25%	1,141	25.1	53	61.0	100.0	72.5	57.6	71.1	70.5	69.3
Next 25%	1,136	24.9	72	63.5	100.0	74.7	53.5	72.6	70.4	71.4
Next 25%	1,139	25.0	83	65.0	3.3	65.4	50.2	73.0	68.4	71.9
Highest 25%	1,138	25.0	94	65.4	0.0	65.4	51.3	73.7	72.6	72.4
Total	4554	100.0	76	63.7	50.8	69.5	53.2	72.6	70.5	71.3
Average transfer value (US$/year)						191.6		207.3		146.9
Cost per additional child enrolled (US$/year)						1240.7		807.1		946.7
Efficiency gain over poverty targeting (%)						–		53.7		31.0

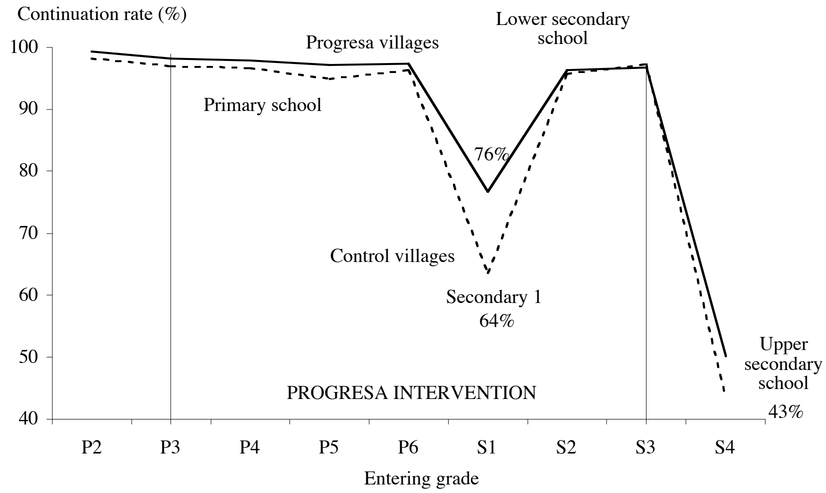

Figure 1. School continuation rates of poor children in sample villages

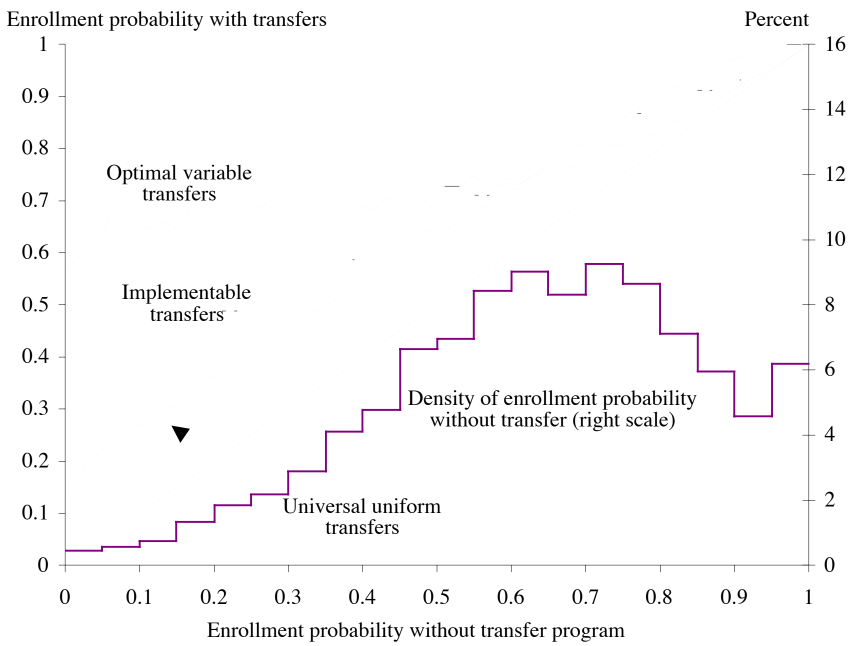

Figure 2. Impact of alternative transfer programs on enrollment rates

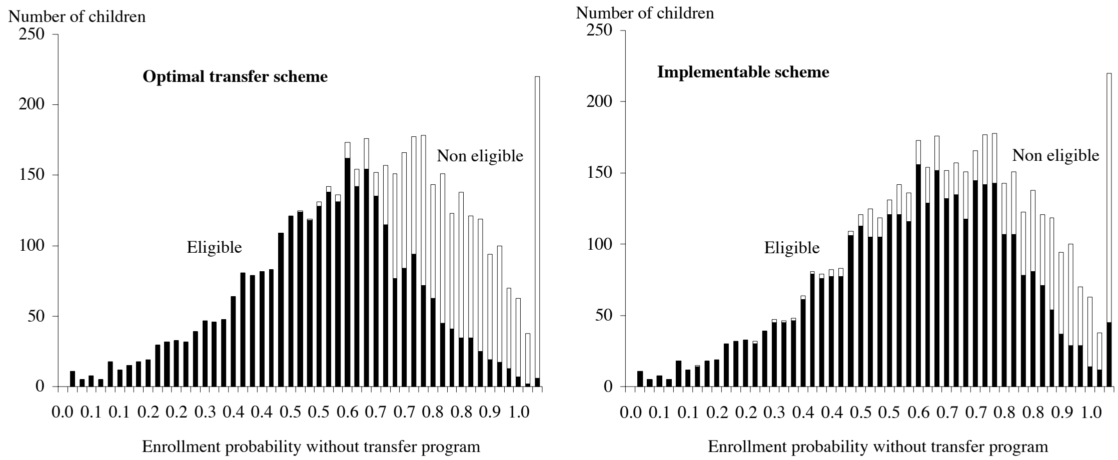

Figure 3. Eligibility in the optimal and implementable schemes

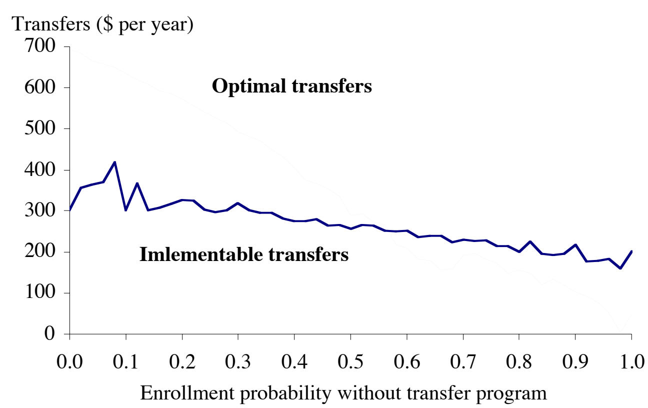

Figure 4. Average transfers in the optimal and implementable schemes

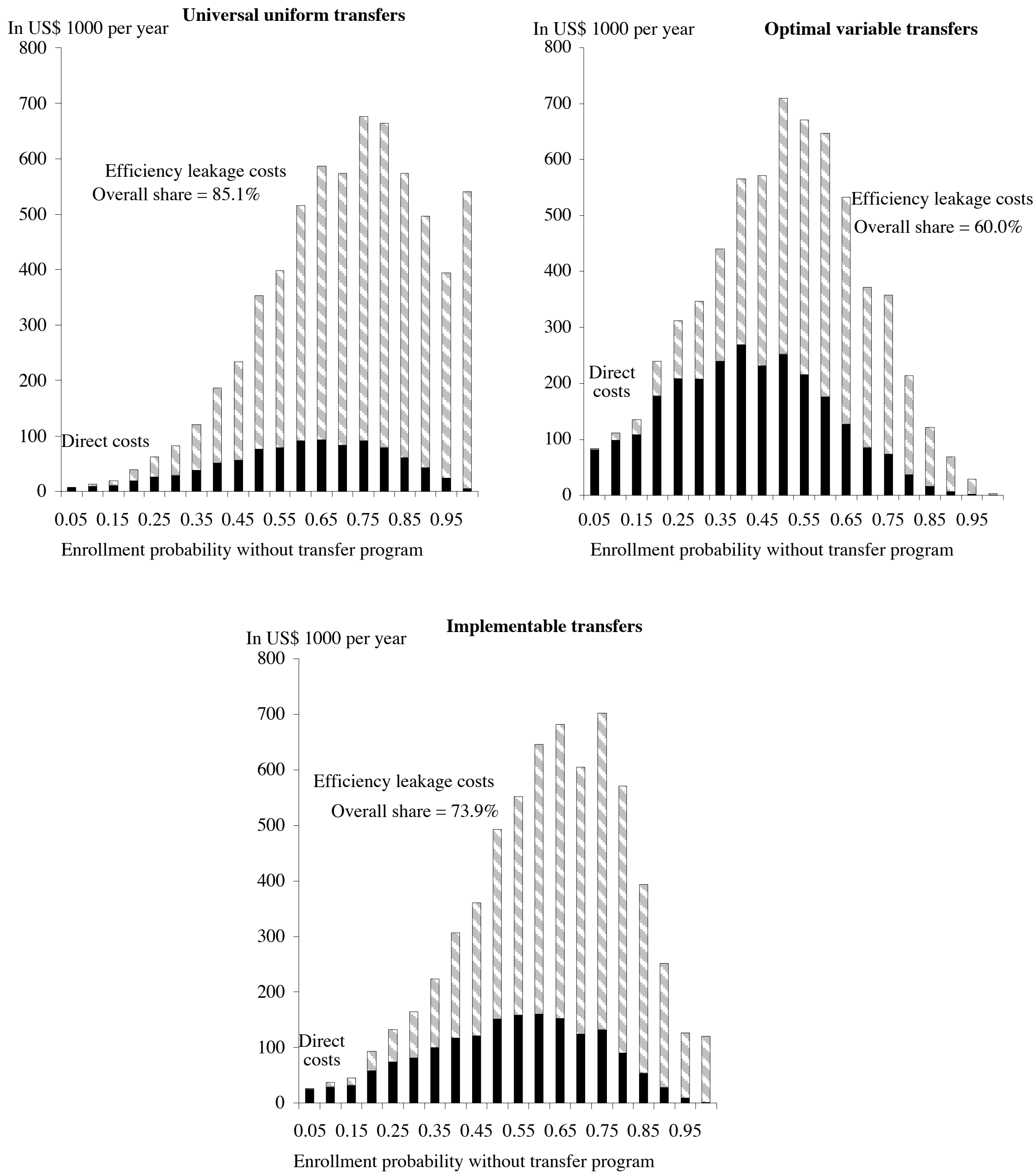

Figure 5. Total direct and leakage costs under different transfer schemes